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FOREWORD

Presented number of Silesian University of Technology. Scientific Papers. Organization and Management Series. Presented papers contain result of researches conducted by various universities. The number consists of 35 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: the implementation of Artificial Intelligence in management; quality management; business ethic; consumer management; green economy; marketing; logistics; administration management; finances; knowledge management; human resource management; small and medium enterprises; environmental management; inventory management; e-consumer; decarbonization; industrial management; project management and information management.

Radosław Wolniak

TRUST AND RESPONSIBILITY IN AI-DRIVEN LEADERSHIP: ACCOUNTABILITY FOR AI DECISIONS

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Purpose: The purpose of this paper is to explore the multifaceted relationship between Artificial Intelligence and organizational leadership, specifically addressing the “responsibility gap” that arises when decision-making is delegated to algorithms. It aims to redefine leadership roles in the “algocratic” era by distinguishing between moral trust and technical reliance. Furthermore, the research seeks to provide a comprehensive governance framework to help leaders navigate the ethical challenges of shared responsibility, ensuring that human judgment remains central to strategic decisions.

Methodology: This study adopts an integrative tertiary review approach to synthesize insights across high-stakes domains including healthcare, the judiciary, and management. By analysing the intersection of technical explainability (XAI) and ethical governance, the paper adapts the TRUST framework (Transparency, Responsibility, Understanding, Social Justice, Trustworthy Oversight) originally proposed in legal scholarship to the context of organizational leadership. The approach moves beyond descriptive analysis to offer a critical synthesis of how leaders can maintain accountability in Human-Machine Teaming.

Findings: The research identifies a critical distinction between “trust” (a moral relationship requiring goodwill, applicable to humans) and “reliance” (based on technical predictability, applicable to AI). The study finds that while AI enhances decision-making efficiency and analytics, it introduces a “responsibility gap” where assigning blame for errors becomes difficult. Furthermore, a paradox is identified where users report higher trust in humans but are behaviorally more willing to disclose sensitive information to AI systems due to lower social evaluation anxiety. The paper concludes that effective leadership requires “Meaningful Human Oversight” where humans retain the authority to override AI, rather than acting as passive validators.

Research limitations/implications: As a conceptual paper based on an integrative review, this study lacks primary longitudinal data regarding the long-term implementation of the TRUST framework in corporate settings. Future research should empirically test the impact of distinguishing “trust” from “reliance” on employee satisfaction and error rates in hybrid teams. Additionally, further investigation is needed into the long-term cognitive effects of “automation bias” on the degradation of human leadership skills.

Practical implications: The paper offers a strategic implementation framework for leaders. Organizations must prioritize AI literacy to ensure leaders can critically evaluate algorithmic outputs rather than blindly accepting them. Leaders are advised to implement specific protocols for Meaningful Human Control, ensuring that AI serves as a decision-support tool rather than

a decision-maker in high-stakes scenarios. Furthermore, the adoption of the TRUST framework provides a roadmap for operationalizing ethics, moving from abstract principles to concrete actions such as algorithmic auditing and equity impact assessments.

Social implications: This research addresses the broader societal risk of algocracy, where opaque systems erode the legitimacy of decision-making in public and private institutions. By emphasizing Social Justice, the paper highlights the necessity of preventing AI from perpetuating historical biases found in training data against marginalized communities. Promoting a culture of “trustworthy oversight” ensures that technological advancement does not come at the cost of human dignity, employee well-being, or democratic values.

Value: This paper provides a novel theoretical contribution by bridging the gap between technical definitions of reliability and philosophical concepts of trust within a leadership context. It adapts the judicial TRUST framework for broader management application, offering a structured solution to the “responsibility gap”. The value lies in its actionable guidance for leaders to navigate the paradox of “algorithmic appreciation” versus “automation bias” ensuring AI is used to augment rather than hollow out human agency.

Keywords: AI leadership, accountability, organizational trust, ethical decision-making, transparency.

Category of the paper: Conceptual paper / Literature review.

1. Introduction

Today's organizations and public institutions are facing a transformation that is referred to as the fourth industrial revolution. A central element of this change is the ubiquity of algorithmic decision systems, which have ceased to be just analytical tools and have become active participants in decision-making processes (European Parliament, 2019). This fact is no longer controversial: the universality and increasing autonomy of algorithms are well documented.

However, these facts lead to a less obvious research question: *what forms of coexistence between humans and AI are possible, and how should responsibility for decisions made with the participation of intelligent systems be understood?* Trust in algorithmic systems and the question of accountability are becoming central concerns: Who is responsible for decisions supported or made by AI? Since 2020, there has been a growing interest in the management and quality literature on the issue of shared responsibility and the redefinition of leadership roles in an environment in which some analytical or decision-making functions are delegated to algorithmic systems. From automating routine tasks to augmenting complex decision-making processes, AI's influence is reshaping how organizations operate, strategize, and interact with their stakeholders (Joshi, 2025, p. 49).

In traditional models, the responsibility rested with the man-leader, who made decisions based on available information and his own competences. In the algocratic era, where the decision-making process is shared with autonomous or semi-autonomous systems, the boundaries of responsibility are blurred. As Madanchian et al. (2024) note, the integration

of AI in management is not just a technological issue, but a fundamental cultural change, requiring new adaptive competencies from leaders. However, with the increasing autonomy of AI systems, there is a pressing problem of the responsibility gap, in which it is difficult to assign blame to a specific entity (designer, user, or algorithm itself).

The article reviews the conceptual literature to explore the multifaceted relationship between AI and organizational dynamics. We delve into the impact of AI on key areas such as management and leadership, decision-making methodologies, stakeholder relations, organizational change management, cross-functional collaboration, and conflict resolution.

The purpose of this article was to provide a comprehensive analysis. Based on a literature review, the article:

- It identifies the key factors influencing trust in AI.
- It examines the ethical and societal challenges of dispersion of responsibility in AI-based management.

2. Methodology

This study utilizes an integrative review approach to synthesize theoretical and empirical literature, facilitating a comprehensive understanding of AI-driven leadership. Given the rapid pace of technological change, a transdisciplinary lens was adopted, integrating insights from management, law, and bioethics.

The aim of this approach is to identify universal mechanisms for building trust and accountability that go beyond the specifics of individual sectors.

2.1. Selection criteria

The literature selection process was not limited to a single database or a narrow definition of management, but deliberately included “high-stakes domains” where AI decisions have a direct impact on human well-being or social justice. To be included in the analysis, an article must meet the following inclusion criteria:

1. *Intersection of technology and ethics*: the works analyzed had to address the point of contact between the technical aspects of AI systems and social or ethical oversight. In particular, studies combining technical explainability with ethical governance were sought.
 - As an example of literature focusing on the technical and business dimensions, works such as Behera et al. (2023) are included, which analyze the impact of XAI on sustainable growth and competitive advantage.

- Critical analyses such as the work of Lima et al. (2022), which examines the conflict between the explainability of algorithms and their legal and moral accountability, have been included as a counterpoint.
2. *Cross-domain synthesis*: because leadership challenges in the algorithmic age are often most evident in highly regulated sectors, the review included literature on healthcare, the judiciary, and operational management.
 - Analysis of the judicial sector (e.g. Flórez Rojas, 2025; Gravett, 2024) allowed to identify risks related to algocracy and automation bias.
 - The medical literature (e.g. Mendel et al., 2024) has provided evidence of paradoxical phenomena of patients' trust in AI compared to doctors.
 - This approach justifies the thesis that the dilemmas faced by judges and doctors are an early warning and a model for business leaders in other sectors.
 3. *Timeliness and scientific rigor*: peer-reviewed articles published between 2019 and 2025 were prioritized to capture the *dynamics* of change related to the implementation of generative AI and the latest legal regulations.

2.2. Analytical procedure

The collected material was subjected to thematic analysis to identify the key dimensions of trust and reliance. The synthesis process consisted in mapping the control mechanisms and risks identified in the literature to the conceptual framework of leadership. In particular, the TRUST framework identified in the legal literature has been adapted and operationalized for the needs of management practice.

This methodological approach allowed us to go beyond a simple description of AI applications, allowing for a critical assessment of the responsibility gap and formulation of recommendations for leaders who need to manage not only technology, but above all relationships in hybrid human-machine teams.

3. AI and decision process transformation

3.1. AI as a decision catalyst

Algorithmic decision-making based on big data has become an essential tool and is pervasive in all aspects of our daily lives: the news articles we read, the movies we watch, the people we spend time with, whether we get searched in an airport security line, whether more police officers are deployed in our neighborhoods, and whether we are eligible for credit, healthcare, housing, education and employment opportunities, among a litany of other commercial and government decisions (Gravett, 2024, p. 282).

AI, especially when combined with big data analytics, is seen as a technology capable of revolutionizing decision-making, providing real-time recommendations and enabling faster response to crises. Scientific research proves that AI plays a significant role in the decision-making process. For example, in a study of 133 employees of Saudi organizations, the results clearly showed that AI has a direct positive impact on improved decision-making. Moreover, improved decision-making has a significant positive impact on individual productivity, organizational performance and organizational culture (Alasmri and Basahel, 2022, p. 1).

AI supports leaders in:

- Analytics and prediction: analyze historical data, forecast future trends (e.g., sales, customer behavior), and detect anomalies that signal upcoming issues early.
- Optimization and automation: it helps automate routine activities and processes, which frees up leaders and teams to focus on strategic tasks. In the IT sector, almost 40% of automation processes concern this department (Trojańczyk, 2024, p. 100).
- Reducing decision-making stress: faced with an increasing number of decisions (a tenfold increase in the last three years) and decision-making stress (85% of leaders), AI can provide recommendations, supporting the selection process under conditions of uncertainty (Trojańczyk, 2024, p. 100).

However, it should be remembered that AI is only a tool, and its analyses, although advanced, may be subject to error. Final, strategic decisions must be made and accepted by humans.

3.2. Epistemic trust and explainability

Trust is a key element in interpersonal relationships and in the functioning of the organization, and in the case of AI implementation, it becomes the foundation for its acceptance. The problem of trust has become especially relevant in connection with the globalization of threats caused by accelerated technological development (Sychev, 2024, p. 39). In the technological context, trust is closely linked to the predictability and reliability of systems.

A key problem in delegating decisions to AI is the so-called black box problem, when even the creators of the algorithm are not able to fully explain how the system arrived at a given result. Behera and co-authors (2023) note that while AI models learning from massive data sets have powerful predictive power, their internal processes are often incomprehensible to humans. Without understanding how the algorithm arrived at a specific recommendation – such as refusing a loan or rejecting a job candidate – leaders cannot take full responsibility for those decisions. As González Arencibia et al. (2024) note, the lack of explainability undermines transparency and trust, which are essential for ethical leadership. This creates a tension between effectiveness and explainability. This opacity undermines trust, especially in autonomous and high-stakes systems (Busuioc, 2021, p. 825).

The drive to build trust is one of the main motivators for the development of Explainable Artificial Intelligence. XAI aims to develop methods and tools that enable humans to understand, rationally explain, and trust the results generated by AI (Behera et al., 2023, p. 1).

Explanations are often not reliable, and can be misleading. If we instead use models that are inherently interpretable, they provide their own explanations, which are faithful to what the model actually computes. The lack of explainability limits the understanding of how AI comes to conclusions, leading to user frustration and hindering the adoption of technology in critical sectors such as medicine and the judiciary.

Empirical research shows that transparency is key to building trust: employees in companies that focus on a high level of communication transparency feel trustworthy 1.6 times more often, are 1.8 times more productive, and 2.3 times more focused on tasks compared to companies with low transparency. Transparency of decisions and processes is therefore not only a matter of ethics, but a factor that directly affects the performance of an organization (Trojańczyk, 2024, p. 38).

In scientific discourse, the concepts of “trust” and “reliance” are increasingly distinguished in the context of interaction with technology. Bruynseels, Asveld, and van den Hoven (2025) argue that assigning “trust” to algorithms is a categorical fallacy because machines lack will or intentionality. Instead, they propose the concept of “epistemic reliance”. Allocation of trust should be reserved for human agents and the organizations they operate in. Reliance applies to foundation models and artificial intelligence agents (Bruynseels et al., 2025).

This distinction is crucial for accountability. If we treat AI as a partner that we “trust” in a moral sense, we risk abdicating our own responsibility to verify its actions. Research by Hallowell et al. (2022) on the use of AI in the diagnosis of rare diseases confirms that relational trust (to the human using the tool) is crucial for clinicians and patients, and evidence-based reliability (epistemic trust) is expected in relation to the tool itself.

Research by Mendel, Nova, and Wiesenfeld (2024) reveals an interesting paradox in the context of remote patient monitoring. Although patients declare a higher level of trust in doctors than in AI, in practice they are more likely to disclose sensitive health information to AI systems when the level of trust is already established. This is due to the fact that users disclose health information more readily to AI than to doctors (Mendel et al., 2024), which may suggest less fear of social evaluation by the machine.

However, as Maris et al. (2024) point out, patients still expect a right to a human doctor. They fear that the introduction of AI into clinical practice will lead to the loss of the “human touch” that is essential for empathetic care and the inclusion of individual patient values in the decision-making process.

3.3. Traditional trust models and autonomous systems

Traditionally, leadership has been based on human judgment, intuition, and experience. The development of AI technologies, in particular machine learning and large language models, has changed the landscape of decision-making. In 2025, AI systems are increasingly being used not only to support managerial decisions, but also to automate routine and strategic choices in sectors ranging from finance and healthcare to public administration. Traditional leadership models are evolving towards hybrid systems, in which leaders collaborate with AI as part of *Human-Machine Teaming (HMT)*. Assaad (2024) defines this dynamic as a transition from a hierarchical to a partnership relationship, where in a teaming operation, the human relies on the roles and responsibilities of the machine to fulfil their own roles and responsibilities, and vice versa. However, this interdependence increases the complexity of the system and introduces new risks, in particular related to the unpredictability of autonomous systems.

In the context of crisis management, as Trojańczyk (2024) points out, the role of the leader changes from an authoritarian decision-maker to an interpreter of data provided by AI. Leaders must have the ability to critically evaluate algorithmic recommendations so as not to fall into the trap of overtrusting technology. Joshi (2025) highlights that in matrix organizations, AI can increase decision-making efficiency by 23% and conflict resolution efficiency by 37%, however, this requires strategic leadership capable of managing change and mitigating employee resistance.

3.4. AI as a co-decision-maker

In more recent years, the information system field is beginning to place its attention on complex and often alarming ways in which the use of IT affects organisational and social life – the dark side of technology and its use. (Mikalef et al., 2022, p. 257). For instance, in gig-economy companies, such as Task Rabbit or Uber, algorithms can independently “deactivate”, thus sanction a worker's account based on an opaque algorithmic decision. Other companies apply integrated and AI-driven performance management platforms that optimize working times, track work procedures, and rate employee productivity in a short-paced manner. (Schafheitle et al., 2021, p. 5473).

The use of AI in the judiciary raises the spectre of “algocracy” – a system in which algorithms take over the decision-making functions of public authority (Flórez Rojas, 2025). An example is the COMPAS system used in the USA to assess the risk of recidivism, which became the subject of the famous State versus Loomis case. Gravett (2024) analyses this phenomenon through the lens of the “technology effect” and “automation bias”.

Judges, under time and cognitive pressure, may be tempted to uncritically accept algorithms' recommendations. Most people will take the road of least cognitive effort, and rather than systematically analyze each decision, will use decision rules of thumb or heuristics. Automated decision aids may act as one of these decision-making heuristics (Gravett, 2024).

This leads to a situation in which the algorithm becomes the de facto final decision-maker, even though it formally only has an advisory function. Flórez Rojas (2025) proposes the TRUST framework – Transparency, Responsibility, Understanding, Social justice, Trustworthy oversight, as an essential safeguard against the erosion of the legitimacy of the justice system in the face of automation. They do not replace traditional legal standards, but complement them by emphasizing the relational and procedural dimensions of trust. Below is a table presenting the TRUST model.

Table 1.
The TRUST Framework for AI Governance

Principle	Description & Objective	Managerial Application	Key Mechanisms & Actions
T – Transparency	Requires openness regarding how AI systems operate and how decisions are reached. It ensures that algorithmic processes are not opaque “black boxes” but are accessible for scrutiny.	- Implementing mandatory “explainability reports” for AI-driven strategic decisions. - Ensuring employees understand why an AI recommended a specific resource allocation.	- Publishing algorithmic transparency reports. - Providing accessible, comprehensible explanations of algorithmic decisions. - Ensuring decisions are open to public and professional feedback.
R – Responsibility	Establishes clear lines of accountability for both the design and deployment of AI systems. It ensures that human judgment is not displaced and that judicial actors remain accountable for decisions mediated by algorithms.	- Defining specific protocols for “Meaningful Human Oversight”. - Leaders must sign off on AI decisions, retaining liability for errors.	- Maintaining meaningful human oversight (human-in-the-loop). - Defining liability for system malfunctions or errors. - Ensuring algorithms support rather than supplant human deliberation.
U – Understanding	Focuses on education and AI literacy for legal professionals and the public. Judges and court administrators must comprehend how tools operate to critically evaluate outputs and recognise potential biases.	- Mandating AI literacy training for managers to recognize “hallucinations” or bias. - Counteracting automation bias through critical evaluation workshop.	- Training programs for judges on AI capabilities and limitations. - Bridging the gap between technological advancements and judicial expertise. - Promoting critical evaluation of generative AI outputs.
S – Social Justice	Aims to prevent AI from perpetuating systemic inequalities or discrimination. It ensures that the integration of AI aligns with fundamental rights and principles of fairness.	Conducting regular algorithmic equity audits to ensure AI tools in HR (hiring/firing) do not discriminate against marginalized groups.	- Auditing systems for bias against marginalised communities. - Ensuring equal access to justice. - Aligning technological functionality with procedural safeguards to protect human rights.
T – Trustworthy Oversight	Involves institutional mechanisms to ensure algorithmic governance remains accountable. It requires independent bodies to monitor compliance with legal standards.	Establish an internal “AI Ethics Board” or independent audit committee to review high-stakes algorithmic deployments.	- Establishing independent bodies empowered to audit AI systems. - Conducting post-implementation reviews. - Intervening in cases of system abuse or malfunction.

Source: own study based on Flórez Rojas, 2025.

The above model is proposed as a normative guide to mitigate the risks associated with algocracy, a situation in which algorithms shape decision-making processes in a way that limits human participation and the ability to challenge decisions.

4. The paradox of accountability for AI-supported decisions

The study, titled *Who is Responsible, the Advisor or the AI? Understanding the Effects of Advisors Disclosing Their AI Use on Their Perceived Responsibility and AI Reliance* by Tamir Mednel, Soumik Mandal, Oded Nov, and Batia Mishan Wiesenfeld of New York University looked at the impact of disclosing AI use. The aim of the study was to examine how advisors' disclosure of the use of AI systems affects their perceived accountability for decisions and the degree of reliance on AI advice.

Financial advisors took part in the experiment and participated in a simulation of financial advice. At the same time, the condition of disclosing to clients whether the advisor used AI disclosed vs. undisclosed was manipulated. The results showed that advisors felt less accountable for their recommendations when their use of AI was disclosed to clients, compared to when it remained undisclosed. In addition, a higher sense of personal responsibility correlated with less reliance on AI. The perceived self-competence of advisors increased their sense of responsibility towards investment decisions compared to AI, while greater trust in AI decreased their sense of responsibility (Mendel et al., 2025, p. 8).

One hypothesis is that advisors' perceived self-responsibility is negatively related to relying on AI advice – in other words, advisors who consider themselves more responsible will rely less on AI, while those who feel less responsible will trust AI recommendations more.

“In combination, the above predictions suggest that disclosure of AI use will lower advisor’s perception of their responsibility, which will in turn increase their reliance on AI. Thus, disclosure of AI use increases reliance on AI by reducing advisor’s perceived self-responsibility” (Mendel et al., 2025, p. 8). The authors also examine whether a sense of personal responsibility mediates the positive relationship between disclosing the use of AI and the degree of reliance on its recommendations.

In their study, the authors also referred to Agency Theory, which is a theoretical framework for analyzing the conflicts and challenges that arise when an “agent” (in the context of this research, an advisor) acts on behalf of another person (e.g., a client). Agency theory emphasizes that the interests of the advisor and the client may not be fully aligned, and the effects of the discrepancy are referred to as “agency problems”. Disclosure of an advisor's use of AI can reduce the asymmetry of information between advisor and client, increasing process transparency and making it easier for clients to evaluate the advisor. In agency theory, disclosure should motivate the advisor to act in the interest of the client, however, in practice,

it can also lower the advisor's sense of personal responsibility, leading to greater reliance on AI and potentially more biased recommendations.

Such a perception of responsibility is not limited to financial advice. It can translate into other areas of human activity supported by AI, where delegating decisions or knowledge to automated systems creates similar ethical and practical dilemmas. Artificial intelligence (AI)-based decision support systems are used extensively in various domains, such as accounting, law, health, and finance (Mendel et al., 2025, p. 2).

One of the most striking innovations in the United States criminal justice system in the course of the last three decades has been the introduction of risk-assessment software, powered by sophisticated and often proprietary algorithms, to predict whether individual offenders are likely to reoffend (the so-called “risk of recidivism”) (Gravett, 2024, p. 282).

In medicine, for example, in radiology an AI system may be used to identify anomalous patterns in image data and In medicine suggest a diagnosis, whose correctness a radiologist verifies before sharing it with the patient (Mendel et al., 2025, p. 2).

In the military sector, AI is used in almost all areas of activity, including military intelligence. “The primary role of military intelligence is to gather and analyze information to help military leaders make informed decisions.” (Nitzl et al., 2025, p. 1). “Military intelligence is thus concerned with the collection and analysis of information to provide a comprehensive picture of the situation. This may entail the collection of data on the armed forces and the examination of the plans and operations of other nations, as well as the gathering of information on developments affecting a nation’s security (Sadiku, Musa, 2021; Nitzl et al., 2025, p. 1). New developments in AI and its integration as an analytical tool promise a wide range of support capabilities for the analyst (Nitzl et al., 2025, p. 2).

“Researchers have identified a tendency towards excessive optimism when making decisions involving technology. This bias towards optimism in technology has been labeled the technology effect” (Gravett, 2024, p. 288).

5. Discussion and conclusions

An analysis of the literature leads to the conclusion that in the age of AI, responsibility cannot be delegated to algorithms. Technology, regardless of its sophistication and autonomy, remains a tool in the hands of people. Trust in AI systems cannot be blind; it must be a conditional trust, based on evidence of reliability and transparency of processes (Hallowell et al., 2022).

An analysis of the literature leads to the conclusion that in the age of AI, responsibility cannot be delegated to algorithms. The growing autonomy of decision-making systems is one of the greatest ethical and legal challenges, leading to the risk of creating the so-called

"responsibility gap". In a moral and legal context, the literature consistently indicates that artificial intelligence, without intentionality, cannot be considered a moral subject. Technology, regardless of its sophistication and autonomy, remains a tool in the hands of people. Trust in AI systems cannot be blind; it must be a conditional fund, based on evidence of credibility and transparency of processes (Hallowell et al., 2022).

Still, there is a tendency for human decision-makers to use AI as a "scapegoat" to avoid blame for mistakes or adverse outcomes.

This phenomenon is particularly dangerous in the light of modern research. Research proves that just disclosing the fact of using AI in the decision-making process can psychologically relieve human advisors or decision-makers of a strong sense of responsibility for the final outcome. This psychological release can lead to uncritical acceptance of algorithmic recommendations, known as "automation bias", where leaders, managers, or judges thoughtlessly accept the results generated by the systems.

Key takeaways for leaders and policymakers include:

1. Rejection of the anthropomorphization of responsibility: AI cannot be a moral subject. Attempts to assign blame to algorithms are a form of avoidance on the part of creators and users.
2. Critical evaluation and education: To counter the bias of automation, users of AI systems (judges, doctors, managers) must be trained not only in the use of the tools, but also in understanding their limitations and potential errors (Gravett, 2024; Mendel et al., 2024).
3. Design with collaboration in mind: AI systems should be designed to support human will, not limit it. Shared responsibility models prove to be more effective at building satisfaction and trust than simple automation (Han, Ko, 2025).

To effectively counter these threats and ensure that AI remains a supporting tool rather than a substitute for human judgment, it is crucial to implement "Meaningful Human Oversight" procedures. This means that regardless of the level of sophistication of the system, the final decision and legal responsibility must rest with the person. Artificial intelligence should be treated only as an advanced support tool, while it is the human operator who must retain the ability to verify, challenge and reject its recommendations, thus guaranteeing an ethical and responsible decision-making process.

6. Directions for further research

Future analyses should go beyond the conceptual framework and focus on empirical verification of the TRUST model in various high-risk sectors. A key area of research is to determine whether training leaders to distinguish between "moral trust" in humans and

“technical reliance” on AI actually reduces excessive technological optimism. Longitudinal studies on the impact of AI on leadership competencies are also necessary to assess whether long-term collaboration with algorithms leads to the erosion of critical thinking and decision-making skills in crisis situations when the system fails.

References

1. Alasmri Naeem, Sarah Basahel (2022). Linking Artificial Intelligence Use to Improved Decision-Making, Individual and Organizational Outcomes. *International Business Research*, 15, 10, 1-15. <https://doi.org/10.5539/ibr.v15n10p1>
2. Assaad, Zena (2024). *A Risk-Based Trust Framework for Assuring the Humans in Human-Machine Teaming*. Second International Symposium on Trustworthy Autonomous Systems (TAS '24), Austin, TX, USA: ACM, <https://doi.org/10.1145/3686038.3686045>
3. Behera, Rajat Kumar, Pradip Kumar Bala, Nripendra P. Rana (2023). Creation of Sustainable Growth with Explainable Artificial Intelligence: An Empirical Insight from Consumer Packaged Goods Retailers. *Journal of Cleaner Production*, 399, 136605. <https://doi.org/10.1016/j.jclepro.2023.136605>
4. Bruynseels, Koen, Lotte Asveld, Jeroen van den Hoven (2025). Foundation Models for Research: A Matter of Trust? *Artificial Intelligence in the Life Sciences*, 7, 100126. <https://doi.org/10.1016/j.ailsai.2025.100126>
5. Bunnell, Arianna, Sharon Rowe (2023). The Effect of AI-Enhanced Breast Imaging on the Caring Radiologist-Patient Relationship. In: H. Sousa Antunes et al. (eds.), *Law, Multidisciplinary Perspectives on Artificial Intelligence and the Law. Governance and Technology Series*, 58. Springer.
6. Busuioc, Madalina (2021). Accountable Artificial Intelligence: Holding Algorithms to Account. *Public Administration Review*, 81, 5, 825-36. <https://doi.org/10.1111/puar.13293>
7. European Parliament (2019). *Directorate General for Parliamentary Research Services. Understanding Algorithmic Decision-Making: Opportunities and Challenges*. Brussels: European Union. doi:10.2861/536131
8. Flórez Rojas, María Lorena (2025). Algocracy in the Judiciary: Challenging Trust in the System. *Revista de Estudios Sociales*, 93, 107-28. <https://doi.org/10.7440/res93.2025.06>
9. González Arencibia, Mario, Hugo Ordoñez-Erazo, Juan-Sebastián González-Sanabria (2024). Explainable Artificial Intelligence as an Ethical Principle. *Ingeniería*, 29, 2, e21583. <https://doi.org/10.14483/23448393.21583>
10. Gravett, Willem H. (2024). Judicial Decision-Making in the Age of Artificial Intelligence.” In: H. Sousa Antunes et al. (eds.), *Multidisciplinary Perspectives on Artificial Intelligence*

- and the Law* (pp. 281-97). *Law, Governance and Technology Series*, 58. Springer, https://doi.org/10.1007/978-3-031-41264-6_15
11. Hallowell, Nina, Shirlene Badger, Aurelia Sauerbrei, Christoffer Nellåker, Angeliki Kerasidou (2022). 'I Don't Think People Are Ready to Trust These Algorithms at Face Value': Trust and the Use of Machine Learning Algorithms in the Diagnosis of Rare Disease. *BMC Medical Ethics*, 23, 112, <https://doi.org/10.1186/s12910-022-00842-4>
 12. Han, Jihyung, Daekyun Ko (2025). Consumer Autonomy in Generative AI Services: The Role of Task Difficulty and AI Design Elements in Enhancing Trust, Satisfaction, and Usage Intention. *Behavioral Sciences*, 15, 4, 534. <https://doi.org/10.3390/bs15040534>
 13. Joshi, Satyadhar (2025). Comprehensive Review of Artificial Intelligence in Management, Leadership, Decision-Making and Collaboration. *International Journal of Science and Social Science Research*, 3, 1, p. 49.
 14. Lima, Gabriel, Nina Grgić-Hlača, Jin Keun Jeong, Meeyoung Cha (2022). *The Conflict Between Explainable and Accountable Decision-Making Algorithms*. ACM Conference on Fairness, Accountability, and Transparency (FAccT '22), 1-18. Seoul, Republic of Korea: ACM. <https://doi.org/10.1145/3531146.3534628>
 15. Madanchian, Mitra, Hamed Taherdoost, Michele Vincenti, Nachaat Mohamed (2024). Transforming Leadership Practices through Artificial Intelligence. *Procedia Computer Science*, 235, 2101-11. <https://doi.org/10.1016/j.procs.2024.04.199>
 16. Maris, Menno T., Ayca Koçar, Dick L. Willems, Jeannette Pols, Hanno L. Tan, Georg L. Lindinger, Marieke A.R. Bak (2024). Ethical Use of Artificial Intelligence to Prevent Sudden Cardiac Death: An Interview Study of Patient Perspectives. *BMC Medical Ethics*, 25, 42. <https://doi.org/10.1186/s12910-024-01042-y>
 17. Mendel, Tamir, Oded Nov, Batia Wiesenfeld (2024). Advice from a Doctor or AI? Understanding Willingness to Disclose Information Through Remote Patient Monitoring to Receive Health Advice. *Proceedings of the ACM on Human-Computer Interaction*, 8, CSCW2, Article 386. <https://doi.org/10.1145/3686925>
 18. Mikalef, Patrick, Kieran Conboy, Jenny Eriksson Lundström, Aleš Popovič (2022). Thinking Responsibly about Responsible AI and 'the Dark Side' of AI. *European Journal of Information Systems*, 31, 3, 257-68. <https://doi.org/10.1080/0960085X.2022.2026621>
 19. Nitzl, Christian, Achim Cyran, Sascha Krstanovic, Uwe M. Borghoff (2025). The Use of Artificial Intelligence in Military Intelligence: An Experimental Investigation of Added Value in the Analysis Process. *Frontiers in Human Dynamics*, 7, 1540450. <https://doi.org/10.3389/fhumd.2025.1540450>
 20. Schafheitle, S.D., A. Weibel, A. Rickert (2021). The Bermuda Triangle of Leadership in the AI Era? Emerging Trust Implications from 'Two-Leader-Situations' in the Eyes of Employees. In: T.X. Bui (ed.), *Proc. Annu. Hawaii Int. Conf. Syst. Sci.*, vols. 2020-January. IEEE Computer Society. Scopus. <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85108319863&partnerID=40&md5=741cc62ca6ca3cb5ac3991ee719c6143>

21. Sychev, A.A. (2024). Looking for confidence: transformation of trust in the digital age. *Monitoring Obshchestvennogo Mneniya: Ekonomicheskie i Sotsial'nye Peremeny*, 183, 5, 38-59. Scopus. <https://doi.org/10.14515/monitoring.2024.5.2595>
22. Trojańczyk, Adam (2024). *Przywództwo w czasach AI: Minipodręcznik dla liderów o zarządzaniu kryzysem w epoce maszyn generatywnych*. Łódź: Adam Trojańczyk, ISBN: 978-83-966626-0-6

QUALITY MANAGEMENT OF HONEY IN THE BANI WORLD: CONSUMER PERCEPTIONS AND MARKET RESPONSES

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Purpose: The article aims to explore the role of quality perception in managing honey quality under market instability, characteristic of the BANI world. The study focuses on the relationship between consumer perceptions and producers' adaptive strategies.

Design/methodology/approach: A mixed-method approach was applied, combining literature analysis with a CAWI survey conducted in 2024 on a sample of 756 adult honey consumers. The study examined quality perception mechanisms, preferences for product origin, and acceptable price levels.

Findings: Consumers show a strong preference for domestically produced honey and are willing to pay a premium for products perceived as local and authentic. However, there is low trust in external quality certifications. Distinct consumer segments were identified, indicating the need for flexible and targeted quality management approaches.

Research limitations/implications: The purposive sampling method limits the generalizability of the results. Further research is recommended to explore how consumer perceptions can be better integrated into quality management systems, particularly in sectors vulnerable to market disruptions.

Originality/value: The study contributes to quality management theory by combining consumer perception with systemic resilience, offering practical insights for the agri-food sector.

Keywords: honey quality, consumer perception, BANI, flexible management, food market.

Category of the paper: Research paper.

1. Introduction

Contemporary quality management in the food sector unfolds amid escalating instability, complexity, and growing difficulty in forecasting change. Climate change adversely affects production yields, food quality, and supply chains (Owino et al., 2022; Mirón, Linares, Díaz,

2023). Moreover, global crises and shifting consumer behaviors place mounting pressure on quality systems to adapt (Sparling et al., 2024).

Disruptive phenomena in contemporary market systems are increasingly interpreted through the lens of the BANI paradigm, which describes conditions as brittle, anxious, nonlinear, and incomprehensible. Unlike the earlier VUCA model (volatility, uncertainty, complexity, ambiguity), BANI highlights structural fragility, anxiety as a dominant decision-making emotion, the nonlinearity of interactions, and difficulty in tracing causality (Mieszajkina, Ostapińska, 2024). Organizational transformation literature emphasizes that operating in the BANI environment requires the implementation of agile management practices, a learning-oriented culture, and resilience-driven leadership (Olkowicz, et al., 2024; Vishwakarma, Pandey, 2025).

In such a dynamic environment, traditional quality management systems often prove inadequate. Effective approaches increasingly demand adaptability, strategic flexibility, and a deeper understanding of stakeholder perceptions, particularly those of consumers (Araújo, Arruda, 2024; Mieszajkina, Ostapińska, 2024).

The honey sector is especially vulnerable to market disruptions. Honey quality results from complex interactions involving environmental conditions such as climate and forage availability, biological processes including bee activity, technological factors like harvesting and storage methods, as well as regulatory and market dynamics. In recent years, both Poland and other European countries have experienced significant supply–demand imbalances in the honey market, caused by weather anomalies, the influx of honey from diverse geographic regions, shifts in consumer preferences, and a growing interest in natural and organic products (Peres et al., 2025; Żak, Wilczyńska, 2023).

From this perspective, honey quality is no longer defined solely by its physicochemical parameters. Instead, it increasingly becomes a perceptual construct shaped in consumers' minds by beliefs, past experiences, marketing communication, and media narratives (Mohamadzade Namin et al., 2023; Manickavasagam et al., 2024). Research shows that perceived quality often diverges from a product's objective attributes, with factors such as certification, labeling, price, and declared geographic origin playing a decisive role in purchasing decisions (Sadílek, 2019; Mohamadzade Namin et al., 2023; Manickavasagam et al., 2024). At the same time, unverified media reports about honey adulteration or the ineffectiveness of quality oversight mechanisms may undermine trust and create confusion among consumers (Żak, Wilczyńska, 2023).

Consequently, quality perception serves as a critical link between market mechanisms and management strategies. It integrates three key domains: market dynamics, including supply and demand fluctuations, import pressures, and pricing policies; consumer expectations and preferences related to apicultural products; and producers' adaptive capacities in areas such as market segmentation, quality communication, and flexible production standardization (Stone, Rahimifard, 2018; Wu et al., 2021).

The primary aim of this article is to examine the role of perceived quality in shaping adaptive quality management strategies for honey under volatile market conditions, typical of the BANI environment. To achieve this goal, the study analyzes key market forces influencing quality perception, identifies consumer preferences, and evaluates their impact on producer strategies. Furthermore, it proposes potential adaptive approaches for quality management practices and offers strategic recommendations for stakeholders in the beekeeping sector, which may also serve as a basis for further research.

The article is structured into five sections. The first outlines the theoretical framework and rationale for the research. The second discusses the destabilizing mechanisms influencing the honey market in Poland. The third presents the research methodology. The fourth describes the survey findings, including consumer segmentation. The final section explores practical implications for quality management in the honey sector, viewed through the lens of organizational and systemic resilience.

2. Market instability in the honey sector

Under BANI conditions, every segment of the food production system, including the honey market, faces heightened structural and external pressures. This section explores the main destabilizing mechanisms affecting the honey market in Poland and globally, along with their implications for quality perception and adaptive strategy development.

2.1. Climatic and economic pressures as sources of supply and price instability

Honey production is highly dependent on environmental factors such as the availability of nectar sources, climatic conditions, and hive health. In recent years, the frequency of extreme weather events - including droughts, heatwaves, and delayed springs - has increased, leading to significant inconsistencies in honey yields in terms of both quantity and quality (e.g., reduced sugar content, increased moisture levels)). Literature on food system resilience emphasizes that climate variability is a major risk factor with downstream effects across the supply chain (Gajardo-Rojas et al., 2022; Roosevelt et al., 2023; Vincze et al., 2025).

Food systems must demonstrate adaptive capacity in the face of disruptions, which in practice involves increasing system flexibility through diversification of supply sources, establishment of buffer stocks, and implementation of shock-absorbing mechanisms (Roosevelt et al., 2023; Deconinck et al., 2023). In the honey sector, such resilience is often constrained by the strong dependence on local climatic conditions and the limited window of optimal nectar collection periods.

On the global market, honey trade between countries has intensified, influencing both international and domestic pricing. Imports from low-cost production regions exert substantial competitive pressure on domestic producers. In a context of volatile exchange rates, fluctuating transportation costs, tariffs, and variable global demand, honey prices are highly susceptible to external shocks, exacerbating market volatility. Studies on food supply chain resilience suggest that food markets are increasingly vulnerable to risk transmission across production and consumption segments (Deconinck et al., 2023; Hadachek, Ma, Sexton, 2024).

Critical analyses of agri-food supply chains underscore that one of the key challenges is the shifting of risk along the value chain - producers, distributors, and retailers respond differently to disruptions, which can lead to risk concentration and systemic imbalance (Stone, Rahimifard, 2018).

2.2. Consumers in market disruption contexts – attitudes, perceptions, and trust

Market instability, especially when accompanied by media coverage of product fraud or concerns about quality, directly influences consumers' perception of risk (Manning, Kowalska, 2021). Under uncertain conditions, consumers are more likely to rely on indirect indicators of quality such as brand reputation, certifications, and peer recommendations, compensating for limited awareness of the product's physicochemical characteristics (Wu et al., 2021). The literature on food systems suggests that during periods of crisis, consumers tend to prefer geographically proximate products obtained through shorter supply chains, which are perceived as more trustworthy and easier to control (Radzyńska, Jakubowska, 2018). In the honey sector, this shift in preferences may benefit local products while simultaneously intensifying competitive pressure on producers to ensure transparency and quality differentiation.

The functioning of the honey market under unstable conditions, marked by fluctuating supply, import pressure, and volatile prices, does not operate in isolation (Ballco, Jaafer, de Magistris, 2022). Rather, it is strongly interlinked with consumer behavior, creating dynamic feedback loops that hold significant systemic relevance. For instance, in response to intensified price competition, producers may increase their emphasis on communicating quality-related attributes such as certification, geographic origin, or production practices (Bravo et al., 2024). These efforts, in turn, shape consumer perceptions of value. As a result, consumers driven by perceived quality may exhibit a higher willingness to pay a premium for products considered safe, authentic, or locally produced (Zeng et al., 2023). This form of market responsiveness opens a path for producers to enhance both the actual and perceived quality of their offerings through technological improvements and strategic communication.

At the same time, disruptions in price or product availability, such as the influx of low-cost honey, may erode consumer trust and destabilize established value assessment mechanisms. These disturbances may require compensatory measures, including adjustments in pricing strategies, promotional efforts, or the redefinition of profit margins (Deconinck et al., 2023).

Scholars in the field of food system resilience emphasize that one of the most effective leverage points for strengthening value chain resilience lies in the area of information management, transparency, and communication among stakeholders (Astill et al., 2019; Burgess, Sunmola, Wertheim-Heck, 2023). This suggests that managing information, both in its technological form and in the way it is perceived, has become a strategic pillar of modern quality management.

Given these interdependencies, the honey market cannot be adequately analyzed using classical linear economic models. A systems-based approach is required, one that incorporates the interrelationships between production, distribution, and consumer-perceived value. At the center of this system stands the consumer, whose preferences, expectations, and sensitivity to risk now constitute the central point of reference for adaptive strategies in the apiculture sector. The following sections explore selected dimensions of consumer perception, with particular focus on the roles of geographic origin and acceptable pricing levels as determinants of purchasing behavior and foundational elements for flexible quality management.

3. Research Methodology

A consumer survey was conducted in 2024 to investigate purchasing preferences related to honey, with particular attention to country of origin, acceptable price levels and product-selection criteria. A quantitative approach was used, employing a Computer-Assisted Web Interview (CAWI) administered online. Respondents were recruited via an established online access panel and selected based on predefined eligibility criteria: being at least 18 years of age and having declared purchasing honey in retail outlets (supermarkets, hypermarkets, or grocery stores). The purposive sample consisted of 756 adult honey consumers.

The study sample included individuals aged 18-34 years (28%), 35-54 years (46%), and over 55 years (26%). The majority of respondents held higher education degrees (58%) or secondary education (31%), while 11% reported having completed primary or vocational education. Urban residents from large cities accounted for 22% of the sample, those from medium and small towns for 51%, and rural residents for 27%. The sampling approach enabled the inclusion of a broad range of consumer attitudes and allowed for the analysis of demographic variation.

The questionnaire included closed-ended questions, both single- and multiple-choice, covering the significance of honey origin in purchasing decisions, preferred price per 1 kg of honey from selected countries (with respondents specifying a value in PLN), and the key factors influencing product selection. Responses were provided using nominal scales, and participants were asked to rank up to three most important criteria. Price-related data were analyzed

descriptively, including calculation of medians, standard deviations, and the proportion of respondents willing to pay a higher price (above 50 PLN).

4. Results of study

The analysis of survey results indicates that the country of origin plays a significant role in honey purchasing decisions among consumers. Approximately 73% of respondents declared that they consider the country of origin when buying honey, and among them, 90% expressed a preference for domestically produced products. This highlights a strong consumer orientation toward local food and a high level of trust in the national food system.

These findings are consistent with previous studies by Žak and Wilczyńska (2023), which emphasized the growing relevance of local origin certifications and geographical indications as factors reinforcing consumer loyalty in the honey market. The results also align with broader research underscoring the importance of short supply chains and geographic proximity as indicators of product credibility, particularly in uncertain conditions (Benos et al., 2022). This behavior may be interpreted through the lens of “food citizenship”, where consumers demonstrate conscious preferences for sustainable and locally rooted production models (Lozano-Cabedo, Gómez-Benito, 2017).

Conversely, the country’s most frequently associated with consumer distrust included China (39.7%), Ukraine (32.6%), and Russia (19.6%) – table 1. These perceptions are consistent with the findings of the European Food Safety Authority (EFSA, 2021), which has repeatedly reported irregularities in the composition and labeling of honeys imported from these origins. Nevertheless, only 12% of all respondents declared a complete rejection of honey from China, suggesting that price sensitivity may outweigh concerns in certain consumer segments.

Table 1.
Countries of origin most frequently rejected by consumers considering origin in their honey purchases

Country of origin	Share [%]
China	39.7
Ukraine	32.6
Russia	19.6
Any country other than Poland	4.9
Any country outside the EU	4.9
Other	10.7
Hard to say / Don’t know	1.8

Note: Multiple answers were allowed. Percentages refer to respondents who indicated that the country of origin influences their honey purchasing decisions.

Source: Own work.

The relationship between the perceived origin of honey and the acceptable price level was confirmed in a detailed analysis. Consumers who considered the country of origin in their purchasing decisions were significantly more likely to pay a premium for honey produced domestically or sourced from trusted regions. In contrast, respondents who did not attribute importance to origin demonstrated greater price flexibility and more often chose the cheaper product regardless of its provenance.

This trend supports the hypothesis formulated by Mohamadzade Namin et al. (2023), who argue that the perception of authenticity and product safety acts as a modulator of price acceptability. In other words, consumers are willing to pay a price premium in exchange for perceived quality, particularly in product categories associated with naturalness, such as honey. These findings emphasize the relevance of market segmentation and the need to adapt quality management strategies to heterogeneous consumer expectations, which is consistent with the principles of value-based pricing and relationship marketing (Hinterhuber, 2017; Espejel, Fandos, Flavián, 2008).

In the question regarding the most important factors influencing honey choice, respondents were asked to indicate up to three determinants from a predefined list. As shown in Figure 1, the most frequently selected criteria included: (1) type of honey (e.g., linden, multifloral), (2) price, (3) degree of crystallization, and (4) country of origin. Secondary factors such as packaging design, presence of certifications, and recommendations from acquaintances played a less decisive role.

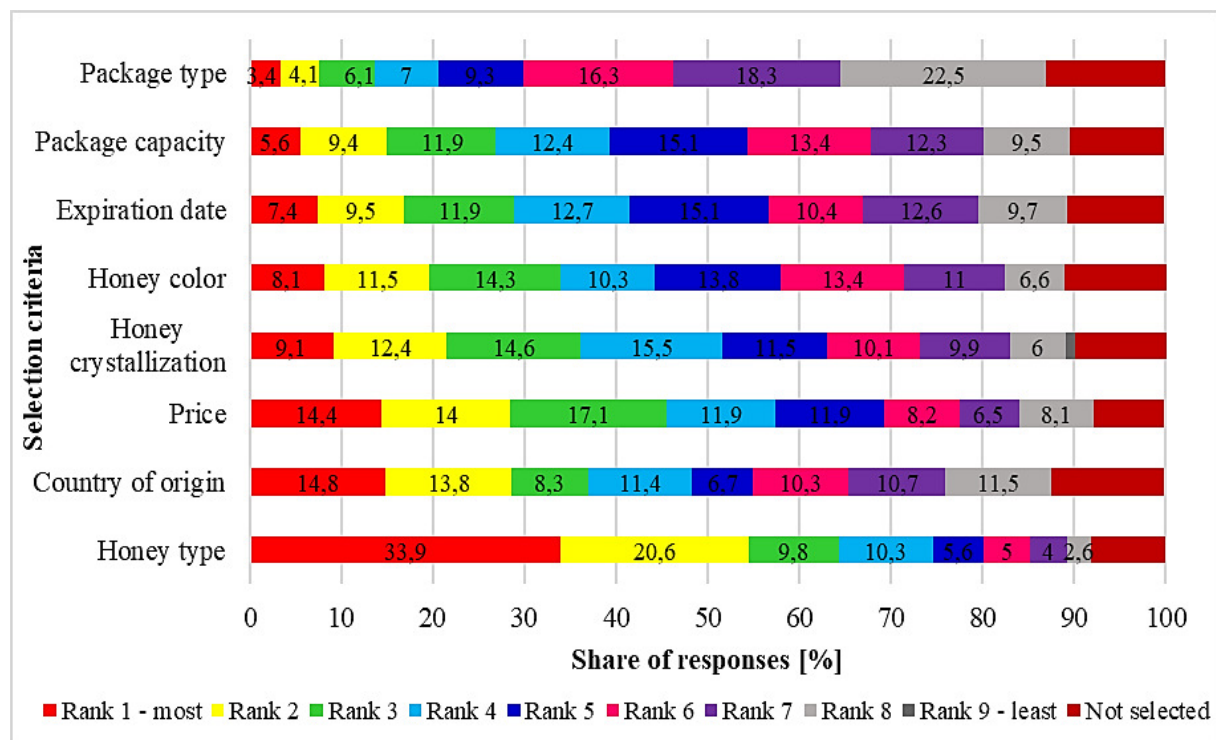


Figure 1. Factors influencing consumer choice of honey.

Source: Own work.

Interestingly, quality certifications (e.g., organic labels) played only a marginal role in purchasing decisions. This may indicate limited consumer trust in external verification systems or a lack of familiarity with certification schemes. This observation is consistent with findings by Peres et al. (2025) and Grunert et al. (2014), who argue that quality labels are only effective when they are both recognized and clearly communicated to consumers.

The analysis of acceptable price levels for honey from different origins (Table 2) revealed distinct differences in consumers' willingness to pay depending on the product's country of origin. The highest median price was reported for domestic honey (PLN 45), whereas products from China and Ukraine were valued lower, at PLN 27 and PLN 32, respectively. As many as 41% of respondents declared a willingness to pay more than PLN 50 per kilogram for Polish honey, compared to only 7% for honey from China. These results support the hypothesis formulated by Mohamadzade Namin et al. (2023), who argue that the perception of authenticity and product safety acts as a modulator of price acceptability.

Table 2.

Acceptable price for 1 kg of honey depending on its country of origin (PLN)

Honey country of origin	Median acceptable price [PLN]	Standard deviation	Proportion of respondents [%] who would accept a price above PLN 50
Poland	45	8.6	41
UE (np Germany, Spain)	39	7.4	25
Ukraine	32	6.2	14
China	27	5.1	7

Note: Responses of respondents who consider the country of origin when purchasing honey.

Source: Own work.

The research findings indicate that under conditions of market instability, the consumer plays a crucial role as an active participant in the quality-management process. Through their purchasing decisions, consumers influence producers' strategies, including choices related to raw-material sourcing, distribution channels, and pricing policies.

Consumer preferences for domestic honey and the willingness to pay a premium for products from trusted sources align with the emerging body of research on resilient consumption. This concept emphasises the importance of local relationships, supply-chain transparency, and personal engagement in product selection (Stone, Rahimifard, 2018; Frewer et al., 2016).

Given the complexity and non-linearity of contemporary markets, understanding consumer perception patterns and preferences becomes essential for building sectoral resilience. The observed differences underscore the importance of tailored quality communication strategies and adaptive market responses.

The analysis of consumer preferences and price acceptance levels presented above is on observed distribution patterns and descriptive comparisons between identified segments. This approach enables a better understanding of perception diversity and provides a basis for identifying key areas relevant to quality communication and market adaptation.

5. Implications for honey quality management under market instability

The empirical findings and analysis of current market dynamics suggest that effective honey quality management in the BANI context requires a departure from traditional models grounded in stability, linearity, and predictability. Increasing complexity, vulnerability to disruptions, and information ambiguity call for a strategic shift - from operational optimization to building systemic resilience, adaptive capacity, and effective quality communication. This section identifies key areas requiring adaptive interventions to enhance the ability of quality management systems to operate in volatile and unpredictable environments.

5.1. Origin transparency and communication as a foundation of trust

Although consumers declare a strong preference for domestic honey, this is not fully reflected in their awareness of authenticity criteria or recognition of quality assurance schemes. Enhancing origin transparency is therefore a strategic priority. This can be achieved through both digital tools (Treiblmaier, Garaus, 2023; Li et al., 2025) and the development of geographical indications alongside consumer-oriented educational initiatives. As Doherty et al. (2023) argue, the resilience of food quality systems depends not only on formal certification mechanisms but also on societal trust and the legitimacy of production practices.

Transparency should thus be viewed not merely as a regulatory requirement, but as a strategic asset that fosters consumer loyalty and competitive advantage. Modern consumers evaluate product value not solely on physicochemical characteristics, but also on symbolic and narrative meanings linked to origin, packaging, certification, and brand identity. For this reason, quality communication must be coherent and multidimensional.

The use of integrated multichannel communication strategies is essential. These should include traditional product labeling, digital technologies, and a wide range of consumer touchpoints, such as retail environments, e-commerce platforms, social media, and promotional or educational initiatives. These elements, treated as integral components of the consumer experience, play a significant role in shaping quality perception, influencing levels of trust, loyalty, and willingness to pay a premium for products perceived as authentic and valuable (Nguyen, Nguyen, 2025; Tran et al., 2024; Wu et al., 2021).

Practical implementation of these principles may include the use of digital traceability tools, such as blockchain-based systems, which enable consumers to check the origin and production details of honey in real time (Treiblmaier, Garaus, 2023; Li et al., 2025). In addition, tools such as stakeholder mapping or QR codes leading to product information and feedback options can support closer cooperation and build trust between producers and consumers. These solutions strengthen transparency not only as a communication element, but also as an integral part of adaptive and responsive quality management.

Supporting this approach, international comparative studies have confirmed the importance of consumer trust and perceived authenticity in food purchasing decisions. Macready et al. (2020) found that trust in the food value chain varies across European countries and significantly affects consumer confidence. Their results underline the need for culturally sensitive communication strategies and locally adapted quality signaling. Similarly, Wilson et al. (2020), analyzing data from Australia, New Zealand, the UK, and Ireland, emphasized that building trust requires not only transparent information but also credible actors and long-term engagement. These findings support our results, showing that country of origin and the clarity of quality cues play a decisive role in purchasing decisions, particularly under conditions of market uncertainty.

Taken together, these observations underscore a broader principle: transparent origin and strategic communication reflect a core component of resilient food systems – namely, the capacity to build and maintain consumer trust despite exogenous shocks. From a resilience theory perspective, trust-building mechanisms act as buffers, mitigating volatility and strengthening system stability by fostering loyalty and informed decision-making (Folke, 2006; Tendall et al., 2015; Hirth et al., 2025).

5.2. Flexibility and resilience as strategic responses to market complexity

The study reveals distinct consumer segments differing in price sensitivity and expectations related to honey origin and quality. Effective quality management therefore requires a differentiated approach in portfolio design, pricing, and communication. A dual-track strategy may be suitable:

1. Standard products targeting price-sensitive consumers.
2. Premium products tailored to consumers who value regional origin, certification, and authenticity and are willing to pay a price premium.

This approach is also supported in the literature. For instance, Hempel (2024) identifies consumer clusters with varying levels of price sensitivity amid rising food prices. Value-based pricing, in which price reflects the perceived value rather than production costs, provides a sound framework for premium strategies in markets where consumers are willing to pay more for higher-quality offerings (Hinterhuber, 2017; Alberto de Moraes Watanabe et al., 2023).

These adaptive strategies resonate with the principles of agile quality management, which prioritizes responsiveness, continuous feedback, and modular decision-making structures (Theobald, Diebold, 2017; Sutar, Wagh, 2025). The empirical segmentation observed in consumer behavior highlights the need for decentralized quality strategies that can flexibly accommodate varying expectations, especially under conditions of high uncertainty and informational ambiguity, characteristic of BANI environments (Stone, Rahimifard, 2018; Skrzypek, 2024).

In the BANI world, the goal is not merely to minimize volatility, but to develop capabilities that enable organizations to absorb, adapt to, and leverage it in strategic decisions. In the honey sector, this includes:

- diversifying raw material sources, including partnerships with apiaries from different regions,
- strengthening internal quality autonomy through the development of proprietary standards and in-house quality control systems,
- adopting proactive risk management practices such as scenario planning, trend monitoring, and flexible decision models (Hobbs, Hadachek, 2024; Pashkevich et al., 2024; Papalexiou et al., 2024).

According to agile quality management principles, quality should be understood not as a static attribute but as a dynamic process of continuous adjustment to changing conditions and stakeholder needs (Theobald, Diebold, 2017). As noted by Stone and Rahimifard (2018) and Banach et al. (2025), flexible and adaptive structures supported by digital technologies such as IoT and AI are becoming essential in managing food quality in globally unstable contexts.

Finally, Skrzypek (2024) underlines the importance of integrating flexible quality approaches with risk management and organizational transformation. Similarly, Olkowicz, Jarosik-Michalak, and Kozłowski (2024) stress the critical role of leadership in shaping employee behavior and communicating quality values - serving as a core adaptive mechanism in quality management.

6. Conclusion

The research findings and contextual analysis of the honey market operating under BANI conditions allow for the formulation of key generalizations regarding future directions in quality management within the apicultural sector.

1. Honey quality, increasingly viewed not solely through the lens of physicochemical parameters but also as a perceptual construct, is shaped by social and behavioral factors. Consumers are demonstrating heightened sensitivity to locality, transparency of origin, and the consistency of communicated quality values.
2. Maintaining competitiveness in a volatile market environment requires producers and distributors to implement flexible quality management mechanisms that account for shifting consumer preferences, diversification of distribution channels, and differentiation in product offerings. Market segmentation strategies, value-based pricing, and the use of advanced communication tools are gaining strategic importance.

3. Effective performance in a complex and unpredictable environment necessitates a paradigm shift in quality management, where resilience and adaptability become key responses to fluctuations in quality perception and changing consumer expectations. Quality management should be understood as a continuous process, integrated with data interpretation, organizational learning, and operational agility.
4. Rebuilding and reinforcing consumer trust must be grounded in the development of traceability systems, transparent supply chains, and the promotion of national and regional quality certification schemes. These elements not only signal market responsibility but also serve as sources of competitive advantage.

In conclusion, operating within the BANI world requires a transformation of traditional quality management approaches in the honey sector - toward more flexible, resilient, and perception-driven models. Producers' ability to integrate market intelligence, anticipate evolving consumer expectations, and communicate quality values effectively is emerging as a critical success factor in navigating economic volatility. These findings underscore the need for further interdisciplinary research on the integration of consumer behavior, quality perception, and resilience-based strategies in food quality management systems. The study's outcomes may serve as a foundation for policy makers, industry stakeholders, and researchers aiming to enhance quality governance in sectors exposed to high levels of complexity and uncertainty.

References

1. Alberto de Moraes Watanabe, E., Alfinito, S., Castelo Branco, T.V., Felix Raposo, C., Athayde Barros, M. (2023). The Consumption of Fresh Organic Food: Premium Pricing and the Predictors of Willingness to Pay. *Journal of Food Products Marketing*, 29(2-3), 41-55. <https://doi.org/10.1080/10454446.2023.2185118>
2. Araújo, W.M.C., Arruda, S.F. (2024). Insights into food perception and consumer behavior. *Foods*, 13(13), 1964. <https://doi.org/10.3390/foods13131964>
3. Astill, J., Dara, R.A., Campbell, M., Farber, J.M., Fraser, E.D., Sharif, S., Yada, R.Y. (2019). Transparency in food supply chains: A review of enabling technology solutions. *Trends in Food Science & Technology*, 91, 240-247. <https://doi.org/10.1016/j.tifs.2019.07.024>
4. Ballco, P., Jaafer, F., de Magistris, T. (2022). Investigating the price effects of honey quality attributes in a European country: Evidence from a hedonic price approach. *Agribusiness*, 38(4), 885-904. <https://doi.org/10.1002/agr.21760>
5. Banach, J.K., Rujna, P., Lewandowski, B. (2025). Integrated Process-Oriented Approach for Digital Authentication of Honey in Food Quality and Safety Systems - A Case Study

- from a Research and Development Project. *Applied Sciences*, 15(14), 7850. <https://doi.org/10.3390/app15147850>
6. Benos, T., Burkert M., Hüttl-Maack V., Petropoulou E. (2022). When mindful consumption meets short food supply chains: empirical evidence on how higher-level motivations influence consumers. *Sustainable Production and Consumption*, 33, 520-530. <https://doi.org/10.1016/j.spc.2022.07.028>
 7. Bravo, I., Colamatteo, I., Balzano, S., Cappelli, L., Iannucci, E. (2024). Consumer Behaviour Regarding Certified Food. *Sustainability*, 16(9), 3757. <https://doi.org/10.3390/su16093757>
 8. Burgess, P.R., Sunmola, F.T., Wertheim-Heck, S. (2023). A review of supply chain quality management practices in sustainable food networks. *Heliyon*, 9(11). <https://doi.org/10.1016/j.heliyon.2023.e21179>
 9. Deconinck, K., Henderson, B., Gregg, D., Hill, D. (2023). Towards resilient food systems: Implications of supply chain disruptions and policy responses. *OECD Food, Agriculture and Fisheries Paper, No. 205*, pp. 5-28.
 10. Doherty, B., Ensor, J., Heron, T., Prado, P. (2023). Food systems resilience: towards an interdisciplinary research agenda. *Emerald Open Research*, 1(10). DOI: <https://doi.org/10.1108/EOR-10-2023-0001>
 11. EFSA (2021). *Annual Report of the European Food Safety Authority*. <https://www.efsa.europa.eu>
 12. Espejel, J., Fandos, C., Flavián, C. (2008). Consumer satisfaction: A key factor of consumer loyalty and buying intention of a PDO food product. *British Food Journal*, 110(9), 865-881. <https://doi.org/10.1108/00070700810900585>
 13. Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global environmental change*, 16(3), 253-267. <https://doi.org/10.1016/j.gloenvcha.2006.04.002>
 14. Frewer, L.J., Fischer, A.R.H., Brennan, M., Bánáti, D., Lion, R., Meertens, R.M., Vereijken, C.M. (2016). Risk/benefit communication about food - a systematic review of the literature. *Critical Reviews in Food Science and Nutrition*, 56(10), 1728-1745. <https://doi.org/10.1080/10408398.2013.801337>
 15. Gajardo-Rojas, M., Muñoz, A.A., Barichivich, J., Klock-Barría, K., Gayo, E.M., Fontúrbel, F.E., Olea, M., Lucas, C.M., Veas, C. (2022). Declining honey production and beekeeper adaptation to climate change in Chile. *Progress in Physical Geography: Earth and Environment*, 46(5), 737-756. <https://doi.org/10.1177/03091333221093757>
 16. Grunert, K.G., Hieke, S., Wills, J. (2014). Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy*, 44, 177-189. <https://doi.org/10.1016/j.foodpol.2013.12.001>

17. Hadachek, J., Ma, M., Sexton, R.J. (2024). Market structure and resilience of food supply chains under extreme events. *American Journal of Agricultural Economics*, 106(1), 21-44. <https://doi.org/10.1111/ajae.12393>
18. Hempel, C. (2024). A segmentation and characterization of consumers affected by rising food prices. *Appetite*, 194, 107192. DOI: 10.1016/j.appet.2023.107192
19. Hinterhuber, A. (2017). Value quantification capabilities in industrial markets. *Journal of Business Research*, 76, 163-178. <https://doi.org/10.1016/j.jbusres.2017.03.012>
20. Hirth, S., Morgan, E., Kaptan, G., Crastes dit Sourd, R., Tallontire, A., Young, W., Winter, M. (2025). Restoring Food System Resilience in a Turbulent World: Supply Chain Actors' Shared Responsibility. *Business Strategy and the Environment*, 34(5), 6007-6023. <https://doi.org/10.1002/bse.4287>
21. Hobbs, J.E. Hadachek, J. (2024). The economics of food supply chain resilience. *Annual Review of Resource Economics*, 16(1), 379-397. DOI: 10.1146/annurev-resource-100423-095119
22. Li, W., Song, R., Yu, K. (2025). Consumer adoption of food blockchain traceability: insights from integrating TAM and TR models. *Frontiers in Sustainable Food Systems*, 9, 1515188. <https://doi.org/10.3389/fsufs.2025.1515188>
23. Lozano-Cabedo, C., Gómez-Benito, C. (2017). A theoretical model of food citizenship for the analysis of social praxis. *Journal of Agricultural and Environmental Ethics*, 30(1), 1-22. <https://doi.org/10.1007/s10806-016-9649-0>
24. Macready, A.L., Raats, M., Shepherd, R., Magnusson, M. (2020). Consumer trust in the food value chain and its impact on consumer confidence: A model for assessing consumer trust and evidence from a five-country study in Europe. *Food Policy*, 92, 101880. <https://doi.org/10.1016/j.foodpol.2020.101880>
25. Manickavasagam, G., Saaïd, M., Lim, V. (2024). Impact of prolonged storage on quality assessment properties and constituents of honey: A systematic review. *Journal of Food Science*, 89(2), 811-833. <https://doi.org/10.1111/1750-3841.16921>
26. Manning, L., Kowalska, A. (2021). Considering fraud vulnerability associated with credence-based products such as organic food. *Foods*, 10(8), 1879. <https://doi.org/10.3390/foods10081879>
27. Mieszajkina, E., Ostapińska, K. (2024). Evaluation of the impact of the BANI world on small business innovation activities. *European Research Studies Journal*, 27(2), 126-139. <https://ersj.eu/journal/3489>
28. Mirón, I.J., Linares, C., Díaz, J. (2023). The influence of climate change on food production and food safety. *Environmental Research*, 216, 114674. <https://doi.org/10.1016/j.envres.2022.114674>
29. Mohamadzade Namin, S., Ghosh, S., Jung, C. (2023). Honey quality control: review of methodologies for determining entomological origin. *Molecules*, 28(10), 4232. <https://doi.org/10.3390/molecules28104232>

30. Nguyen, M.H., Nguyen, D.H. (2025). Transparent and traceable food supply chains: Exploring consumers' value co-creation with quality suppliers through trust and relationship commitment. *Journal of International Food & Agribusiness Marketing*, 1-26.
31. Olkowicz, J., Jarosik-Michalak, A., Kozłowski, A. (2024). The Role of a Leader in Shaping Employee Behaviour in the VUCA/BANI world. *Journal of Modern Science*, 2, 56. DOI: doi.org/10.13166/jms/188913
32. Owino, V., Kumwenda, C., Ekesa, B., Parker, M.E., Ewoldt, L., Roos, N., Lee, W.T., Tome, D. (2022). The impact of climate change on food systems, diet quality, nutrition, and health outcomes: A narrative review. *Frontiers in Climate*, 4, 941842. <https://doi.org/10.3389/fclim.2022.941842>
33. Peres, F.A.P., Bondarczuk, B.A., Gomes, L.D.C., Jardim, L.D.C., Corrêa, R.G.D.F., Baierle, I.C. (2025). Advances in food quality management driven by Industry 4.0: A systematic review-based framework. *Foods*, 14(14), 2429. <https://doi.org/10.3390/foods14142429>
34. Radzyńska, M., Jakubowska, D. (2018). Local food systems, short supply chains and perception of local food by consumers: A review and quantitative research. *Journal of Agribusiness and Rural Development*, 50(4), 435-444. <https://doi.org/10.17306/J.JARD.2018.00426>
35. Roosevelt, M., Raile, E.D., Anderson, J.R. (2023). Resilience in food systems: Concepts and measurement options in an expanding research agenda. *Agronomy*, 13(2), 444. <https://doi.org/10.3390/agronomy13020444>
36. Sadílek, T. (2019). Perception of Food Quality by Consumers: Literature Review. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 69(4), 857-864. <https://doi.org/10.11118/actaun.2021.068>
37. Skrzypek, E. (2024). Uwarunkowania sukcesu organizacji w nowej gospodarce. In: E. Skrzypek, B. Spychalski, *Jakość w zarządzaniu. Nowoczesne metody zarządzania współczesną organizacją*, 13 (pp. 13-34). Kalisz: Wyd. Naukowe Uniwersytetu Kaliskiego.
38. Sparling, T.M., Offner, C., Deeney, M., Denton, P., Bash, K., Juel, R., Moore S., Kadiyala, S. (2024). Intersections of climate change with food systems, nutrition, and health: an overview and evidence map. *Advances in Nutrition*, 15(9), 100274. <https://doi.org/10.1016/j.advnut.2024.100274>
39. Stone, J., Rahimifard, S. (2018). Resilience in agri-food supply chains: a critical analysis of the literature and synthesis of a novel framework. *Supply Chain Management: An International Journal*, 23(3), 207-238. <https://doi.org/10.1108/SCM-06-2017-0201>
40. Sutar, R., Wagh, P. A study on agile project management with reference to its application for enhancement of business development outcomes. *Journal of Research in Marketing Management and Sales*, 7(1), 121-125. <https://doi.org/10.33545/26633329.2025.v7.i1b.218>

41. Tendall, D.M., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q.B., Kruetii P., Grant M., Six, J. (2015). Food system resilience: Defining the concept. *Global food security*, 6, 17-23. <https://doi.org/10.1016/j.gfs.2015.08.001>
42. Theobald, S., Diebold, P. (2017). Beneficial and harmful agile practices for product quality. *Proceedings of the International Conference on Agile Software Development*, 150-165. <https://arxiv.org/abs/1710.06119>
43. Tran, D., Schouteten, J.J., Gellynck, X., De Steur, H. (2024). How do consumers value food traceability? A meta-analysis. *Food Control*, 162, 110453. <https://doi.org/10.1016/j.foodcont.2024.110453>
44. Treiblmaier, H., Garaus, M. (2023). Using blockchain to signal quality in the food supply chain: The impact on consumer purchase intentions and the moderating effect of brand familiarity. *International Journal of Information Management*, 68, 102514. <https://doi.org/10.1016/j.ijinfomgt.2022.102514>
45. Wilson, A.M., Withall, E., Coveney, J., Meyer, S.B., Henderson, J., McCullum, D., Webb, T., Ward, P.R. (2020). Cross-country comparison of strategies for (re)building consumer trust in food systems: Comparative evidence from Australia, New Zealand, the UK and Ireland. *Health Promotion International*, 35(6), 988-1000. <https://doi.org/10.1093/heapro/daw024>
46. Vincze, C., Leelőssy, Á., Zajácz, E., Mészáros, R. (2025). A review of short-term weather impacts on honey production. *Int. J. Biometeorol.* 69(2), 303-317. doi: 10.1007/s00484-024-02824-0
47. Vishwakarma, S.S., Pandey, S.K. (2025). *Agile Transformation: Business Strategies and Best Practices for VUCA and BANI World. Digital Project Management-Strategic Theory and Practice: Strategic Theory and Practice, Chapter 3*, 33-52.
48. Wu, W., Zhang, A., van Klinken, R.D., Schrobback, P., Muller, J.M. (2021). Consumer trust in food and the food system: a critical review. *Foods*, 10(10), 2490. <https://doi.org/10.3390/foods10102490>
49. Żak, N., Wilczyńska, A. (2023). The Importance of Testing the Quality and Authenticity of Food Products: The Example of Honey. *Foods*, 12(17), 3210. <https://doi.org/10.3390/foods12173210>
50. Zeng, M., Yan, W.Y., Zeng, Z.J. (2023). Analysis of consumers' willingness to pay for honey in China. *Sustainability*, 15(2), 1500. <https://doi.org/10.3390/su15021500>

THE DYNAMIC EVOLUTION OF COMMUNICATION ETHICS

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Purpose: This literature review examines how ethical communication influences organizational behavior, leadership effectiveness, and business success. It highlights best practices for transparent communication strategies in professional settings, emphasizing the role of digitalization, leadership, and symmetrical communication in shaping workplace ethics.

Design/methodology/approach: The study employs a Critical Literature Review (CLR) to synthesize research on leadership, ethical communication and its digitalization. Articles from Google Scholar, Emerald, and Cambridge Journals were selected using keyword-based searches, focusing on literature from 2015-2024.

Findings: Ethical communication plays a vital role in workplace culture, leadership effectiveness, and corporate sustainability. It can enhance employees' trust, engagement, and social capital through transparent approach. Meanwhile, digitalization introduces new ethical challenges, including technology-driven bias, misinformation, and data privacy concerns, requiring clear guidelines. Ethical crisis communication is crucial for mitigating reputational risks and maintaining trust. Additionally, two-way symmetrical communication fosters inclusivity, fairness, and accountability within organizations.

Research limitations/implications: The study is limited to English-language sources and does not include empirical data. Future research should incorporate qualitative and quantitative methods, such as surveys and case studies, to expand knowledge based on these findings.

Practical implications: The review provides strategies for leaders and HR professionals to integrate ethical communication frameworks, improve employee engagement, stakeholder trust, and decision-making process. Organizations must also develop ethical guidelines for technology-driven communication to mitigate bias and misinformation risks.

Social implications: This study also contributes to corporate social responsibility (CSR) by highlighting how ethical communication promotes workplace fairness, diversity, and responsible corporate governance. Ethical leadership and transparent communication positively impact employee well-being and public trust.

Originality/value: This study synthesizes ethical communication, leadership, and digitalization in workplace reality. It is relevant for academics, business professionals, and policymakers aiming to embed ethical principles into communication strategies for long-term success.

Keywords: Communication ethics, communication evolution, ethical problems, communication technologies.

Category of the paper: Literature review.

1. Introduction

Communication is a fundamental aspect of human interaction, enabling individuals to share ideas, build relationships, and achieve common goals. It involves not only the clear transmission of messages but also the acknowledgment and verification of those messages (Paguio, Jackling, 2016). Beyond spoken language, communication encompasses both verbal and non-verbal cues, making it a dynamic and multifaceted process (Kaiser, Kuckertz, 2023, Sampaio et al., 2022). Moreover, communication allows people to transcend their existing perspectives, facilitating personal and professional growth through interaction (Meyer, Hühn, 2020).

In organizational settings, communication plays a crucial role in establishing legitimacy, building stakeholder trust, and reducing uncertainty (Kaiser, Kuckertz, 2023). It is a fundamental mechanism for ensuring an organization's survival and is integral to achieving strategic objectives (Kaiser, Kuckertz, 2023). Effective and transparent communication fosters trust, encourages knowledge sharing, and strengthens the sense of community among employees by promoting active engagement and dialogue (Alizadeh, Dirani, Qiu, 2021). All employees should be recognized as valuable talent, as they possess the potential to contribute innovative ideas (Reinert, Debebe, 2023). Furthermore, networking and effective communication are essential for generating social capital, which is vital for organizational success (Akbari et al., 2017).

As communication evolves, rapid advancements in technology have significantly reshaped the reality, forcing organizations to adapt to new communication methods (Killingsworth, Flynn, 2016). The increasing integration of social media within organizations has disrupted traditional corporate control, transforming internal communication structures (Madsen, Andersen, 2024). Additionally, global trends such as digitalization, shifting stakeholder expectations, and an emphasis on efficiency and risk management will continue to shape the future of communication within organizations (Zerfass, Verčič, Wiesenberg, 2016).

Employees today expect communication to be transparent, direct, and useful, particularly in times of organizational change (Einwiller, Ruppel, Stranzl, 2021). Generation Y, commonly referred to as Millennials, emerged in an era characterized by relative economic prosperity, rapid advancements in electronic communication, and globalization. Millennials generally prioritize flexibility and freedom, particularly in terms of achieving a balance between work and personal life (Self, Gordon, Jolly, 2019). Compared to earlier generations, Millennials, in particular, seek more frequent and immediate feedback from their supervisors, reflecting a shift in workplace expectations (Hess, 2020). This generation also favors a flatter, team-based work environment over traditional hierarchical structures and views rigid (like 9-to-5) schedules as outdated, given the increasing flexibility enabled by technology (Hess, 2020). A well-established diversity climate further influences how employees perceive and communicate with one another, shaping workplace interactions and behaviors (Goby, Nickerson, David, 2015).

Ethical considerations in communication are equally critical. Ethical communication is inherently rooted in truthfulness, requiring accuracy and avoidance of falsehoods or misrepresentations (Killingsworth, Flynn, 2016). Leaders play a pivotal role in fostering an ethical climate within their organizations, not only through their communication but also through their actions (Ehrich et al., 2015). Ethics in organizational settings extends beyond individual behavior to encompass relationships, shaping individuals' awareness and responsibility to act ethically (Yağmur, 2022). Encouraging ethical communication helps organizations uphold fundamental moral values such as human rights, fairness, and diversity (Alizadeh, Dirani, Qiu, 2021).

As organizations continue to navigate an increasingly interconnected and rapidly changing world, the role of communication remains more vital than ever. Whether in shaping workplace culture, fostering collaboration, or maintaining ethical standards, effective communication serves as the foundation for organizational success.

Given the critical role of communication in organizational success, ethical considerations have become increasingly important in shaping workplace interactions. As communication methods evolve, particularly with the rise of digitalization and shifting employee expectations, organizations face new ethical challenges that impact transparency, trust, and accountability. To explore these complexities, this article examines three key research questions: **(Q₁) What are the key ethical challenges in modern organizational communication, and how do they impact transparency, trust, and accountability in the workplace?** **(Q₂) How has the digitalization of workplace communication influenced ethical standards, and what strategies can organizations implement to maintain ethical communication practices?** and **(Q₃) What role do leaders play in fostering an ethical communication climate, and how does ethical leadership influence employee engagement and organizational culture?** By addressing these questions, this study aims to provide a deeper understanding of the ethical implications of communication and the strategies organizations can adopt to ensure ethical and effective communication practices.

2. Methods

This study employs a Critical Literature Review (CLR) as its methodological approach to assess the existing body of knowledge concerning the value of communication within organizations. CLR enables researchers to systematically summarize, critique, and synthesize scholarly works, allowing for the identification of gaps and areas that require further investigation. By using this structured method, the study highlights both the strengths and limitations of prior research, offering a comprehensive perspective on the topic.

To gather relevant publications, sources from the fields of management, economics, and human resource management were selected. The databases chosen for this review included **Google Scholar**, **Emerald**, and **Cambridge Journals**, as they provide a broad and diverse range of scientific articles in the study's area of interest. The author selected these databases due to their extensive coverage of research within the field under analysis. A combination of specific keywords was used to ensure a comprehensive search, including **“communication” /AND/ “ethic”, “culture”, “team management”, “evolution”, “management”, “challenges”, “team ethics”, “technology”, and “role”**. Boolean operators were employed to refine search results, ensuring relevance while maintaining the focus within the study's scope.

To determine the relevance of articles for inclusion in this study, the following selection criteria were applied: (1) The primary focus of the paper had to be **communication** or **communication ethics**. (2) Articles needed to address communication-related **challenges**, **evolution**, or **ethical concerns**. (3) Research had to originate from a variety of disciplines, ensuring a diverse perspective. (4) Selected articles were required to reflect **recent developments** in workplace environments and be no older than **15 years**, with most sources published between **2015 and 2024**. (5) Only articles written in **English** were included, as it remains the most widely used language in scientific literature.

The initial search provided **3,873 results**, demonstrating the breadth of the inquiry. To refine the dataset, a three-stage selection process was applied:

- 1) **Screening of Titles and Abstracts:** In the first phase, titles and abstracts were reviewed to assess their alignment with the research focus. This step led to the exclusion of 3,098 papers, primarily due to their limited relevance, such as discussions of unrelated communication topics.
- 2) **Verification of Eligibility:** The remaining **675 articles** were further evaluated against the established inclusion criteria. At this stage, **589 papers** were removed for lacking direct relevance to the core research themes, particularly those discussing general aspects of communication without emphasis on ethical value or organizational influence.
- 3) **Full-Text Analysis:** The final **86 articles** underwent an in-depth review to assess their contribution to the research questions. Ultimately, **30 publications** were identified as highly relevant for a detailed analysis, as they specifically addressed the ethical dimensions of communication, its organizational influence, and cultural considerations.

This methodological approach has some limitations. Potential selection bias may arise from database choices, and the exclusive reliance on English-language sources could lead to the omission of valuable studies published in other languages. To overcome these constraints, future literature reviews could broaden the scope by incorporating additional databases and including multilingual searches to enhance the inclusivity of findings.

3. Literature review – Ethical communication in light of organizational success

Effective communication is a fundamental aspect of ethical leadership, organizational success, and interpersonal relationships. As communication evolves - both in traditional and digital contexts - it presents ethical challenges that must be carefully navigated. This literature review explores key themes surrounding ethical communication, including its historical foundations, role in leadership, impact of technology, and challenges posed by cultural diversity. Additionally, it examines how communication can foster inclusivity within teams, the feasibility of meeting all stakeholder expectations, and the ethical consequences of contemporary communication challenges. By providing a comprehensive understanding of how ethical communication influences organizational behavior and leadership effectiveness, this review highlights best practices for conducting transparent and responsible communication strategies in professional settings.

3.1. Evolution of Communication and Ethical Implications

The study of ethics has deep historical roots, originating from religious traditions, philosophical doctrines, and cultural norms that have evolved over centuries (Alizadeh, Dirani, Qiu, 2021). Ethics, broadly speaking, is defined as *a system of moral principles by which human actions may be judged as good or bad, right or wrong* (Alizadeh, Dirani, Qiu, 2021). Within an organizational context, ethical principles serve as the foundation for behavioral standards, promoting honesty and integrity while discouraging self-serving actions (Alizadeh, Dirani, Qiu, 2021).

The term ethics itself is derived from the Greek word *ethos*, which represents the collective character, values, and moral sentiment of a society (Alizadeh, Dirani, Qiu, 2021). This foundational understanding of ethics has shaped the way individuals and societies engage in moral reasoning and ethical decision-making. Aristotle, a key figure in ethical philosophy, emphasized that morality is not merely about following rules but about cultivating virtue as "excellence in the human soul" (Anderson, Ichiho, 2017). His virtue ethics framework, which has received significant attention from philosophers and business ethicists, has also found its place in organizational studies (Meyer, Hühn, 2020).

These ethical foundations extend into modern organizational settings, particularly in leadership and communication. Aristotle's concept of the 'Golden Mean', which suggests a balance between extremes, remains a useful lens for ethical decision-making in leadership (Kantar, Bynum, 2021). Ethical behavior in leadership is not simply about compliance with policies but about fostering a culture of moral integrity within organizations (Lei, Do, Le, 2019). Ethical leaders shape organizational culture by consistently upholding and reinforcing ethical standards through communication (Lei, Do, Le, 2019). Leadership, ethics, and trust are now

recognized as three critical attributes that determine the effectiveness of senior communicators within an organization (Killingsworth, Flynn, 2016).

Effective communication serves as the primary mechanism through which ethical considerations are conveyed and reinforced within an organization. Managers, for instance, dedicate approximately two-thirds to three-fourths of their time to verbal communication (Lounsbury et al., 2016). Moreover, research indicates that ethical leadership explicitly emphasizes "two-way communication", allowing for open dialogue and trust-building within organizations (Yağmur, 2022). Expressing ethics as a continuous and central value through an effective communication system not only prevents unethical behaviors but also helps uncover their underlying causes (Yağmur, 2022).

Beyond internal communication, ethical decision-making at the executive level shapes not only an organization's internal culture but also its external reputation. Leaders do not merely shape their organizations - they are also shaped by them in a cyclical process that reflects their ethical choices (Bridges, 2018). Ethical executives must consider not only personal values but also their company's mission, culture, and broader financial objectives when making decisions (Bridges, 2018). Furthermore, when managers integrate ethical considerations into their decision-making processes, they contribute to building social capital and fostering ethics-centered relationships (Akbari et al., 2017).

In times of crisis, ethical leadership and communication become even more critical. Organizations that prioritize ethical internal communication foster mutual social exchange and enhance trust among employees (Einwiller, Ruppel, Stranzl, 2021). When executed effectively, crisis communication does more than just provide information - it conveys symbolic social resources that reinforce employee commitment and support (Einwiller, Ruppel, Stranzl, 2021).

Aristotle famously linked rhetoric to ethics, emphasizing that persuasive communication should promote human excellence rather than manipulation (Meyer, Hühn, 2020). Likewise, modern leaders must harness communication as a tool for ethical influence within their organizations. Ultimately, communication and ethics are deeply intertwined. Ethical leadership relies on effective communication to inspire trust, uphold integrity, and create a culture of accountability.

3.2. Technology and Ethical Challenges in Communication

Building upon the ethical foundations established in leadership, the rapid rise of digital communication has introduced new ethical challenges, requiring a reevaluation of traditional principles in a technologically interconnected world. The Internet has facilitated unprecedented global connectivity, making ethical discrepancies across cultures more apparent (Kantar, Bynum, 2021). Digital interactions among individuals from diverse cultural backgrounds often lead to 'transculturation', a process where ethical perceptions shift as cultural values converge and evolve (Hite, Daspit, Dong, 2015). However, this adaptation is not uniform, and ethical standards that are widely accepted in one cultural context may be perceived differently in

another, leading to potential conflicts in cross-cultural communication (Alizadeh, Dirani, Qiu, 2021). Ultimately, people may not recall specific words or actions, but they will remember the emotions and feelings they experienced as a result of those interactions (Nahmad-Williams, Taylor, 2015).

The foundations of **Information and Communication Technology (ICT) Ethics** were laid by Norbert Wiener, regarded as the "founding father" of the field, whose pioneering work established the principles for navigating ethical dilemmas in digital interactions (Kantar, Bynum, 2021). Expanding on this foundation, James Moor introduced the concept of logical malleability, emphasizing that the flexibility of digital technology creates 'policy vacuums' that necessitate ethical surveillance (Kantar, Bynum, 2021). To bridge these ethical gaps, Moor introduced 'Just Consequentialism', a framework that balances the consequences of digital policies against principles of justice, embedding ethics into technological advancements (Kantar, Bynum, 2021).

These ethical considerations have become particularly relevant as businesses and entrepreneurs increasingly rely on digital platforms for stakeholder engagement. Digital communication plays a crucial role in reducing uncertainty and fostering trust among stakeholders, particularly in highly competitive or crisis-prone environments (Kaiser, Kuckertz, 2023). Entrepreneurs and businesses use digital tools not only to maintain visibility but also to build relationships and demonstrate ethical responsibility in their interactions (Kaiser, Kuckertz, 2023). In times of crisis, ethical communication becomes even more essential, as inadequate or misleading messaging can harm both an organization's reputation and stakeholder trust (Kaiser, Kuckertz, 2023).

To navigate these challenges, organizations must proactively embed ethical principles into their digital communication strategies. One approach is the development of a robust 'Code of Ethics', which serves as a guiding framework for ethical conduct in digital spaces. A well-structured ethical code sets clear expectations for employee behavior, ensuring that online interactions align with corporate values and broader societal norms (Mazza, Furlotti, 2020). Furthermore, workplace ethics are typically reinforced through formal codes of conduct, which outline acceptable digital communication practices and provide employees with the tools to make ethical decisions in a rapidly evolving technological landscape (Alizadeh, Dirani, Qiu, 2021).

Ultimately, as digital technologies continue to reshape communication dynamics, ethical considerations must remain at the forefront. Ethical codes are generally followed because individuals perceive adherence as the morally correct course of action (Ramakrishnan et al., 2022). However, individuals with a lower work ethic may be more likely to engage in risky behaviors, such as disregarding acceptable use policies that are designed to safeguard an organization's systems (Ramakrishnan et al., 2022). At that time, ethical leadership, guided by frameworks such as 'Just Consequentialism', offers a structured approach to addressing the moral dilemmas that arise in digital spaces. By prioritizing transparency, accountability,

and cross-cultural awareness, organizations can uphold ethical integrity in digital interactions, fostering lasting trust in an increasingly interconnected world.

3.3. Cultural Differences and Ethical Pitfalls in Communication

Ethical decision-making is a critical component of leadership, influencing both organizational success and employee morale. Ethical decision-making follows a structured cognitive process: individuals first recognize the moral implications of a situation, then form a judgment, establish ethical intent, and ultimately act accordingly (Alizadeh, Dirani, Qiu, 2021). This multi-step process highlights the importance of ethical awareness and accountability in leadership roles. Leaders must not only assess the immediate consequences of their decisions but also consider the long-term implications for their organizations, stakeholders, and broader society. Ethical decision-makers, therefore, take into account an organization's mission, values, culture, and financial objectives when making critical choices (Bridges, 2018).

Leadership style plays a pivotal role in shaping ethical cultures within organizations. Transformational leadership, in particular, fosters a reciprocal relationship between leaders and followers, enhancing ethical awareness and motivation at all levels (Akbari et al., 2017). By prioritizing collective interests over individual gains, transformational leadership fosters a culture rooted in justice, equality, and accountability (Akbari et al., 2017). Through consistent ethical conduct, transformational leaders serve as role models, inspiring employees to integrate moral reasoning into their professional decisions.

Beyond leadership, corporate culture significantly influences ethical behavior within an organization. An organization's culture comprises deeply ingrained traditions, shared beliefs, and collective values that guide decision-making processes (Bridges, 2018). However, while a strong ethical culture can reinforce positive behaviors, certain work environments may pressure employees to compromise their personal ethical values - particularly when unethical actions go unpunished or are implicitly rewarded (Bridges, 2018). This underscores the need for corporate leaders to actively shape and monitor organizational culture, ensuring that ethical standards remain a priority.

A well-established ethical culture contributes to employee engagement and trust, strengthening social capital within an organization. Leaders who uphold ethical principles and accountability-whether in public or private sectors-facilitate communication networks, enhance transparency, and cultivate mutual trust (Akbari et al., 2017). Furthermore, ethical leadership and open communication channels have been linked to increased employee engagement, as organizations that prioritize transparency and integrity foster a stronger sense of commitment among employees (Einwiller, Ruppel, Stranzl, 2021). This demonstrates the critical interplay between ethics, leadership, and employee morale-where ethical leadership not only enhances decision-making but also improves workplace dynamics and organizational stability.

To reinforce ethical behavior, organizations often implement formal mechanisms such as ‘Codes of Ethics’ and Corporate Social Responsibility (CSR) initiatives. Establishing a clear ethical framework helps organizations set expectations for employee behavior, reducing ambiguity and promoting accountability (Alizadeh, Dirani, Qiu, 2021). Additionally, CSR initiatives serve as an extension of ethical leadership, ensuring that organizations uphold their moral obligations not only internally but also in their external relationships with stakeholders and communities (Alizadeh, Dirani, Qiu, 2021). When organizations integrate ethical principles into both internal policies and external engagements, they enhance their reputation, foster stakeholder trust, and create a more sustainable ethical business model.

Ultimately, sustaining an ethical culture, fostering employee engagement, and enforcing ethical policies ensure that organizations embed ethics into their leadership and operational strategies, securing long-term trust and success.

3.4. Ethical Communication and Business Success

The role of ethical communication extends beyond cultural considerations to directly influence overall business success. A workplace that fosters ethical and transparent communication enhances employee engagement, trust, and overall organizational performance (Alizadeh, Dirani, Qiu, 2021). However, ethical communication goes beyond transmitting information accurately; it demands transparency, fairness, and openness to feedback, fostering an inclusive and participatory workplace (Killingsworth, Flynn, 2016). Enhancing employee commitment through effective communication and ethical leadership has been shown to improve job satisfaction, reduce turnover, and increase dedication to organizational objectives (Akbari et al., 2017). Consequently, organizations that prioritize ethical communication practices create an environment that nurtures trust, social capital, and long-term loyalty among employees (Akbari et al., 2017).

Public relations plays a crucial role in shaping public perception and reinforcing an organization's commitment to integrity and ethical responsibility (Killingsworth, Flynn, 2016). Beyond strengthening relationships with external stakeholders, ethical public relations and corporate communication enhance internal reputation management, boosting employee confidence in leadership (Killingsworth, Flynn, 2016). Organizations rely on strategic communication to foster mutual understanding between businesses and their stakeholders, ensuring that corporate values align with public expectations. Ethical public relations and corporate communication strategies help organizations navigate ethical dilemmas while preserving stakeholder trust (Killingsworth, Flynn, 2016).

At the core of ethical communication lies managerial transparency, which significantly influences employees’ ability to interpret their work environment and make informed decisions (Einwiller, Ruppel, Stranzl, 2021). To be perceived as ethical and trustworthy, organizational communication must exhibit key characteristics such as timeliness, completeness, accuracy, and clarity (Einwiller, Ruppel, Stranzl, 2021). When managers prioritize transparent

communication, employees experience greater job satisfaction and stronger alignment with corporate values, reinforcing ethical work cultures. Additionally, formal managerial communication strategies provide employees with the necessary tools to navigate ethical challenges, reducing ambiguity and fostering responsible decision-making (Einwiller, Ruppel, Stranzl, 2021).

A key approach to ethical communication in business is symmetrical communication, which promotes a balanced and open flow of information between managers and employees. Two-way symmetrical communication serves as a mechanism for listening, responding to concerns, and ensuring inclusivity in decision-making (Yağmur, 2022). When employees feel their voices are heard, they develop a stronger sense of identification with the organization, leading to increased workplace cohesion and ethical engagement (Einwiller, Ruppel, Stranzl, 2021). Moreover, symmetrical communication fosters a participatory corporate culture, where power dynamics are balanced, and employees are encouraged to engage in ethical decision-making (Yağmur, 2022).

Beyond its internal impact, ethical communication shapes broader corporate responsibility efforts, as organizations that prioritize ethical transparency are better equipped to address societal concerns and enhance corporate social responsibility (CSR) initiatives. Ethics, however, is not merely about adhering to a fixed set of policies; rather, it is a continuous and evolving practice that requires proactive engagement and ethical leadership (Ehrich et al., 2015). Those in leadership and oversight roles bear the responsibility of ensuring fairness, accessibility, and ethical decision-making within their organizations (Anderson, Ichiho, 2017). Embedding ethical communication into corporate culture enables organizations to foster trust, achieve long-term success, and make a meaningful societal impact.

3.5. Contemporary Communication Challenges and Ethical Consequences

Despite the benefits of ethical communication, modern business environments present complex challenges. Ethical scandals in corporate settings have highlighted the importance of establishing robust ethical frameworks that guide organizational behavior and decision-making (Nedelko, Mulej, Potocan, 2017). However, ethical breaches occur when individuals prioritize personal gains over ethical principles, resulting in conflicts of interest and reputational damage (Nedelko, Mulej, Potocan, 2017). The application of business ethics is often influenced by situational and procedural factors, including corporate priorities and the personal or professional interests of stakeholders, which can complicate ethical decision-making (Nedelko, Mulej, Potocan, 2017). In such cases, transparent communication serves as a critical safeguard, fostering employee engagement and helping to prevent ethical breaches before they escalate into crises (Einwiller, Ruppel, Stranzl, 2021).

When organizations fail to communicate effectively during crises, the consequences can be severe, affecting both employees and the broader corporate reputation. Ineffective crisis communication can erode employee morale, drive higher turnover rates, and escalate workplace

conflicts, underscoring the essential role of ethical leadership in maintaining stability (Einwiller, Ruppel, Stranzl, 2021). Ethical leaders not only provide clear and timely communication but also offer emotional support by actively listening to employees' concerns, addressing their needs, and expressing gratitude for their resilience during challenging periods (Einwiller, Ruppel, Stranzl, 2021). By reinforcing trust-based relationships, ethical leadership ensures that employees remain engaged, motivated, and committed to the organization's ethical principles (Yağmur, 2022). Ethical leaders do more than just uphold moral standards - they proactively guide employees through ethical dilemmas and embed ethical decision-making into corporate culture (Yağmur, 2022).

While ethical communication is fundamental to business success, it is not always possible to satisfy every stakeholder. Stakeholder communication is inherently complex, as different individuals and groups hold unique expectations, values, and cultural perspectives, making it challenging to craft messages that resonate equally with all (O'Mathúna, Hunt, 2020). Nevertheless, by prioritizing transparency, fairness, and ethical consistency, organizations can maintain trust and integrity, even in the face of competing stakeholder interests (O'Mathúna, Hunt, 2020). The fundamental goal of ethical communication is to promote a "good life" shared with others, upheld through just institutions and fair communication practices that transcend individual biases (O'Mathúna, Hunt, 2020).

As communication continues to evolve due to technological advancements and cultural shifts, maintaining ethical standards is more important than ever. The rise of digitalization and shifting stakeholder expectations have transformed the role of corporate communicators, requiring them to act as change consultants and ethical guides within organizations (Zerfass, Verčič, Wiesenberg, 2016). In this interconnected business landscape, communicators must ensure that structured and transparent communication strategies align with broader corporate responsibility efforts while navigating the ethical dilemmas brought about by globalization (Zerfass, Verčič, Wiesenberg, 2016).

In today's fast-evolving digital and global business landscape, ethical communication is not just an asset - it is a necessity for sustaining trust, ensuring accountability, and fostering responsible corporate practices. The presented sections explored how these ethical considerations manifest in real-world communication practices and identified strategies for fostering responsible and inclusive communication in professional settings.

4. Discussion

Building on the literature review, this section critically examines the key findings concerning ethical communication in organizations. The discussion is structured around the three core research questions posed in the introduction: **(Q1) What are the key ethical**

challenges in modern organizational communication, and how do they impact transparency, trust, and accountability in the workplace? (Q₂) How has the digitalization of workplace communication influenced ethical standards, and what strategies can organizations implement to maintain ethical communication practices? and (Q₃) What role do leaders play in fostering an ethical communication climate, and how does ethical leadership influence employee engagement and organizational culture?

4.1. The Role of Ethical Communication in Organizational Success

Ethical communication is a cornerstone of organizational integrity, employee engagement, and trust-building. A well-defined ethical communication framework fosters a positive corporate culture, encourages transparent decision-making, and reduces the risk of ethical breaches (Alizadeh, Dirani, Qiu, 2021). This research highlights that many ethical violations do not arise from deliberate misconduct but rather from a lack of ethical awareness, emphasizing the need for ethics education and leadership development initiatives (Alizadeh, Dirani, Qiu, 2021). Employees who operate within an environment that prioritizes moral responsibility and open communication tend to exhibit higher levels of job satisfaction, loyalty, and commitment to organizational goals (Akbari et al., 2017).

Organizations that fail to uphold ethical communication standards risk significant reputational damage and internal discord. Ethical scandals typically emerge when corporate decision-makers prioritize short-term gains over long-term ethical responsibilities (Bridges, 2018). The role of leadership in shaping an ethical culture cannot be overstated, as executives are responsible for instilling corporate values, ensuring compliance, and maintaining ethical consistency (Bridges, 2018). Research further suggests that organizations with strong ethical foundations outperform those with weak ethical oversight, particularly in areas of employee trust, stakeholder relations, and brand reputation (Bridges, 2018).

4.2. Digitalization and Its Ethical Implications in Communication

The rapid digitalization of workplace communication has introduced new ethical dilemmas. technology-driven communication tools, real-time messaging platforms, and remote work models have redefined corporate interactions, requiring organizations to rethink traditional ethical communication policies (Kantar, Bynum, 2021). The use of technologies in workplace communication, particularly in automated decision-making and chatbot interactions, raises concerns about bias, misinformation, and ethical accountability (Kantar, Bynum, 2021). Ethical considerations in technology deployment should include transparency in algorithms, ensuring unbiased communication outputs, and maintaining human oversight in critical decision-making processes (Kantar, Bynum, 2021).

Moreover, data privacy and digital surveillance present ethical challenges, as employees and stakeholders increasingly demand clarity regarding how their information is collected, stored, and used (Mazza, Furlotti, 2020). Organizations must adopt ethical digital policies that prioritize data protection, informed consent, and accountability to mitigate the risks associated with unethical surveillance and data misuse (Mazza, Furlotti, 2020). Research suggests that digital ethics frameworks, such as those proposed by Simon Rogerson, offer structured guidance for aligning digital communication with ethical principles, ensuring responsible corporate digitalization strategies (Kantar, Bynum, 2021).

As technology-driven communication tools continue to evolve, organizations must not only develop policies for transparency and accountability but also establish oversight mechanisms to prevent bias and misinformation. Without these safeguards, digital communication strategies may inadvertently perpetuate ethical blind spots, leading to a loss of stakeholder trust and regulatory scrutiny.

4.3. Ethical Leadership and Its Impact on Workplace Communication

Leadership is one of the most influential factors in shaping an organization's ethical communication climate. Ethical leaders serve as role models, reinforcing principles of transparency, integrity, and fairness (Ehrich et al., 2015). Employees perceive ethical leaders as trustworthy and just, leading to higher levels of engagement, morale, and commitment (Ehrich et al., 2015). The role of ethical leadership extends beyond compliance - it requires active promotion of ethical dialogue, accountability, and social responsibility (Alizadeh, Dirani, Qiu, 2021).

Ethical leadership has also been linked to enhanced social capital within organizations (Akbari et al., 2017). Leaders who cultivate trust-based relationships foster a positive work environment, strengthening collaboration, ethical decision-making, and employee retention (Akbari et al., 2017). Furthermore, positive leadership approaches, such as transformational and virtuous leadership, promote an organizational culture of excellence, integrating virtue ethics, universal moral principles, and utilitarian ethics to guide communication practices (Anderson, Ichiho, 2017).

4.4. Crisis Communication and Ethical Challenges

Ethical communication plays a crucial role in crisis management, where transparency and empathy are essential to maintaining stakeholder trust (Einwiller, Ruppel, Stranzl, 2021). Poor crisis communication can lead to employee disengagement, reputational damage, and internal uncertainty (Einwiller, Ruppel, Stranzl, 2021). Organizations that implement clear and ethical crisis communication strategies - including informational and relational crisis communication - are more likely to retain employee trust and mitigate reputational harm (Einwiller, Ruppel, Stranzl, 2021).

Failure to uphold ethical crisis communication not only affects internal employee morale but also erodes public trust, potentially leading to long-term reputational harm and financial consequences. Therefore, ethical leaders must prioritize open dialogue during crises, allowing employees to voice concerns, seek guidance, and feel supported (Yağmur, 2022).

4.5. The Importance of Symmetrical Communication in Ethical Decision-Making

Organizations that promote two-way symmetrical communication encourage a culture of openness, trust, and employee empowerment (Yağmur, 2022). Ethical decision-making is inherently a dynamic and interactive process, where communication serves as the foundation for moral reasoning, co-orientation, and ethical dialogue (Yağmur, 2022). The effectiveness of ethical communication is strongly correlated with employee engagement, organizational trust, and ethical leadership practices (Lei, Do, Le, 2019).

Researches highlights that organizations fostering symmetrical communication experience higher employee morale, reduced unethical behavior, and improved organizational identification (Yağmur, 2022). This approach ensures that employees feel valued, heard, and included in ethical decision-making processes (Yağmur, 2022). Furthermore, symmetrical communication serves as a mechanism for social exchange, where ethical leadership and transparency positively influence workplace culture and ethical conduct (Yağmur, 2022).

Ethical communication is central to the long-term success of organizations, shaping employee trust, leadership accountability, and corporate transparency. The influence of digitalization, ethical leadership, and crisis communication highlights the evolving nature of ethical challenges in modern business environments. Organizations that prioritize symmetrical communication, enforce ethical communication technology policies, and cultivate an ethical leadership culture are more likely to navigate these challenges successfully. As communication continues to evolve, future research should focus on empirical case studies to further explore the real-world application of ethical communication frameworks in diverse organizational settings.

5. Summary

Ethical communication is essential for organizational success, influencing trust, transparency, and employee engagement (Alizadeh, Dirani, Qiu, 2021). As workplaces become more digital and globally connected, ethical communication ensures accountability, corporate integrity, and strong stakeholder relationships (Einwiller, Ruppel, Stranzl, 2021). This study explores how ethical communication frameworks help organizations navigate emerging ethical challenges while maintaining professional and ethical standards (Yağmur, 2022).

A key finding is that ethical communication fosters a strong organizational culture, where leadership and employee engagement are enhanced through transparency and ethical decision-making. Ethical leadership plays a pivotal role in reinforcing corporate values and workplace integrity, leading to higher employee motivation and loyalty (Akbari et al., 2017). Organizations that prioritize ethics education and moral reasoning create an environment where employees make ethical choices in professional interactions (Alizadeh, Dirani, Qiu, 2021).

This study also highlights the ethical challenges posed by digitalization. Technology-driven communication, real-time decision-making, and data transparency concerns require companies to implement digital ethics policies (Kantar, Bynum, 2021). Ensuring responsible use of technology is crucial, as ethical lapses in digital communication may result in bias, misinformation, or breaches of trust (Mazza, Furlotti, 2020). Organizations must balance technological efficiency with ethical responsibility, ensuring that employees and stakeholders remain protected in the evolving digital space (Kantar, Bynum, 2021). Additionally, as Generation Z, which currently storm the labor market, is the most technologically proficient generation, organizations should consider leveraging technology in their training programs to align with their digital and ethical expertise (Self, Gordon, Jolly, 2019).

The role of ethical leadership in communication is another major focus. Ethical leaders serve as role models, reinforcing trust, fairness, and responsible decision-making (Ehrich et al., 2015). Transformational leadership enhances employee engagement, promoting ethical standards in daily interactions (Akbari et al., 2017). Since leadership significantly shapes corporate ethical frameworks, organizations must integrate ethical leadership principles into communication strategies and decision-making processes (Bridges, 2018).

Crisis communication is a crucial area where ethical considerations have a direct impact on stakeholder trust and organizational reputation. Failure to communicate transparently and ethically during crises can lead to employee disengagement and long-term reputational harm (Einwiller, Ruppel, Stranzl, 2021). Ethical crisis communication must be clear, timely, and empathetic, ensuring that employees and stakeholders feel supported and informed (Yağmur, 2022). More and more research suggests that balancing cognitive and emotional responses in crisis communication helps maintain organizational resilience and public trust (Einwiller, Ruppel, Stranzl, 2021).

Finally, this study underscores the importance of symmetrical communication in ethical decision-making and employee engagement. Organizations that implement two-way communication models create a culture where employees feel valued, involved, and motivated to uphold ethical workplace practices (Yağmur, 2022). Research also shows that ethical communication strengthens trust, enhances collaboration, and reduces unethical behavior (Lei, Do, Le, 2019). Transparency in workplace communication improves employee alignment with corporate values, fostering a more ethical and responsible work environment (Einwiller, Ruppel, Stranzl, 2021).

As communication continues to evolve in the digital era, organizations must remain proactive in addressing ethical challenges. Ethical leadership, responsible use of technology, and transparent crisis management are key to maintaining organizational trust and accountability (Bridges, 2018). By integrating strong ethical communication practices, companies can build a culture of trust, engagement, and long-term success in an increasingly complex business environment (Yağmur, 2022).

6. Limitations

This study has several limitations that should be acknowledged. First, the research relies exclusively on English-language sources, which may result in the exclusion of valuable studies published in other languages. This linguistic limitation could impact the diversity of perspectives on ethical communication, particularly in regions where corporate ethics and communication practices differ significantly from Western norms.

Second, this study is theoretical in nature, as it is based on a critical literature review rather than empirical research. While the analysis synthesizes existing knowledge and highlights key insights, the absence of first-hand data collection means that the study does not provide direct evidence from organizations. Future research should incorporate qualitative and quantitative empirical studies, such as surveys and case studies, to validate and expand upon the findings.

Third, the study focuses primarily on corporate environments, with limited exploration of ethical communication in non-profit organizations, government institutions, or educational settings. Since communication ethics may vary across different industries and organizational structures, future research should broaden the scope to examine ethical communication across various sectors.

Finally, as workplace communication continues to evolve due to technological advancements and shifting employee expectations, this study's findings may become outdated as new communication trends and ethical challenges emerge in the nearest future. Upcoming research should adopt a longitudinal approach, continuously reassessing ethical communication frameworks in response to technological innovations and changing business environments.

By addressing these limitations in future studies, researchers can develop a more comprehensive understanding of ethical communication, ensuring that best practices evolve alongside organizational, cultural, and technological transformations.

References

1. Akbari, M., Seyyed Amiri, N., Imani, S., Rezaeei, N., Foroudi, P. (2017). Why leadership style matters: a closer look at transformational leadership and internal marketing. *Bottom Line*, 30(4), 258-278. <https://doi.org/10.1108/BL-08-2017-0021>
2. Alizadeh, A., Dirani, K.M., Qiu, S. (2021). Ethics, code of conduct and ethical climate: implications for human resource development. *European Journal of Training and Development*, 45(8-9), 674-690. <https://doi.org/10.1108/EJTD-04-2020-0077>
3. Anderson, V., Ichiho, R. (2017). Reforming the criminal justice system – an ethical leadership approach. *International Journal of Public Leadership*, 13(2), 64-75. <https://doi.org/10.1108/ijpl-10-2016-0035>
4. Bridges, E. (2018). Executive ethical decisions initiating organizational culture and values. *Journal of Service Theory and Practice*, 28(5), 576-608. <https://doi.org/10.1108/JSTP-07-2017-0106>
5. Buckley, M.R., Baur, J.E., Hardy, J.H., Johnson, J.F., Johnson, G., MaCdougall, A.E., Banford, C.G., Bagdasarov, Z., Peterson, D.R., Peacock, J. (2015). Management lore continues alive and well in the organizational sciences. *Journal of Management History*, 21(1), 68-97. <https://doi.org/10.1108/JMH-05-2013-0027>
6. Ehrich, L.C., Harris, J., Klenowski, V., Smeed, J., Spina, N. (2015). The centrality of ethical leadership. *Journal of Educational Administration*, 53(2), 197-214. <https://doi.org/10.1108/JEA-10-2013-0110>
7. Einwiller, S., Ruppel, C., Stranzl, J. (2021). Achieving employee support during the COVID-19 pandemic – the role of relational and informational crisis communication in Austrian organizations. *Journal of Communication Management*, 25(3), 233-255. <https://doi.org/10.1108/JCOM-10-2020-0107>
8. Goby, V.P., Nickerson, C., David, E. (2015). Interpersonal communication and diversity climate: Promoting workforce localization in the UAE. *International Journal of Organizational Analysis*, 23(3), 364-377. <https://doi.org/10.1108/IJOA-09-2014-0796>
9. Hess, J.P. (2020). The latest Millennials (1995-2000): examining within-group work ethic. *International Journal of Organizational Analysis*, 28(3), 627-642. <https://doi.org/10.1108/IJOA-02-2019-1653>
10. Hite, D.M., Daspit, J.J., Dong, X. (2015). Examining the influence of transculturation on work ethic in the United States. *Cross Cultural Management*, 22(1), 145-162. <https://doi.org/10.1108/CCM-12-2013-0190>
11. Kaiser, M., Kuckertz, A. (2023). Emotional robustness in times of crisis: the effects of venture funding on the digital communication styles of entrepreneurs. *Journal of Small Business and Enterprise Development*, 30(4), 828-850. <https://doi.org/10.1108/JSBED-10-2022-0423>

12. Kantar, N., Bynum, T.W. (2021). Global ethics for the digital age – flourishing ethics. *Journal of Information, Communication and Ethics in Society*, 19(3), 329-344. <https://doi.org/10.1108/JICES-01-2021-0016>
13. Killingsworth, C., Flynn, T. (2016). Assessing the CPRS Pathways to the Profession competency framework: Perspectives on corporate communication leadership competencies and credentials. *Corporate Communications*, 21(2), 177-194. <https://doi.org/10.1108/CCIJ-03-2015-0013>
14. Lei, H., Do, N.K., Le, P.B. (2019). Arousing a positive climate for knowledge sharing through moral lens: the mediating roles of knowledge-centered and collaborative culture. *Journal of Knowledge Management*, 23(8), 1586-1604. <https://doi.org/10.1108/JKM-04-2019-0201>
15. Lounsbury, J.W., Sundstrom, E.D., Gibson, L.W., Loveland, J.M., Drost, A.W. (2016). Core personality traits of managers. *Journal of Managerial Psychology*, 31(2), 434-450. <https://doi.org/10.1108/JMP-03-2014-0092>
16. Madsen, V.T., Andersen, H.T. (2024). A move to the bright side? When journalism is invited into internal communication. *Corporate Communications*, 29(2), 221-237. <https://doi.org/10.1108/CCIJ-12-2022-0156>
17. Mareque, M., de Prada Creo, E., Gonzalez-Sanchez, M.B. (2019). Fostering creativity and communicative soft skills through leisure activities in management studies. *Education and Training*, 61(1), 94-107. <https://doi.org/10.1108/ET-07-2018-0149>
18. Mazza, T., Furlotti, K. (2020). Quality of code of ethics: an empirical analysis on the stakeholder employee. *Social Responsibility Journal*, 16(8), 1377-1402. <https://doi.org/10.1108/SRJ-03-2019-0113>
19. Meyer, M., Hühn, M.P. (2020). Positive language and virtuous leadership: walking the talk. *Management Research*, 18(3), 263-284. <https://doi.org/10.1108/MRJIAM-11-2019-0972>
20. Mistry, T.G., Hight, S.K., Okumus, F., Terrah, A. (2022). Managers from heaven: how do hospitality employees describe good managers? *International Hospitality Review*, 36(1), 2-24. <https://doi.org/10.1108/ihr-09-2020-0055>
21. Nahmad-Williams, L., Taylor, C.A. (2015). Experimenting with dialogic mentoring: a new model. *International Journal of Mentoring and Coaching in Education*, 4(3), 184-199. <https://doi.org/10.1108/IJMCE-04-2015-0013>
22. Nedelko, Z., Mulej, M., Potocan, V. (2017). How to requisitely holistically consider internal gaps of business ethic. *Kybernetes*, 46(6), 914-932. <https://doi.org/10.1108/K-01-2017-0027>
23. O'Mathúna, D.P., Hunt, M.R. (2020). Ethics and crisis translation: insights from the work of Paul Ricoeur. *Disaster Prevention and Management: An International Journal*, 29(2), 175-186. <https://doi.org/10.1108/DPM-01-2019-0006>

24. Paguio, R., Jackling, B. (2016). Teamwork from accounting graduates: What do employers really expect? *Accounting Research Journal*, 29(3), 348-366. <https://doi.org/10.1108/ARJ-05-2014-0049>
25. Ramakrishnan, T., Hite, D.M., Schuessler, J.H., Prybutok, V. (2022). Work ethic and information security behavior. *Information and Computer Security*, 30(3), 364-381. <https://doi.org/10.1108/ICS-02-2021-0017>
26. Reinert, K., Debebe, G. (2023). The ethics of talent development: frameworks and identities. *European Journal of Training and Development*, 47(3-4), 327-347. <https://doi.org/10.1108/EJTD-07-2021-0106>
27. Sampaio, S., Wu, Q., Cormican, K., Varajão, J. (2022). Reach for the sky: analysis of behavioral competencies linked to project success. *International Journal of Managing Projects in Business*, 15(1), 192-215. <https://doi.org/10.1108/IJMPB-09-2020-0276>
28. Self, T.T., Gordon, S., Jolly, P.M. (2019). Talent management: a Delphi study of assessing and developing GenZ hospitality leaders. *International Journal of Contemporary Hospitality Management*, 31(10), 4126-4149. <https://doi.org/10.1108/IJCHM-11-2018-0915>
29. Yağmur, A. (2022). Impact of interactional context on relationship between ethical leadership and unethical behaviors: a serial mediation model. *Management Research Review*, 45(7), 865-881. <https://doi.org/10.1108/MRR-09-2020-0551>
30. Zerfass, A., Verčič, D., Wiesenber, M. (2016). Managing CEO communication and positioning: A cross-national study among corporate communication leaders. *Journal of Communication Management*, 20(1), 37-55. <https://doi.org/10.1108/JCOM-11-2014-0066>

WHO CONSUMES RESPONSIBLY? PERSONAL VALUES AND SOCIO-DEMOGRAPHIC PREDICTORS OF SOCIALLY RESPONSIBLE CONSUMPTION IN POLAND

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Purpose: The study investigates how socio-demographic characteristics and personal values of Polish consumers influence their purchasing behaviour within the framework of Socially Responsible Consumption (SRC). It aims to identify the determinants of ethical, environmental, and socially conscious consumption in the context of growing sustainability challenges.

Design/methodology/approach: The research employed a Computer-Assisted Web Interview (CAWI) survey conducted among 1,081 Polish consumers. Data analysis included descriptive statistics and Spearman's rank correlation to examine relationships between SRC dimensions and respondents' value orientations.

Findings: The results indicate that socially responsible consumption is more prevalent among older, better-educated, and financially secure individuals. Gender was not a significant factor, while income and place of residence significantly influenced responsible purchasing patterns. Positive correlations were found between SRC dimensions and values related to morality, community, and environmental protection.

Research limitations/implications: The study is limited by its reliance on self-reported data and a cross-sectional design, which may restrict causal interpretations. Future research could include longitudinal analyses and cross-cultural comparisons to validate the findings.

Practical implications: Insights from the study can support policymakers and marketers in designing targeted initiatives that promote sustainable lifestyles and enhance consumer awareness of socially responsible products.

Social implications: By emphasizing the role of individual values and socio-demographic factors, the study contributes to understanding how to foster ethical and environmentally conscious behaviour within society, supporting broader goals of sustainable development.

Originality/value: This research provides empirical evidence on socially responsible consumption in a Central European context, enriching theoretical discussions on sustainable consumer behaviour and offering actionable guidance for promoting pro-social consumption patterns.

Keywords: socially responsible consumption; sustainable behaviour; ethical consumption; consumer values; environmental responsibility.

Category of the paper: Research article.

1. Introduction

Consumers are becoming more socially aware, while taking purchasing decisions that take account of consequences for the natural and social environment. Thanks to the greater volume of products on the market, consumers have more opportunities to reveal their social preferences during the process of making purchasing decisions (Prendergast, Tsang, 2019). More and more frequently, they take account of their moral beliefs and ethical values in taking purchasing decisions (Crane, Matten, 2004). Taking account of ethical values in the behaviour of consumers is reflected in the concept of socially responsible consumption (SRC). Our reference point is accepted to be values associated with responsibility and justice, which are the basis of creating the foundations of the co-responsibility of a consumer for the effects of social and environmental consumption.

The idea of SRC is becoming increasingly attractive. This is the result of multiple premises, firstly consumers increasingly search for ecological products, thus reducing waste and CO₂ emissions (Shmelev et al., 2023). Secondly, the choice of ethical products (e.g. fair trade, local or vegetarian goods) allows them to feel good and have the feeling that they are doing something good (Weaver et al., 2024). Thirdly, buying from socially responsible firms (e.g. that pay a fair wage to employees, support local communities) helps to build a better economy and eliminate exploitation (Zong et al., 2024). Fourthly, the conviction arises that ecological products, natural cosmetics or local food are frequently healthier and free from harmful substances. Thanks to this, consumers not only care for the planet, but also for their own health (Amberg, Fogarassy, 2019). Fifthly, buying responsible products may be a form of expressing status and sense of belonging to a community that propagates a new lifestyle, e.g. online consumer community (Assimos et al., 2019).

The objective of the present study is to enhance the understanding of how individual socio-demographic characteristics of Polish consumers and their personal values influence purchasing behavior, as predicted by the dimensions of Socially Responsible Consumption (SRC) proposed by Francois-Lecompte and Roberts (2006).

In Poland, research on SRC remains relatively scarce. The limited number of existing studies primarily focus on the analysis of consumers' willingness to bear the costs of responsible consumption (Stoparczyk, 2018), the identification of attitudes toward environmental protection and pro-environmental practices in the context of responsible consumption (Teneta-Skwiercz, 2018), and the comparison of socially responsible consumption patterns in Poland with selected EU countries (Dąbrowska, Kresło, 2022). However, there is a lack of studies aimed at identifying distinct patterns of socially responsible consumption in the Polish context. To address this research gap, the following research question was formulated:

RQ1: To what extent are SRC patterns manifested in the purchasing behaviors of Polish consumers?

From the perspective of research on socially responsible consumption, it is crucial to examine the relationships between the dimensions of SRC and psychosocial characteristics. Age has been found to be positively associated with ethical consumption (Ganglmair-Wooliscroft, Wooliscroft, 2017). Similarly, previous research confirms that age significantly affects SRC (Dickson, 2005). Education level and income have also been identified as important predictors of SRC (Zhaon et al., 2014; Ritter et al., 2015; Pedrini, Ferri, 2014). With regard to gender, numerous studies report differences in attitudes and behaviors related to ethical consumption, with women generally exhibiting higher levels of engagement (Witkowski, Reddy, 2010; Ríos-Rodríguez et al., 2021). Based on the reviewed literature, the following research question was posed:

RQ2: To what extent do socio-demographic characteristics—such as gender, age, education level, income level, and place of residence—differentiate behaviors associated with SRC?

Among the principal determinants influencing socially responsible consumption, scholars highlight attitudes (Canova et al., 2023), perceived credibility (Eberhardt et al., 2021), self-identity (O'Connor et al., 2017), ethical obligation (Wang et al., 2020), and personal values (Ladhari, Tchegnna, 2015). Although personal values have been identified in the literature as significant predictors of consumer preferences and decision-making, only a limited number of studies have explored the relationship between personal values and the purchase or consumption of goods associated with socially responsible consumption (Dickson, 2000; Doran, 2009). Consequently, the following research question was formulated:

RQ3: What relationships exist between the dimensions of SRC and consumers' personal values?

2. Socially responsible consumption –theoretical background

In deliberations over the ethical dimension of consumption, the term socially responsible consumer arises. Webster (1975), defined this new type of consumer, as one of the first to do so, by placing emphasis on the significance of the awareness of social problems arising from over-consumption. According to him, a socially responsible consumer takes account of the public consequences of his/her private consumption, or tries to avail of his/her purchasing power in order to lead to social changes. He suggested that socially conscious consumers must have three features, namely, they should notice the social problem and be motivated to purchase products or services; they should feel that they have the power to have an impact on the behaviour of other consumers; they should be active in social issues and socially involved.

Mohr et al. (2001), developed the concept of a socially responsible consumer, by indicating the role of the awareness of the effects of consumption of certain goods when making decisions about the acquisition of the particular product. A consumer in the process of acquiring and consuming or using a product strives towards minimizing or eliminating the threat to society and the maximization of all long-term benefits for society. With relation to this, a socially responsible consumer will avoid products or services from firms that they perceive to be harmful to society and prefer products or services from firms that bring benefits to society.

Another conceptualization of the term SRC was presented by Devinney et al. (2006), according to whom a socially responsible consumer concentrates on the moral motives, or in other words, in taking consumer decisions he/she takes account of personal and moral beliefs. Likewise, Dąbrowska and Kresło (2022), connect SRC with morality. According to them, a socially responsible consumer respects moral norms in his/her consumer behaviour, which have an impact on the conscious decisions in the whole process of satisfying needs, while accepting or not accepting products that an enterprise offers on the market. A broader perspective of socially responsible consumption was proposed by Falcao and Roseira (2022), according to whom SRC encompasses the choices of consumers who weigh up the impact on other people, the environment and the animal welfare, regardless of the main motivations or types of practices. Apart from purchases, the scope of this notion may also encompass action such as recycling, sharing or production of goods, provision of services as an alternative to purchasing. Hence, it is possible to accept that a socially responsible consumer is a person that is socially conscious of his/her consumer choices, while his/her actions on the market are morally justified and is ready to give up consumption of goods that damage the natural and social environment. Such a consumer tries to acquire products or services of firms acknowledged to be responsible with regard to the social and natural environment.

Socially responsible consumption (SRC) has developed as an area of research in the last several years (Petrovskaya, Haleem, 2021; Park et al., 2022; Sharma et al., 2025). It was observed that consumers in their consumer choices are increasingly guided by such factors as: climate change, global warming and social development of marginalized social groups, etc. (Mittelstaedt et al., 2014), while their preferences relating to responsible consumption are growing (Sheth, Parvatiyar, 2021). Socially responsible consumption is explained by mostly the emotional engagement of consumers, while to a lesser extent by the perceived effectiveness of the consumer (Palacios-González, Chamorro-Mera, 2022).

The process of shaping the socially responsible consumer is conditioned by the changes in the systems of values of consumers in the direction of ethical values, among others, justice, co-responsibility, respect for other people, while also emphasizing the significance of responsibility for the natural environment. Spreading these values has an impact on increasing the environmental awareness of people.

The process of shaping the socially responsible consumer is conditioned by the changes in the systems of values of consumers in the direction of ethical values, among others, justice, co-responsibility, respect for other people, while also emphasizing the significance of responsibility for the natural environment. Personal values are equally important. They are defined as “desirable transsituational goals, varying in importance, that serve as guiding principles in the life of a person ...” (Schwartz, 1994, p. 21). Accordingly, values are expected to play a significant role as antecedents of consumers' sustainable development awareness (Balderjahn, Hüttel, 2019). Individuals tend to behave in accordance with their personal values because they seek consistency between their beliefs and actions (Bardi, Schwartz, 2003). Numerous scholars have indicated that personal values stimulate behaviors related to SRC (Green, Tinson, Peloza, 2016; Lee, Kim, 2016). They represent stable motivational constructs underlying human decision-making in the domain of socially responsible consumption.

From the perspective of research on SRC, it is significant to specify its dimensions. The most important of these may include the following: ethical issues in relations with producers, ethical dimension of goods, relations with natural environment, as well as the local community. Ethical issues in relations with producers are key for socially responsible consumers. The range of these relations is wide from the acceptance to the boycott of products of particular producers. Nowadays consumers are perceived as active agents, who enter relations with producers by evaluating them from an ethical viewpoint. In order to assess a product with regard to its ethical values, consumers must know where the product comes from, e.g. in the case of food, the knowledge of how it is produced and how this production has an impact on other people, animals and the environment is significant (Roos et al., 2007). Ethical transparency and ethical identifiability gives consumer the possibility of forming the ethical judgement of the practices applied while creating the particular production.

The ethical dimension of consumer goods constitutes a further area of SRC. Doane (2000), is of the opinion that the ethical dimension of a product is associated with its ethical production (in accordance with human rights, working conditions, environmental protection, etc.). Bylok (2013), proposes to apply the notion of a product with ethical content, which defines its ethical element that encompasses the “fair” production and biologically neutral impact on the natural environment in terms of the process of production. Brinkmann and Peattie (2008), opine that the ethicality of a product involves the perception of it in a broader dimension, namely, as a physical product, its marketing, corporations that produce it, while even the country from where it originates. In the evaluation of the ethical dimension, account is taken of the process of manufacturing, namely, the project, raw materials, materials used in the process of manufacturing the product, way of its production, amount of energy used in its manufacturing process, amount of materials acquired from recycling, low level of contamination and pollution, while also the application of biodegradable raw materials. Likewise, the characteristics of its usage are important, namely, safety for the consumer, possibility of recycling, as well as the

biodegradability of the product. The social responsibility of the consumer is revealed when the ethical attributes are taken into account when choosing a product.

A significant dimension of SRC is the natural environment. It is accepted that consumers as entities availing of the natural environment are responsible for it, which is associated with envisaging their actions, while also taking account of the effects of those actions when making decisions and taking responsibility for them. In the context of responsibility for the natural environment, the concept of green consumption was built, which refers to behaviour whose aim is to use products that are environmentally friendly. This places emphasis on the environmental factors more than on the social factors (ElHaffar et al., 2020). Green consumers are conscious of the negative effects of failing to use green products both for their own health and environmental health (Arli et al., 2018). The approach of socially responsible consumption with regard to the natural environment is broader than green consumption and more inclusive as it also encompasses the social consequences of green consumption.

Actions on behalf of the local community is another area of SRC. Castaño et al. (2016) stated that including “local consumption” within the range of SRC is beneficial from an economic viewpoint and improves the economic conditions of the life of the local community. According to DeVincenzo and Scammon (2015), socially conscious consumption is associated with purchasing regional goods with the aim of supporting small firms and regional communities. Support for local communities may be interpreted as economic benefits and have positive social impact as it enhances living standards of a given area and offers economic stability (VillaCastaño et al., 2016). One of the actions undertaken by socially responsible consumers may become the propagation of the consumption of local products associated with local culture, the so-called consumer localism.

3. Methods

The survey method was applied in the research and the research tool was the standardized questionnaire. The online survey called CAWI was applied for analysing consumers. The research was of a nationwide nature and the selection of people for research was conducted by means of the application of stratified sampling and taking account of the size of the place of abode, sex type and age group. The sums in the particular layers were selected according to the structures of GUS (Chief Statistics Office of Poland – National Register, 2021). On the basis of the method of random selection, a research sample was built consisting of 1080 adult inhabitants of Poland. The research was participated in by 50% women and 50% men, aged between 18 and 24 (7%), 25-34 (17%), 35-44 (20%), 45-54 (18%), 55 years of age or older (38%), with basic education, vocational, secondary school or university level, place of abode in a village, in a small town up to 20,000 inhabitants, medium-sized town between 21,000

and 99,000 inhabitants, in a large city of between 100,000 and 499,000 inhabitants, while also in a larger city of 500,000 inhabitants or more, having an income of 399 PLN per person in the household, between 400 and 799 PLN, from 800 to 1199 PLN, from 1200 to 1499 PLN, and from 1500 PLN.

SRC was measured with the use of the scale created by Francois-Lecompte and Valette-Florence (2006), while also Francois-Lecompte and Roberts (2006) that was adapted for Polish conditions. This scale consisted of 23 claims characterizing six various dimensions of responsible consumption as follows: PSP – purchasing products connected with social purposes, PEE – purchasing products with an ethical element, PSS – purchasing in small shops, PGP – purchasing based on the geographical origin of the product, LCP – limiting consumption product, AEP – actions on behalf of environmental protection. Regarding the measurement model of the scale, the internal consistency of the tests and measurements was estimated for each construct using Cronbach's alpha reliability coefficient, with a threshold value greater than 0.80. Values exceeding this threshold indicate a high level of internal consistency, confirming the reliability of the measurement scales used in the study. For the purpose of analyzing the responses, means, standard deviations, dominant values, the Student's t-test, the Mann-Whitney test, and the Kruskal-Wallis test were employed. To examine the relationships between the dimensions of socially responsible consumption and the value orientations of Polish consumers, the nonparametric Spearman's rank correlation coefficient (r_s) was applied.

This method was selected due to the non-normal distribution of the variables (Shapiro-Wilk test, $p < 0.05$) and their ordinal level of measurement. Spearman's coefficient allows for the assessment of the strength and direction of monotonic relationships between variables without assuming linearity or homoscedasticity.

4. Results

The analysis of the data presented in Table 1 includes six dimensions of socially responsible consumption: purchasing products connected with social purposes (PSP), purchasing products with an ethical element (PEE), shopping in small local stores (PSS), purchasing based on the geographical origin of products (PGP), limiting consumption (LCP), and engaging in actions on behalf of environmental protection (AEP). The mean values across all variables indicate a high level of declared prosocial and pro-environmental attitudes (ranging from 4.23 to 5.04 on the measurement scale). The highest results were recorded for purchases based on the geographical origin of products (PGP; $M = 5.04$) and limiting consumption (LCP; $M = 4.95$), suggesting that respondents strongly value local origin and a conscious reduction of excessive consumption. The lowest score was observed for purchasing products with an ethical element (PEE; $M = 4.23$), which may indicate that ethical aspects of consumption (e.g., fair trade, workers' rights) are considered less important than ecological or local concerns. Standard

deviations ranging from 1.3 to 1.5 indicate moderate variability in responses. Most variables display negative skewness, meaning that higher ratings dominate (respondents generally agree with the socially responsible statements). The only exception is AEP (skewness = 0.74), where a more diverse distribution suggests the presence of a subgroup of less environmentally engaged consumers. Kurtosis values close to zero imply approximately normal distributions.

In summary, the findings indicate that the respondents demonstrate a relatively high level of socially responsible consumption, particularly in the dimensions related to local purchasing and limiting consumption. Ethical aspects appear to be somewhat less emphasized.

Table 1.
Dimensions of socially responsible consumption (SRC)

Statement	M	SD	Var	Kurt	Skew
PSP	4.73	1.58	2.33	-0.02	-0.42
PEE	4.23	1.41	1.99	0.25	-0.37
PSS	4.27	1.41	2.11	-0.15	-0.41
PGP	5.04	1.42	2.02	0.37	-0.63
LCP	4.95	1.32	1.74	0.45	-0.54
AEP	4.65	1.44	2.76	-0.80	0.74

Source: Author's own study.

Scale: 1 – definitely unimportant, 2 – unimportant, 3 – rather unimportant, 4 – I don't have an opinion, 5 – rather important, 6 – important, 7 – definitely important.

The Student's t-test (Welch's version) was conducted to assess similarities and differences between the SRC dimensions ($N = 1080$, $\alpha = 0.05$) (Table 2). Significant differences between means were observed when $p < 0.05$. The analysis revealed that PSP and AEP did not differ significantly from each other but differed from the remaining dimensions. Similarly, PEE and PSS were comparable to each other yet significantly different from most other variables, while PGP and LCP did not differ from one another but differed from the majority of the remaining dimensions.

Table 2.
Student's t-test dimensions of socially responsible consumption (SRC)

Variable 1	Variable 2	t-value	df	p-value
PSP	PEE	7.759	2130.6	0.0000
PSP	PSS	7.139	2130.6	0.0000
PSP	PGP	-4.796	2133.9	0.0000
PSP	LCP	-3.512	2091.8	0.0005
PSP	AEP	1.230	2139.7	0.2189
PEE	PSS	-0.659	2158.0	0.5098
PEE	PGP	-13.302	2157.9	0.0000
PEE	LCP	-12.251	2148.7	0.0000
PEE	AEP	-6.849	2157.0	0.0000
PSS	PGP	-12.645	2157.9	0.0000
PSS	LCP	-11.570	2148.7	0.0000
PSS	AEP	-6.196	2157.0	0.0000
PGP	LCP	1.526	2146.6	0.1273
PGP	AEP	6.337	2157.6	0.0000
LCP	AEP	5.047	2141.9	0.0000

With the aim of defining the impact of the notion of SRC on the behaviour of consumers, an analysis was conducted on the relations between the dimensions and the socio-demographic features. Research on the relations between sex types and the dimensions of SRC was conducted with the use of the Mann-Whitney test (Table 3). The Mann–Whitney U test results indicate that women scored significantly higher than men across all measured dimensions (PSP, PEE, PSS, PGP, LCP, AEP). This finding implies that gender is a differentiating factor, with women demonstrating higher levels of the studied characteristics in each analyzed area.

In summary, the Mann - Whitney test confirmed the existence of statistically significant differences between women and men in all analyzed areas. Women scored higher across all variables, suggesting that, in a marketing context, they represent a more emotionally and relationally engaged consumer group. Taking these differences into account can significantly enhance the effectiveness of marketing and communication strategies.

Tabela 3.

Mann-Whitney test results dimensions of socially responsible consumption (SRC)

	Total ranks of men	Total ranks of women	U	Z	p	Z	p
PSP	270581.5	313158.5	124511.5	-4.15	0.00	-4.27	0.00
PEE	276646.5	307093.5	130576.5	-2.96	0.14	-3.10	0.00
PSS	280941.5	302798.0	134871.5	-2.13	0.04	-2.18	0.04
PGP	278346.0	305393.5	132276.0	-2.63	0.02	-2.70	0.01
LCP	276378.0	307361.5	130308.0	-3.01	0.04	-3.11	0.03
AEP	271305.0	312435.0	125235.0	-4.00	0.00	-4.14	0.00

$p < 0.050$.

The Kruskal-Wallis (Table 4) test was availed of for the purpose of analysing the relations between the dimensions of SRC and the independent variables, namely, age, education, place of abode and income per person in a household. The analysis of the Kruskal-Wallis test results revealed significant differences depending on the demographic characteristics of the participants:

1. Age – all scales (PSP, PEE, PSS, PGP, LCP, AEP) showed statistically significant differences between age groups ($p < 0.001$), with the largest differences observed in the PGP and AEP scales.
2. Place of residence – significant differences were found in the PEE ($p = 0.02$) and AEP ($p = 0.016$) scales, suggesting that the living environment affects results in these areas.
3. Education – the PEE ($p = 0.03$), LCP ($p < 0.001$), and AEP ($p = 0.01$) scales differed significantly depending on participants' education level.
4. Income – significant differences were observed in the PSP, PEE, PGP, LCP, and AEP scales ($p = 0.02$ – 0.001), indicating a relationship between results and participants' income level.

In summary, the PGP and AEP scales show the greatest variability between groups, indicating high sensitivity of these areas to demographic factors.

Table 4.*Kruskal-Wallis test results dimensions of socially responsible consumption (SRC)*

	Age		Place of abode		Education		Income per person in a household	
	H(4)	p	H(5)	p	H(5)	p	H(6)	p
PSP	18.306	0,00					23.91	0.00
PEE	25.89	0,00	11.37	0.02	11.86	0.03	26.99	0.00
PSS	30.88	0,00	-	-	--	-	-	-
PGP	71.22	0,00	-	-	-	-	23.46	0.00
LCP	29.68	0,00	-	-	18.02	0.00	17.26	0.02
AEP	43.51	0,00	12.17	0.02	14.46	0.01	23.26	0.02

p < ,050.

In a further research step it was decided to identify the socio-demographic features that characterize the socially responsible consumers in Poland in order to build their profile. In analysing the dimensions of SRC, it is possible to note the significant differences with regard to sex type, age, education, place of abode and income. The people who purchase products associated with social aims are women, people aged 55 or more, having a higher level of education, living in a city between 100,000 and 500,000 inhabitants.

Acquiring products with an ethical element is the dimension of SRC that is strongly associated with ethical consumption. The products with an ethical element are first and foremost taken into consideration when taking purchasing decisions in the case of women, people aged 55 or more, having a higher level of education, living in smaller cities and receiving a low income per person in the household.

One of the areas of SRC is to support local products. The research indicates that the majority of respondents pay attention to the country of origin and choose products made in Poland. This particularly relates to the purchase of fruit and vegetables grown in Poland. Hence, consumers who pay attention to the geographical origin of a product and make purchases on the basis of such are women, people aged 55 or more, having a medium level of education or higher level, living in a village.

The afore-mentioned dimension is connected with supporting local firms by means of buying products in small shops, e.g. local or rural shops. Research displays that this dimension to a small extent has more of an impact on purchasing decisions than in the case of the remaining areas of social responsibility. If consumers decide to do shopping in local shops they usually choose small bakery shops, butcher shops or bookshops. Consumers who help local business by making purchases in small shops are women, people aged 45-54, having basic vocational school education, living in a village.

One of the notions of SRC is the limitation of the consumption of goods. Research indicates that generally speaking, the analysed respondents try to restrict the consumption of goods to the amounts necessary to maintain living standards. Such behaviour is displayed by the majority of consumers analysed. Generally speaking, the analysed consumers try to restrict the consumption of goods, particularly in the case of women, aged 55 or more, having basic level of education and living in a village.

Care of the natural environment is another dimension of SRC. Research illustrates that the majority of Poles declare taking actions that are aimed at protecting the natural environment. An action that significantly reduces pressure on the natural environment is the limitation of the consumption of goods that potentially damage the natural environment, namely, energy, clothing, food to the level of actual needs. The majority that declare such behaviour are women, people aged 55 or more, having a medium level of education, living in cities from 100,000 to 199,000 inhabitants and from 200,000 to 499,000 inhabitants.

In the concept of SRC the awareness of the threat to the natural environment is significant. Respondents declare that by means of their actions they are contributing to environmental protection. Hence, changes in their behaviour towards a more environmentally friendly one are declared by women, people aged 55 or more, living in a city from 100,000 to 499,000 inhabitants and receiving income of between 400 and 799 PLN per person in a household. The education variable did not differentiate the analysed respondents.

A cognitive curiosity is the identification of mutual relations between the dimensions of SRC (Table 5). The analysis of Spearman's rank correlation coefficients revealed that all examined variables (PSP - AEP) are positively correlated, with varying strengths of association. The correlation coefficients range from 0.308 to 0.532, indicating weak to moderate monotonic relationships between the analyzed parameters. The strongest correlation was observed between acquiring products connected with social purposes (PSP) and acquiring products with ethical element (PEE) ($r_s = 0.532$), suggesting that an increase in one variable is moderately associated with an increase in the other. Conversely, the weakest correlation occurred between acquiring products connected with social purposes (PSP) and Limiting consumption of products (LCP) ($r_s = 0.308$), indicating a relatively low degree of association. The absence of negative correlations implies that none of the variables are inversely related to the others.

In general, it can be stated that the studied variables have positive, but not very strong, relationships with each other, which may suggest that they refer to related, but not identical, aspects of the analyzed phenomenon.

Table 5.

Spearman's Rank Correlation Coefficient between dimensions of socially responsible consumption (SRC)

	PSP	PEE	PSS	PGP	LCP	AEP
PSP	1.000	0.532	0.369	0.392	0.308	0.434
PEE	0.532	1.000	0.532	0.532	0.532	0.532
PSS	0.369	0.369	1.000	0.369	0.369	0.369
PGP	0.392	0.392	0.392	1.000	0.392	0.392
LCP	0.308	0.308	0.308	0.308	1.000	0.308
AEP	0.434	0.434	0.434	0.434	0.434	1.000

$p < .001$.

The table presents the importance of ten key life values among Polish consumers, measured on descriptive statistics include the mean, standard deviation, variance, kurtosis, and skewness for each value (table 6). The analysis shows that security ($M = 6.34$), self-respect ($M = 6.17$),

and warm relationships with others ($M = 5.96$) are the most important values for Polish consumers. These results indicate that stability, self-esteem, and social bonds form the core of the Polish value system. Conversely, the least important values are excitement/stimulation ($M = 4.45$), career achievement ($M = 4.55$), and fun and enjoyment in life ($M = 4.98$), suggesting that hedonistic and materialistic motivations play a smaller role in the consumers' hierarchy of values. The standard deviations (0.9-1.4) indicate moderate variability in responses. All variables have negative skewness, which means that high importance ratings predominate. High positive kurtosis, especially for security (3.40), shows that the majority of respondents consistently rated this value as very important.

Table 6.
Hierarchy of personal values of Polish consumers

Statement	M	SD	Var	Kurt	Skew
V1 Sense of safety	6.34	0.88	0.79	3.40	-1.59
V2 Self-respect	6.17	0.92	0.86	1.94	-1.07
V3 Warm relationships with others	5.96	0.96	0.92	1.58	-0.98
V4 Self-fulfilment	5.77	1.07	0.94	1.64	-0.87
V5 Being respected	5.75	1.07	1.15	1.47	-0.95
V6 Sense of accomplishment	5.27	1.09	1.27	1.08	-0.68
V7 Sense of belonging	5.19	1.20	1.45	0.32	-0.55
V8 Fun and enjoyment in life	4.98	1.26	1.60	0.49	-0.59
V9 Achieving a high professional status	4.55	1.42	2.01	-0.14	-0.41

Scale: 1 – definitely unimportant, 2 – unimportant, 3 – rather unimportant, 4 – I don't have an opinion, 5 – rather important, 6 – important, 7 – definitely important.

Source: Author's own study.

The analysis revealed numerous statistically significant and positive correlations between the dimensions of socially responsible consumption and consumers' value orientations (tab.7). This finding indicates that the higher the importance of certain values in an individual's hierarchy, the stronger the tendency to engage in socially, ethically, or environmentally responsible consumer behaviors. The strongest correlations were observed for AEP (actions on behalf of environmental protection) and PGP (purchasing based on geographical origin). The AEP dimension exhibited the highest associations with V8 ($r_s = 0.312$; $p < 0.001$), V2 ($r_s = 0.282$; $p < 0.001$), and V4 ($r_s = 0.287$; $p < 0.001$). Similarly, PGP showed the strongest correlations with V1 ($r_s = 0.289$; $p < 0.001$) and V6 ($r_s = 0.280$; $p < 0.001$), suggesting that consumers motivated by values of tradition, community, and responsibility are more likely to choose local or domestic products.

Moderate correlations were found for PSP and PEE, with coefficients ranging from 0.135 to 0.265 ($p < 0.001$), indicating that ethical and empathetic values significantly—but moderately—influence purchasing decisions related to social and moral concerns.

The lowest correlations were noted for PSS (purchasing in small shops) and LCP (limiting consumption), with several coefficients non-significant, suggesting that these behaviors may be driven more by pragmatic factors than by deeply internalized value orientations.

Table 7.

Spearman's Rank Correlation Coefficient between dimensions of socially responsible consumption (SRC) and personal values

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
PSP	0.228*	0.232*	0.162*	0.234*	0.205*	0.176*	0.135*	0.253*	0.083**	0.090**
PEE	0.247*	0.181*	0.170*	0.232*	0.190*	0.265*	0.141*	0.179*	0.114*	0.146*
PSS	0.183*	0.158*	0.130*	0.210*	0.114*	0.222*	0.132*	0.174*	0.126*	0.162*
PGP	0.289*	0.228*	0.175*	0.289*	0.247*	0.280*	0.133*	0.256*	0.048	0.117*
LCP	0.193*	0.209*	0.080**	0.224*	0.219*	0.155*	0.075**	0.261*	0.043	0.050
AEP	0.258*	0.282*	0.163*	0.287*	0.259*	0.252*	0.173*	0.312*	0.090**	0.086**

*p <,001 **<,050.

In summary, the study revealed a clear relationship between consumers' value orientations and their tendency to engage in socially responsible purchasing behaviors. Individuals who prioritize values such as tradition, community, responsibility, and environmental care are more likely to act in environmentally friendly ways and choose local products.

5. Discussion

The research conducted on the sphere of occurrence of SRC in Poland facilitated answering the research questions put forward. Research on the dimensions of SRC, namely, acquiring products connected with social aims, acquiring products with an ethical element, purchases in small firms, purchases on the basis of geographical origin of the product, restriction of the consumption of the products, actions aimed at environmental protection indicate great potential for development in Poland. The dimension of the demographic origin of the product was rated highly. The majority of Poles indicated that in their purchasing decisions they take account of goods produced in Poland, among others, cosmetics, clothing, footwear and food, namely, vegetables and fruit. When they have a choice between a Polish product and an imported one, they usually choose the local product. The second important dimension of SRC is the acquisition of products connected with social aims. This dimension represents preferences for products associated with social aims, including purchases of products of firms that respect their employees, do not employ children and do not harm the natural environment. Likewise, in the analysis of consumption in Spain, this dimension turned out to be the most important for consumers (Pérez-Barea et al., 2015). A significant dimension for SRC for Polish people is the restriction of the consumption of products that harm the natural environment and which are essential for normal functioning in life. Generally speaking, the socially responsible consumer behaviour declared was at the level of above average, which means that they have the potential for growth. This research indicated that consumer may display their social engagement in various ways, without attaching the same weight to all the types of actions that enable them to illustrate this in terms of purchasing decisions. This signifies that socially responsible consumption is characterized by various nuances depending on the specific consumer.

From the perspective of the research aim, it was important to build a profile of a socially responsible consumer. The findings indicate that gender significantly differentiates socially responsible consumers. Gender, age, and personal values were found to be significant factors influencing SRC. Previous research indicates that women are generally more likely than men to engage in SRC-related behaviors (Bisonette, Contento, 2001; Lee, Choo, 2019). Consistently, the present study shows that women demonstrate a stronger preference for behaviors characteristic of SRC.

Age is an important factor influencing SRC. Rifkin (2010) found a negative correlation between age and SRC, with younger consumers showing a greater tendency to engage in prosocial behaviors, including recycling, donations, volunteering, and helping others. Similarly, Lee and Choo (2018) reported that younger individuals demonstrate higher levels of socially responsible consumption than older consumers. In contrast, the present study revealed an opposite trend: age significantly differentiated respondents, with declarations of SRC-related behaviors increasing with age. The highest prevalence of such behaviors was observed among individuals aged 55 and older, followed by those aged 45-54, highlighting the growing engagement of older consumers in socially responsible practices.

As regards the level of income, some research connects socially responsible behaviour with a higher level of income (Ritter et al., 2015). However, other research displays that people with lower incomes behave in a way that is more socially responsible (Singh, 2009). Analysis of the research findings of the author reveal that most frequently socially responsible behaviour characterized people receiving income between 400-799 PLN per person in a household. In the case of education, the results of some research indicates that the level of education differentiates socially responsible behaviour in terms of consumption. People with a high level of education behave in a manner that is more socially responsible (Muncy, Vitell, 1992). Likewise, in Poland people with a higher and medium level of education usually declared such behaviour. The place of abode has the least impact on the declarations of behaviour in accordance with SRC. Relatively frequently these people live in a city between 100,000 and 500,000 inhabitants, while also in a village.

Furthermore, personal values represent a fundamental determinant of SRC. Empirical studies suggest that Polish consumers exhibit a balanced and stability-oriented value system, emphasizing personal security, self-respect, and close interpersonal relationships. These values act as stable motivational constructs that guide decision-making in the domain of socially responsible consumption (Bardi, Schwartz, 2003; Freestone, McGoldrick, 2008; Green et al., 2016; Lee, Kim, 2016). Together, these demographic and psychological factors underscore the multifaceted nature of socially responsible consumer behavior and its dependence on both intrinsic values and sociodemographic characteristics.

The obtained Spearman correlation results between the dimensions of socially responsible consumption and personal values confirm that socially responsible consumer behaviors largely stem from an individual system of values. Prosocial, moral, and ecological values promote attitudes related to environmental protection and concern for others.

In turn, the strong associations between the purchasing based on the geographical origin of the product dimension and the values of tradition and community may indicate the growing importance of consumer patriotism and responsibility toward the local economy. Weaker correlations observed for the purchasing in small shops and limiting consumption product dimensions suggest that actions such as reducing consumption or supporting small retail outlets are less driven by axiological (value-based) motives and more by pragmatic factors (e.g., price, availability, or habit). Therefore, socially responsible consumption among Polish consumers has a strong value-based component, with particular importance placed on values related to responsibility, community, and care for the natural environment.

The findings of this study offer valuable theoretical insights into socially responsible consumption (SRC). They confirm that SRC is deeply rooted in consumers' personal value systems, supporting perspectives that view consumption as a moral and identity-driven process rather than a purely economic one. The results also demonstrate that the strength of the value–behavior relationship varies across SRC dimensions: environmentally and socially oriented behaviors are strongly value-based, whereas practices such as limiting consumption or shopping in small stores are more pragmatic. Furthermore, the study highlights the multidimensional and context-dependent nature of SRC and provides a basis for an enhanced value-based model in which responsible consumer behaviors result from interactions between personal values, demographic factors, and cultural context. Future research should empirically validate this framework across diverse cultural settings and investigate how specific value orientations shape or moderate responsible consumption patterns.

Summary

In general terms, the findings of the research conducted rather unequivocally indicate the significance of behaviour in the area of socially responsible behaviour in Poland. However, they are not sufficient for the unequivocal claim relating to the strength of the impact of the dimensions of socially responsible consumption on changes in consumption in the near future. The findings highlight the axiological foundations of socially responsible consumption in Poland. Pro-environmental and community-oriented values emerge as the key drivers of responsible consumer behavior. These research findings may be helpful to practitioners and managers in terms of creating marketing strategies directed at socially responsible consumers.

The author of this paper wishes to indicate the limitation in the use of research findings as the research conducted with the use of the survey method was aimed at outlining the intricate problematic area of socially responsible behaviour in Poland and constitutes a starting point for further research on its role in the development of consumption.

It is worth undertaking further research on socially responsible consumption that would encompass an analysis of the impact of other variable bases, social norms or a level of knowledge on the subject of the effects of socially responsible consumption. Furthermore, as socially responsible behaviour is dynamic, it may be interesting to repeat this research in different cultural contexts and in other time periods. Likewise, it would be valuable from a cognitive viewpoint to focus on specific consumer behaviour or categories of products.

References

1. Amberg, N., Fogarassy, C. (2019). Green consumer behavior in the cosmetics market. *Resources*, Vol. 8, No. 3, 137. <https://doi.org/10.3390/resources8030137>
2. Anuar, M.M., Omar, K., Ismail, R., Omar, M.W. (2014). The influence of materialism on socially responsible consumption. *Journal of Global Business and Economics*, Vol. 8, No. 1, pp. 75-80.
3. Arli, D., Tan, L.P., Tjiptono, F., Yang, L. (2018). Exploring consumers' purchase intention towards green products in an emerging market: The role of consumers' perceived readiness. *International Journal of Consumer Studies*, Vol. 42, No. 4, pp. 389-401. <https://doi.org/10.1111/ijcs.12432>
4. Assimos, B.M., Pinto, M.D.R., Leite, R.S., Andrade, M.L.D. (2019). Conspicuous consumption and its relation to brand consciousness, status consumption and self-expression. *BBR. Brazilian Business Review*, Vol. 16, pp. 350-368. <https://doi.org/10.15728/bbr.2019.16.4.3>
5. Balderjahnand, I., Hüttel, A. (2019). Why Consumers Buy Sustainably: The Role of Personal Values. *Marketing ·ZFP*, Vol. 41, No. 1, pp. 24-38. <https://doi.org/10.15358/0344-1369-2019-1-24>
6. Bardi, A., Schwartz, S.H. (2003). Values and behavior: Strength and structure of relations. *Personality and Social Psychology Bulletin*, Vol. 29, No. 10, pp. 1207-1220. <https://doi.org/10.1177/0146167203254602>
7. Bisonette, M.M., Contento, I.R. (2001). Adolescents' perspectives and food choice behaviors in terms of the environmental impacts of food production practices: application of a psychosocial model. *Journal of Nutrition Education*, Vol. 33, No. 2, pp. 72-82. [https://doi.org/10.1016/S1499-4046\(06\)60170-X](https://doi.org/10.1016/S1499-4046(06)60170-X)

8. Brinkmann, J., Peattie K. (2008). Consumer Ethics Research: Reframing the Debate about Consumption for Good. *Electronic Journal of Business Ethics and Organization Studies*, Vol. 13, No. 1, pp. 22-31. <http://hdl.handle.net/11250/93282>
9. Bylok, F. (2013). *Konsumpcja, konsument i społeczeństwo konsumpcyjne. Studium socjologiczne*. Katowice: Śląsk.
10. Canova, L., Bobbio, A., Manganelli, A.M. (2023). Sustainable purchase intentions: The role of moral norm and social dominance orientation in the theory of planned behavior applied to the case of fair trade products. *Sustainable Development*, Vol. 3, No. 2, pp. 1069-1083. <https://doi.org/10.1002/sd.2441>
11. Crane, A., Matten, D. (2004). *Business Ethics: A European Perspective: Managing Corporate Citizenship and Sustainability in the Age of Globalization*. Oxford: Oxford University Press.
12. d'Astous, A., Legendre, A. (2009). Understanding consumers' ethical justifications: A scale for appraising consumers' reasons for not behaving ethically. *Journal of Business Ethics*, Vol. 87, pp. 255-268. <https://doi.org/10.1007/s10551-008-9883-0>
13. Dąbrowska, A., Janoś-Kresło, M. (2024). *Společna odpowiedzialność konsumenta w czasie pandemii. Badania międzynarodowe*. Warszawa: Oficyna Wydawnicza SGH.
14. DeVincenzo, M.H., Scammon, D. (2015). Principle-based consumption communities: Exploring the meanings derived from socially conscious consumption practices. *Journal of Public Policy & Marketing*, Vol. 34, No. 2, pp. 143-155. <https://doi.org/10.1509/jppm.13>
15. Devinney, T.M., Auger, P., Eckhardt, G., Birtchnell, T. (2006), The Other CSR: Consumer Social Responsibility. *Stanford Social Innovation Review*, No. 15-04, pp. 29-37. <http://dx.doi.org/10.2139/ssrn.901863>
16. Dickson, M. (2005). Identifying and profiling apparel label users. In: R. Harrison, T. Newholm, D. Shaw (Eds.), *The ethical consumer* (pp. 155-172). Thousand Oaks CA: Sage.
17. Dickson, M.A. (2000). Personal Values, Beliefs, Knowledge, and Attitudes Relating to Intentions to Purchase Apparel from Socially Responsible Businesses. *Clothing and Textiles Research Journal*, Vol. 18, No. 1, pp. 19-30. <https://doi.org/10.1177/0887302X0001800103>
18. Doane, D. (2001). *Taking Flight: The Rapid Growth of Ethical Consumerism*. London: New Economics Foundation.
19. Doran, C.J. (2009). The Role of Personal Values in Fair Trade Consumption. *Journal of Business Ethics*, Vol. 84, pp. 549-563. <https://doi.org/10.1007/s10551-008-9724-1>
20. Eberhardt, T., Hubert, M., Lischka, H.M., Hubert, M., Lin, Z. (2021). The role of subjective knowledge and perceived trustworthiness in fair trade consumption for fashion and food products. *Journal of Consumer Marketing*, Vol. 38, No. 1, pp. 58-68. <https://doi.org/10.1108/JCM-08-2019-3356>

21. ElHaffar, G., Durif, F., Dubé, L. (2020). Towards closing the attitude-intention-behavior gap in green consumption: A narrative review of the literature and an overview of future research directions. *Journal of Cleaner Production*, Vol. 275, 122556. <https://doi.org/10.1016/j.jclepro.2020.122556>
22. Falcão, D., Roseira, C. (2022). Mapping the socially responsible consumption gap research: Review and future research agenda. *International Journal of Consumer Studies*, Vol. 46, No. 5, pp. 1718-1760. <https://doi.org/10.1111/ijcs.12803>
23. François, A., Valette-Florence, P. (2006). Mieux connaître le consommateur socialement responsable. *Décisions marketing*, Vol. 41, No. 1, pp. 67-79. <https://doi.org/10.7193/DM.041.67.79>
24. Francois-Lecompte, A., Roberts, J.A. (2006). Developing a measure of socially responsible consumption in France. *Marketing Management Journal*, Vol. 16, No. 2, pp. 50-66.
25. Ganglmair-Wooliscroft, A., Wooliscroft, B. (2017). Ethical behaviour on holiday and at home: Combining behaviour in two contexts. *Journal of Sustainable Tourism*, Vol. 2, No. 4, pp. 589-604. <https://doi.org/10.1080/09669582.2016.1260573>
26. Green, T., Peloza, J. (2011). How does corporate social responsibility create value for consumers? *Journal of Consumer Marketing*, Vol. 28, No. 1, pp. 48-56. <https://doi.org/10.1108/07363761111101949>
27. Ladhari, R., Tchetgna, N.M. (2015). The influence of personal values on Fair Trade consumption. *Journal of Cleaner Production*, Vol. 87, pp. 469-477. <https://doi.org/10.1016/j.jclepro.2014.10.068>
28. Lee, J., Cho, M. (2019). New insights into socially responsible consumers: The role of personal values. *International Journal of Consumer Studies*, Vol. 43, No. 2, pp. 123-133. <https://doi.org/10.1111/ijcs.12491>
29. Lee, J., Kim, J. (2016). The effect of consume characteristics on the cause-related marketing campaign: The role of personal life values. *International Journal of Business and Management*, Vol. 11, No. 9, 82. <https://doi.org/10.5539/ijbm.v11n9p82>
30. Mittelstaedt, J.D., Shultz, C.J., Kilbourne, W.E., Peterson, M. (2014). Sustainability as megatrend: Two schools of macromarketing thought. *Journal of Macromarketing*, Vol. 34, No. 3, pp. 253-264. <https://doi.org/10.1177/0276146713520551>
31. Mohr, L.A., Webb, D.J., Harris, K.E. (2001). Do Consumers Expect Companies to be Socially Responsible? The Impact of Corporate Social Responsibility on Buying Behavior. *Journal of Consumer Affairs*, Vol. 35, No. 1, pp. 45-72. <https://doi.org/10.1111/j.1745-6606.2001.tb00102.x>
32. Muncy, J.A., Vitell, S.J. (1992). Consumer ethics: An investigation of the ethical beliefs of the final consumer. *Journal of business Research*, Vol. 11, pp. 585-597. <http://www.jstor.org/stable/25123665>

33. O'Connor, E.L., Sims, L., White, K.M. (2017). Ethical food choices: Examining people's Fair Trade purchasing decisions. *Food Quality and Preference*, Vol. 60, pp. 105-112. <https://doi.org/10.1016/j.foodqual.2017.04.001>
34. Palacios-González, M.M., Chamorro-Mera, A. (2022). Analysis of the predictive variables of socially responsible consumption. *Business Strategy & Development*, Vol. 5, No. 3, pp. 187-196. <https://doi.org/10.1002/bsd2.189>
35. Park, J., Eom, H.J., Spence, C. (2022). The effect of perceived scarcity on strengthening the attitude-behavior relation for sustainable luxury products. *Journal of Product & Brand Management*, Vol. 3, No. 3, pp. 469-483. <https://doi.org/10.1108/JPBM-09-2020-3091>
36. Pedrini, M., Ferri, L.M. (2014). Socio-demographical antecedents of responsible consumerism propensity. *International Journal of Consumer Studies*, Vol. 38, No. 2, pp. 127-138. <https://doi.org/10.1111/ijcs.12074>
37. Petrovskaya, I., Haleem, F. (2021). Socially responsible consumption in Russia: Testing the theory of planned behavior and the moderating role of trust. *Business Ethics, the Environment & Responsibility*, Vol. 30, No. 1, pp. 38-53. <https://doi.org/10.1111/beer.12322>
38. Prendergast, G.P., Tsang, A.S. (2019). Explaining socially responsible consumption. *Journal of Consumer Marketing*, Vol. 36, No. 1, pp. 146-154. <https://doi.org/10.1108/JCM-02-2018-2568>
39. Rifkin, J. (2010). *The empathic civilization: The race to global consciousness in a world in crisis*. New York, NY: Tarcher.
40. Ríos-Rodríguez, M.L., Salgado-Cacho, J.M., Moreno-Jiménez, P. (2021). What impacts socially responsible consumption? *Sustainability*, Vol. 13, No. 8, 4258. <https://doi.org/10.3390/su13084258>
41. Ritter, Á.M., Borchardt, M., Vaccaro, G.L., Pereira, G.M., Almeida, F. (2015). Motivations for promoting the consumption of green products in an emerging country: exploring attitudes of Brazilian consumers. *Journal of Cleaner Production*, Vol. 106, pp. 507-520. <https://doi.org/10.1016/j.jclepro.2014.11.066>
42. Roos, G., Terragni, L., Torjusen, H. (2007). The local in the global—creating ethical relations between producers and consumers. *Anthropology of food*, S2. <https://doi.org/10.4000/aof.489>
43. Sharma, V., Banerji, D., Saha, V. (2025). Differentiating and synthesizing socially responsible consumption: A multi-level conceptual framework and future research directions. *Journal of Macromarketing*, 02761467241306305. <https://doi.org/10.1177/027614672413063>
44. Sheth, J.N., Parvatiyar, A. (2021). Sustainable marketing: Market-driving, not market-driven. *Journal of Macromarketing*, Vol. 41, No. 1, pp. 150-165. <https://doi.org/10.1177/0276146720961836>

45. Shmelev, S. E., Agbleze, L., and Spangenberg, J. H. (2023). Multidimensional Ecosystem Mapping: Towards a More Comprehensive Spatial Assessment of Nature's Contributions to People in France. *Sustainability*, Vol. 15, No. 9, 7557. <https://doi.org/10.3390/su15097557>
46. Singh, N. (2009). Exploring socially responsible behaviour of Indian consumers: an empirical investigation. *Social Responsibility Journal*, Vol. 5, No. 2, pp. 200-211. <https://doi.org/10.1108/17471110910964487>
47. Villa Castaño, L.E., Perdomo-Ortiz, J., Duenas Ocampo, S., Duran Leon, W. F. (2016). Socially responsible consumption: An application in Colombia. *Business Ethics: A European Review*, Vol. 25, No. 4, pp. 460-481. <https://doi.org/10.1111/beer.12128>
48. Wang, E.S.T., Chou, C.F. (2020). Norms, consumer social responsibility and fair trade product purchase intention. *International Journal of Retail & Distribution Management*, Vol. 4, No. 1, pp. 23-39. <https://doi.org/10.1108/IJRDM-09-2019-0305>
49. Weaver, T., Ellen, P.S., Curasi, C. (2024). Ethical Biographies: Product Provenance and the Pursuit of Ethical Consumption. *Journal of Sustainable Marketing*, No. 2, pp. 149-176. <https://doi.org/10.51300/JSM-2024-125>
50. Webster, F.E. Jr. (1975). Determining the characteristics of the socially conscious consumer. *Journal of Consumer Research*, Vol. 2, No. 3, pp. 188-196. <http://dx.doi.org/10.1086/208631>
51. Witkowski, T.H., Reddy, S. (2010). Antecedents of ethical consumption activities in Germany and the United States. *Australasian Marketing Journal*, Vol. 18, No. 1, pp. 8-14. <https://doi.org/10.1016/j.ausmj.2009.10.011>
52. Zhao, H.H., Gao, Q., Wu, Y.P., Wang, Y., Zhu, X.D. (2014). What affects green consumer behavior in China? A case study from Qingdao. *Journal of Cleaner Production*, Vol. 63, pp. 143-151. <https://doi.org/10.1016/j.jclepro.2013.05.021>
53. Zong, W., Tu, H., Luo, F., Junejo, I., Din, A.U., Zhou, D., Luo A., He, H. (2024). Social Factors Affecting Sustainable Socially Responsible Purchasing: A Mediating Role of Corporate Social Responsibility. *SAGE Open*, Vol. 14, No. 1, 21582440231216276. <https://doi.org/10.1177/21582440231216276>

PROSPECTS FOR THE GREEN ECONOMY IN THE SILESIAN REGION – SME ENTREPRENEURS' PERSPECTIVE

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Purpose: The article aims to explore how small and medium-sized enterprise (SME) entrepreneurs perceive the prospects for the green economy in the Silesian region, which is currently undergoing a profound economic transformation supported by the Just Transition Fund (JTF). The research adopts a comprehensive perspective on sustainability, consistent with the international policy framework defined by the Sustainable Development Goals (SDGs). It addresses a knowledge gap regarding the determinants influencing SMEs' adoption of green solutions and the relationship between financial standing, firm size, and willingness to engage in environmentally friendly practices.

Methodology: A mixed-methods approach was employed, integrating quantitative and qualitative techniques. Empirical data were collected through 635 computer-assisted telephone interviews (CATI) conducted among two groups of entrepreneurs: (a) SMEs with the potential to create green jobs and (b) green-sector SMEs. Additionally, 10 in-depth interviews (IDI) with non-randomly selected SME owners provided a qualitative understanding of motivations, barriers, and enabling factors.

Findings: The study reveals that SMEs perceive sustainability as both a challenge and an opportunity for business growth and competitiveness. Entrepreneurs acknowledge the key role of the JTF in enabling technological modernization, automation, and energy efficiency improvements. The analysis identifies clear differences between SMEs with potential for green job creation and those already operating in the green sector, reflecting varying levels of readiness and motivation to engage in the green transition.

Research limitations: The study focuses on a single region, which may limit generalizability. Future research could extend the analysis to other regions undergoing similar transformations or investigate sector-specific dynamics in greater depth.

Practical implications: The results highlight the need for tailored financial and informational incentives to encourage SMEs to integrate sustainability into their business models.

Social implications: Supporting SME participation in the green economy contributes to regional resilience, employment creation, and public awareness of sustainable development pathways.

Originality: This study fills a research gap by providing empirical evidence on the role of SMEs in implementing the green economy in a post-industrial region. It demonstrates the significance of the JTF as a catalyst for sustainable modernization and offers valuable insights for policymakers and practitioners promoting the green transition in similar contexts.

Keywords: green economy, SME, economic transformation, green management, ESG.

Category of the paper: Research paper.

1. Introduction

The first decade of the 21st century changed the outlook on the functioning of the global economy. The financial crisis that began in the US exposed the unreliability of the principles of liberal economic doctrine (Stiglitz, 2010). The response to the crisis became a conviction about the need to strengthen international cooperation in the search for global solutions to growing economic and social problems (Goswami, 2018). The social cost of the crisis has been the loss of public trust in banks, financial institutions, corporations, and public institutions and governments that have tolerated irregularities and risks in the economic system for years. The crisis has made societies and governments realise that a return to previous economic models is impossible and that it is necessary to search for new solutions (Antetomaso et al., 2018) for sustainable development.

The gradual evolution of the concept of sustainable development has brought the idea of the green economy into the EU mainstream. The search for an efficient economic model became the basis for the formulation of the next global and regional green strategies (European Commission The European Green Deal, 2019) and the creation of mechanisms to strengthen corporate responsibility for sustainable development (CSRD, 2022; CSDD, 2024).

The rejection of the traditional economic model based on fossil fuels and the adoption of a green economy model requires a fundamental change in the relationship between the economy and ecosystems. The emphasis on sustainability and environmental protection challenges entrepreneurs to integrate green solutions into their business models (United Nations Environment Programme, 2011).

The provision of non-refundable grants or soft loans to businesses that choose to implement the principles of the green economy will be key to their adoption. It is particularly important to lay the foundations for the development of micro, small and medium-sized enterprises. These entities play an important role in the economy, both in terms of employment and contribution to Gross Domestic Product (GDP).

Small and medium-sized enterprises play a key role in the economy. They are the dominant form of economic activity, accounting for between 95% and over 99% of all active enterprises, depending on the country (PARP Raport, 2023). SMEs are seen as an important source of economic growth, and their economic activity contributes to strengthening the competitiveness of regions. SMEs are known for their high level of product and process innovation. SME innovation manifests itself both in the creation of new solutions that can be captured by larger firms and in the adaptation of proven solutions to their own needs (Love et al., 2015), (Wellalage, Fernandez, 2019). As confirmed by research, this type of innovation fits with the thesis of the key role of SMEs in the adoption of the green economy (Del Brío, Junquera, 2003; Blundel et al., 2013; Higgs, Hill, 2018).

The green economy model is conducive to job creation (Kucęba, Ulewicz, 2016). Analysis of statistical data (GUS, 2023) shows that SMEs are more flexible and adapt faster to changing environments, creating more jobs than large enterprises (Voulgaris et al., 2004).

SMEs are a very diverse group of enterprises. There is no definition in the literature that clearly specifies the criteria for a business entity to belong to the group of micro, small and medium-sized enterprises (Magdziarczyk, Widera, 2024). Most often, quantitative and qualitative criteria are specified, considering differences in macroeconomic and socio-economic conditions, as well as the specificity of the industry in which these economic entities operate (Magdziarczyk, 2023; Wach, 2014). To implement a common economic policy within the EU Member States and the European Economic Area, in 2003 the European Commission adopted a uniform system for classifying companies operating in the European Union (European Commission, 2003). In Polish law, the concept of micro, small and medium-sized enterprises has been defined in accordance with the European Union guidelines in Article 7 of the Law on Entrepreneurs (Parliament of Poland, 2024). Three quantitative classification criteria have been adopted to distinguish SMEs: average annual employment in full-time equivalents (employees: micro 1-9, small 10-49, medium 50-249), net turnover from sales of goods, products, services and financial operations (turnover in euro: up to 2 million euro, up to 10 million euro, over 10 million to 20 million) and total assets in the balance sheet at the end of the financial year (assets in euro: up to 2 million euro, up to 10 million euro, over 10 million to 20 million).

In the economic structure of the EU, Poland or the Silesian Region, SMEs are numerically dominant and employ more than two thirds of the workforce (see: Table 1). The economic condition of SMEs is crucial for the proper functioning of the economy.

Table 1.*Type of enterprises and their number, structure and employees*

Number and structure of enterprises by type						
Type of company	EU		Poland		Silesian Region	
	abs. numbers	%	abs. numbers	%	abs. numbers	%
Micro	21 851 492	93,5	1 963 893	95,0	515 471	96,2
Small	1 287 959	5,5	84 353	4,1	16 414	3,1
Medium	201 000	0,9	14 712	0,7	3 323	0,6
Large	42 000	0,2	3 251	0,2	531	0,1
Total	23 382 451	100	2 066 209	100	535 739	100
Number and structure of employees in enterprises by type						
Type of company	EU		Poland		Silesian Region	
	abs. numbers	%	abs. numbers	abs. numbers	%	abs. numbers
Micro	37 204 470	29,2	3 477 828	34,8	421 360	24,9
Small	24 743 146	19,4	1 664 747	16,7	297 124	17,5
Medium	20 088 003	15,7	1 519 964	15,2	342 318	20,2
Large	45 584 293	35,7	3 334 374	33,3	634 738	37,4
Total	127 619 912	100	9 996 913	100	1 695 540	100

Source: GUS (2024). Bank Danych Lokalnych, <https://bdl.stat.gov.pl>

The ability of companies to respond to changes in their environment is crucial to their growth. Although green economy practices are most developed in large companies, which will be required to report on their activities according to Environmental, Social, Governance (ESG) standards from 2024 (CSRD, 2022; CSDD, 2024), the active involvement of SMEs in the green economy process, facilitated inter alia by the support instruments (Just Transformation Funds – JTF) provided by the European Green Deal (European Commission The European Green Deal, 2019), is most important for the uptake of green economy principles. The JTF established on the basis of Article 175 of the Treaty on the Functioning of the European Union and a Regulation of the European Parliament and of the Council of the EU (European Parliament and Council of the European Union, 2021), aims to support regions and sectors affected by the transition, in particular those dependent on fossil fuels and with high greenhouse gas emissions.

For the period 2021–2027, the JTF has a budget of €17.5 billion, of which Poland received €3.85 billion, the largest amounts are dedicated for the regions of Lower Silesia, Silesia (the main JTF beneficiary in Poland – EUR 2.22 billion), Małopolska, Łódź, Wielkopolska and Lublin Regions. Adopting a green development model is particularly important in regions undergoing profound economic change. An example of such a region in Poland is the Silesian Region, which for many years was dominated by the mining, steel and energy industries. The economic transformation currently taking place there is being supported by several financial instruments, including those aimed at SMEs.

The aim of this paper is to gain an understanding of how entrepreneurs from the SME sector assess the prospects for the development of the green economy in the Silesian Region. To achieve this goal, the following research questions were formulated:

RQ1: What is the predilection to implement the Green Economy according to the size of the SME?

RQ2: Does the current financial situation of the SME influence the decision to implement and/or continue to implement the Green Economy in the business model?

RQ3: Will the estimated financial health of the SME in 2027 influences the decision to implement or continue to implement the Green Economy in the business model?

Finding answers to the given research questions required the analysis of statistical data and key publications connected to the definition of SMEs. The crucial is also to emphasis their role in the economy, as well as the characteristics of financial support instruments available in the Silesian Region and their results.

The article is divided into the following five sections: (1) Introduction, presenting the context and importance of green growth; definition of SMEs and sources of financial support in the Silesian Region; (2) Materials and Methods, describing the research methods used; (3) Results presenting; (4) Discussion the main findings of the study and their implications and (5) Conclusions and recommendations, summarizing the results and formulating recommendations.

The article is of a practical nature, diagnosing selected phenomena of the labour market in the Silesian Region.

2. Materials and Methods

The study employed a mixed methods approach (Creswell, 2008), drawing on data from two key investigations. The first, *The Labour Market in the Field of Green Economy in the Silesian Region* (2024), was conducted by the BST Group for the Voivodeship Labour Office in Katowice. The second was carried out within the framework of the *Sustainable Alliance Manager: Learning Experience towards Collaborative Skills with Green Consciousness* project (023–1–ES01–KA220–HED–000157968; SAMExperience), involving partners from Mondragon Unibertsitatea (Spain), West University of Timisoara (Romania), Lithuania Business College (Lithuania), Universita di Foggia (Italy), University of Katowice (Poland), and Resolvo Responsible Solution (Italy). These investigations provided the foundation for the analysis presented in this article.

The first study (see: Table 2), was carried out from August to December 2023. The sample was selected on a stratified quota basis. A total of 635 computer-assisted telephone interviews (CATI) were conducted.

Table 2.*Number and structure of respondents*

Number of employees	Entrepreneurs with the potential to create green jobs	Entrepreneurs in the green sector
Micro (1-9)	121	100
Small (10-49)	125	115
Medium (50 and over)	88	86
Total	334	301

Source: *The Labour Market in the Field of Green Economy in the Silesian Voivodeship* (2024).

The results of the survey had a confidence level of 95% and a maximum margin of error of 4%. The respondents were selected from two groups of entrepreneurs: (a) SME entrepreneurs with the potential to create green jobs and (b) SME green sector entrepreneurs. The research was conducted using a questionnaire consisting of 20 closed questions for entrepreneurs with the potential to create green jobs and 18 closed questions for SME green sector entrepreneurs. The questionnaire included questions on the number of employees, the type of business and the geographical region of the business. The number of employees was used for subsequent statistical analyses to identify differences in the views of the two groups of respondents.

In the first group of SMEs with the potential to create green jobs, 334 computer-assisted telephone interviews were conducted. The final qualification of an enterprise with the potential to create green jobs for the study was a consequence of the respondent's confirmation of carrying out activities or introducing solutions contributing to the improvement of the environment in at least two categories distinguished based on the provisions of the *Regional Innovation Strategy of the Silesian Region* (RISSW 2030).

In the second group of respondents: SME green sector entrepreneurs with jobs already classified as green, 301 computer-assisted telephone interviews were conducted.

Eligible companies in this group had to demonstrate that they are active in the green economy areas and/or use green economy related technologies identified in the RISSW (2021). The next study resulted from the tasks of the project Sustainable Alliance Manager: Learning Experience towards Collaborative Skills with Green Consciousness 2023–2026, which aims to develop knowledge on green consciousness and green competences among SME entrepreneurs. The analysis is based on the results of in-depth interviews (IDIs) conducted with SME entrepreneurs who have formed strategic alliances with partners operating in green sectors or using green sector-related technologies. The IDIs aimed to deepen the knowledge of the phenomena identified in a study commissioned by the Voivodship Labour Office in Katowice. Interviews were conducted between May and July 2024 with 10 non-randomly selected SME entrepreneurs from the green sector (Szreder (2004)). To conduct the in-depth interviews, 12 pre-prepared dispositions written in the interview questionnaire were used. The interviews were recorded and transcribed. In this article, expert statements have been marked as SAMExperience.

The research sought to identify the factors that determine the interest of the entrepreneurs surveyed in green solutions. In addition, it was decided to find out how companies with the potential to create green jobs differ in this respect from SME green sector entrepreneurs. For this reason, the survey, which consisted of three steps, was carried out separately in these two groups of companies.

Step 1. Chi-square test (Cramer, 1946) was used to identify factors that may significantly influence the interest of companies in implementing pro-environmental measures. It is a tool to examine the relationship between two qualitative variables.

Step 2. For those factors that were found to significantly influence interest in pro-environmental solutions, an additional correspondence analysis was conducted (Greenacre, 2021). This is an exploratory technique for examining contingency tables, the aim of which is to produce a suitable graph, known as a correspondence map, showing the relationships between the categories of variables under study. These relationships are inferred from the arrangement of the points representing these categories on the map. The closer the points analysed are to each other, the more the categories corresponding to them are related to each other.

Step 3. As already mentioned, the survey was carried out separately in the group of companies with the potential to create green jobs and separately among SME green sector entrepreneurs. Thus, in the final stage, the results obtained were compared and relevant conclusions were drawn, which were also confronted with the opinions of the experts participating in the in-depth interviews.

It should be emphasised that the aim of the study was achieved using appropriate data analysis methods. The choice of these methods was guided, among other things, by the scale of measurement of the variables, which very often determines the choice of appropriate statistical tools. This was also the case here the identification of relationships between the nominal variables studied and their categories was possible thanks to the chi-square test and correspondence analysis.

Given the applied nature of the article and the wide availability of relevant literature on the subject, a detailed description of the methods used has been omitted, as it is not necessary to explain the results of the study.

3. Results

In line with the stated aim of the research and the description of the analysis, the first step was to find out which characteristics of the SMEs surveyed had a significant impact on their interest in adopting green solutions. The results of the chi-square tests carried out are presented in Table 3.

Table 2.

Results of the chi-square tests carried out based on Respondents' Opinions on Companies' Interest in Implementing Environmentally Friendly Measures in the Silesian Voivodeship

	Green sector		Companies with green potential	
	χ^2	p-value	χ^2	p-value
Company size	13,313	0,038	14,468	0,025
Current financial and economic condition of the company	6,945	0,643	25,523	0,002
Future financial and economic health of the company	16,990	0,049	21,234	0,012

Source: authors' own work.

It is well known that if the calculated p-value is less than the accepted level of significance, we treat the verified relationship as statistically significant. In this case, this means that:

- The interest of companies in the green sector in introducing pro-environmental solutions depends significantly on: the size of these companies, their belief in their future financial condition and future employment situation, and their views on the future of the green economy in Silesia.
- In turn, among companies with the potential to create green jobs, interest in green measures is influenced by the size of these companies, their current financial situation, but also an assessment of their future financial condition and future employment situation, as well as views on the future of the green economy in Silesia.

In the next stage, the survey was extended by performing a correspondence analysis. As already mentioned, it made it possible to check which categories of factors, significantly influencing interest in pro-environmental activities, are most frequently associated with respondents' answers concerning this interest. As before, SME green sector entrepreneurs and companies with green potential were analysed separately, in each case interpreting and comparing the results of the analyses presented in the correspondence maps.

3.1. Size of SMEs and propensity to implement environmental solutions

Small (37.4%) and micro enterprises (36.2%) accounted for the largest number of respondents with the potential to create green jobs. Among the pro-environmental activities undertaken, respondents reported waste separation (95.9%) and recycling or use of recycled materials (28.1%). A slightly smaller group of respondents reduce energy consumption by purchasing energy efficient equipment (22.5%), upgrading buildings (19.2%) and using renewable energy sources (18.3%). Small (38.2%) and micro-enterprises (33.2%) were also the most common types of green sector respondents. The main areas of activity reported by respondents were waste collection and separation (75.2%), technologies for ecological, safe and efficient waste treatment and management (45.5%) and waste management and recycling (30.9%).

The analysis of the relationship between the size of the SME and the adoption of environmentally friendly solutions showed a relationship for both enterprises with the potential to create green jobs and those already active in the green sector. As shown in Figure 1, medium-sized enterprises with the potential to create green jobs are most likely to report that they are not interested in adopting green solutions, while medium-sized enterprises in the green sector are most likely to report that they are interested in adopting such solutions. Small enterprises with the potential to create green jobs and small enterprises in the green sector very often indicate a moderate interest in adopting innovative solutions.

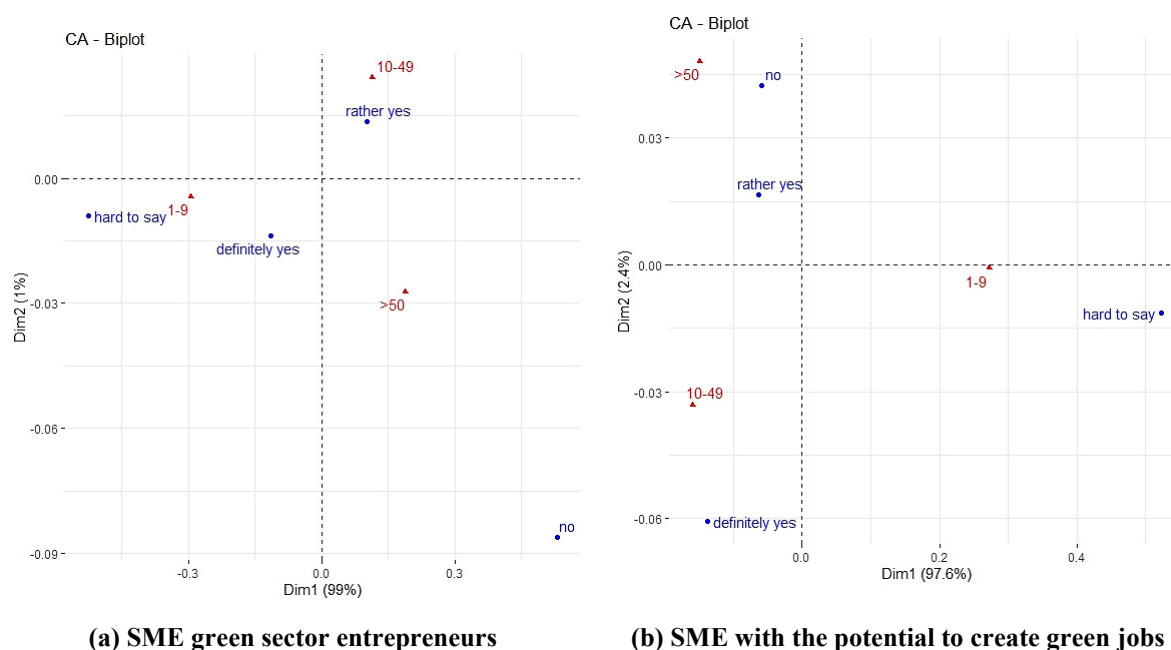


Figure 1. Relationship between interest in green solutions and company size among companies in (a) SME green sector entrepreneurs and (b) SME with the potential to create green jobs.

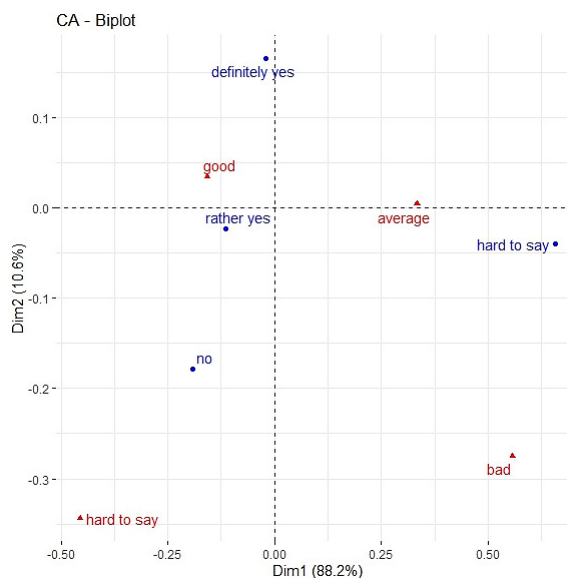
Source: own elaboration in R.

The flexibility of SMEs determines how quickly they engage in future-oriented industries, key to the green economy. An expert from SAMExperience stated that “Silesia’s transformation depends on entrepreneurs’ attitudes toward innovation and the availability of aid funds, with SME absorption being crucial”. Another SAMExperience expert highlighted “that education and financial and regulatory incentives influence interest in green products and services among entrepreneurs and the public”. Medium-sized enterprises show discrepancies in survey results due to their industry, as those in traditional sectors are less inclined to take risks. Companies with the potential to create green jobs locate their activities in more traditional sectors of the economy and hence have a lower propensity to take risks. However, according to SAMExperience expert: “in Silesia, industrial traditions, along with developed technical and social infrastructure, support the green economy’s growth”. This view is confirmed by studies on municipal institutional development (Frączkiewicz-Wronka et al., 2020).

3.2. Current financial condition of SMEs and propensity to implement green solutions

The financial condition of an enterprise is a key factor influencing the undertaking of activities related to a change of sector or type of activity, including the implementation of green solutions. Of the respondents with the potential to create green jobs, the majority (62.0%) consider their financial situation to be good and one in three (30.8%) consider it to be average. Only a small proportion of respondents (2.7%) gave a negative assessment. Enterprises with a higher number of employees are more likely to be in a better financial situation: 75.0% of small and medium-sized enterprises assess their situation positively, compared with 48.8% of micro enterprises. A similar trend can be observed among SME green sector entrepreneurs, where 66.4% rate their financial situation as good and 25.6% as average. Enterprises with a higher number of employees are more likely to have better ratings, with 81.4% of small and medium-sized enterprises rating their situation positively, compared with 52.0% of micro enterprises. Negative assessments are rare, but more common among micro enterprises (8.0%) than among enterprises with higher number of employees (0.9%).

When asked how the current financial situation of enterprises with the potential to create green jobs affects their willingness to implement the green economy, SMEs in good condition indicate that they are interested in such solutions, while enterprises in average condition very often do not formulate a clear answer about green solutions. Companies that are unable to assess their current financial situation are the most likely to report a lack of interest in environmental issues (Figure 2). There is no statistically significant relationship between SME green sector entrepreneurs, so there is no basis for a correspondence analysis and to create a correspondence map.



(b) SME with the potential to create green jobs

Figure 2. Relationship between interest in green solutions and current financial situation of the company among (b) SME with the potential to create green jobs.

Source: own elaboration in R.

The financial condition, the number and competence of the workforce and the vision of strategic development directions formulated by entrepreneurs determine the survival and growth of their companies. No less important are the developmental conditions occurring in the company's environment. Importance should be attributed to the ability of public labour market actors to create an ecosystem of labour market services (Kozak, 2023). Effective ecosystems of labour market services support the activity of entrepreneurs and foster the creation of the value they desire, which is the possibility of obtaining support for innovation from European funds. A product or service produced in a way that does not burden the environment is also a desirable public value that translates into the quality of life of society (Osborne, 2020). The introduction of SDGs including especially the funding of initiatives related to the implementation of the green economy by SMEs contributes to the financial condition of companies. Respondents from both SME groups surveyed perceive the inflow of funds under the Polish National Recovery Plan (NRP) as an opportunity to achieve a better position in the competitive market. An expert from SAMExperience said that "the increase in consumer awareness will force companies to implement green solutions, which in turn will influence the demand for increased specialists in the area of sustainability and ecology".

3.3. Future financial condition of SMEs and propensity to implement green solutions

The entrepreneurs surveyed with the potential to create green jobs are most likely to believe that the financial situation of their enterprise will remain unchanged (40.1%) or improve (35.9%) in the perspective of 2027. One in five respondents was unable to assess the possible change in their company's situation in such a perspective (19.2%). Only 4.8% of employers expected the situation to get worse. An analysis of the responses to the question according to the size of the SME shows that medium-sized enterprises are more likely than other respondents to expect an improvement (43.2% against 28.1% for micro enterprises). On the other hand, micro enterprises were more likely to report no change in their financial situation in 2027 (47.1% compared with 31.8% of medium-sized enterprises), and they were more likely to perceive their current financial situation as average.

SME green sector entrepreneurs were the most likely to expect their financial situation to improve (39.5%) or remain unchanged (35.2%) by 2027. Few entrepreneurs expect their business to get worse in the coming years (3.7%). The larger the enterprise, the higher the percentage of employers who believe that the financial and economic situation will improve by 2027 (47.7% for medium-sized enterprises compared with 31.0% for micro enterprises). On the other hand, the distribution of answers among those who believe that their company's situation will not change is even and similar to the general distribution.

For enterprises with the potential to create green jobs, the assessment of future financial condition has a significant influence on the declaration of interest in green solutions. However, the declarations of the different groups of companies are slightly different for companies with potential than for SME green sector entrepreneurs. Figure 3 shows that companies that believe

their financial situation will improve are the most likely to express an interest in green measures (“rather yes” and “definitely yes”). However, the answer “definitely yes” to interest in green solutions was also frequently chosen by companies that did not expect their financial situation to change. In addition, the answer “rather yes” was often chosen by companies that had difficulties in assessing their situation. Companies that say their situation will get worse do not expect to implement environmental solutions.

When asked about the potential impact of a company’s financial condition in 2027 on the decision to implement the green economy, respondents SME green sector entrepreneurs who expected their financial condition to improve were the most likely to indicate an interest in green measures. Companies that expect their situation to remain the same are more likely to be moderately interested in these measures. Companies that say their situation will get worse or have no opinion about their future green activities will not be acting in a pro-ecological way.

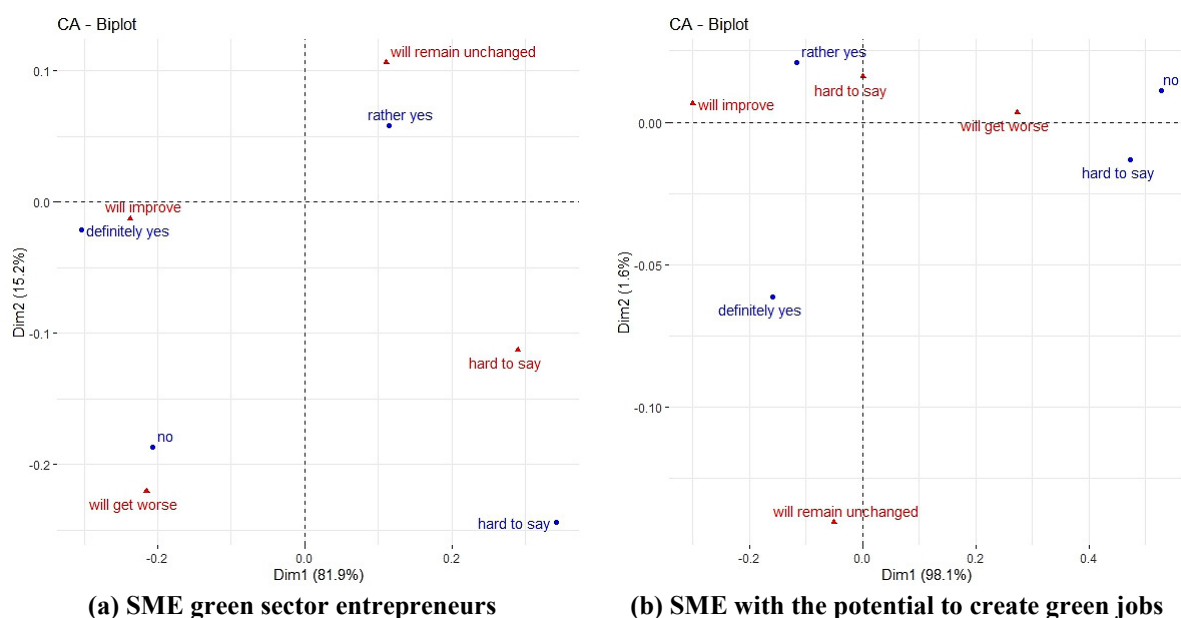


Figure 3. Relationship between interest in green solutions and the future financial condition in (a) SME green sector entrepreneurs and (b) SME with the potential to create green jobs.

Source: own elaboration in R.

As a consequence of the activities of the public labour market actors, the level of use of subsidies for taking pro-environmental measures by entrepreneurs in the Silesian Region is very high. However, the results of the conducted survey indicate moderate support for the implementation of green solutions if they do not generate a better financial condition of the company. Respondents from companies in the green sector believe that they will take pro-environmental measures even if their condition does not change. The SAMExperience pointed out that, in his opinion, the mere fact of benefiting from a subsidy for the pro-environmental development of a company is a significant gain. It may not bring an immediate improvement in the SME’s financial condition, but it will not be insignificant in the long run of the business for achieving a better position in the competitive market. The possibility to support the business with external funds is important. It is important to

convince respondents that the introduction of pro-environmental solutions will also bring them financial benefits in the future, as they see in ecology the possibility of gaining a competitive advantage by following trends.

4. Discussion

The implementation of sustainable development principles, including ESG (Environmental, Social, Governance) strategies, is becoming increasingly important for small and medium-sized enterprises (SMEs) in the Silesian region. Analysing scientific literature and available reports allows for a better understanding of the factors influencing the implementation of these strategies, as well as the benefits and challenges associated with their adoption.

Research indicates a positive correlation between the implementation of ESG strategies and the financial performance of enterprises. For example, companies engaging in pro-environmental and social activities often enjoy greater customer trust, which translates into increased sales and consumer loyalty (Garrido-Ruso et al., 2024). Additionally, investors are increasingly considering ESG practices when making investment decisions, which can facilitate SMEs' access to capital (Whelan et al., 2021). Momtaz and Parra (2024) demonstrated that ESG disclosure by SMEs can lead to improved financial performance, as it enhances investor trust and attracts financial institutions' interest.

A meta-analysis conducted by Friede, Busch, and Bassen (2015), as well as Whelan, Atz, Van Holt, and Clark (2021), found that in most cases, there is a positive relationship between ESG practices and financial performance. Similar conclusions were presented by Hamdi, Guenich, and Ben Saada (2022), showing that better financial performance can also contribute to improved ESG outcomes. However, research by Earnhart and Lizal (2006) suggests that the effectiveness of these strategies may depend on ownership structure and access to capital. Thus, implementing ESG strategies also comes with challenges. Smaller enterprises may encounter difficulties due to limited financial and human resources, which can hinder the effective adoption of comprehensive sustainability strategies (Gholami, Murray, Sands, 2022; Fatemi et al., 2018). Similarly, De Haas et al. (2021) highlight that financial and managerial barriers are key obstacles to the transition of SMEs towards a low-carbon economy. Additionally, a lack of awareness about the benefits of ESG may lead to resistance to change (Akhtar, Senadjki, Kumaran, 2023; Khan et al., 2016). Nicoara and Kadile (2023) emphasize that for SMEs in the United Kingdom, the key factors determining engagement in ESG include stakeholder pressures and opportunities to enhance reputation and client relationships.

An extensive body of literature suggests that the relationship between ESG (Environmental, Social, and Governance) performance and a company's financial results is complex and not always positive. While some studies highlight a beneficial correlation, others suggest no link

or even a negative impact. For instance, research conducted by Wasiuzzaman et al. (2022) indicates that ESG disclosure may, under certain conditions, negatively affect a firm's financial standing. Similar conclusions were drawn by Fahad and Busru (2021), who examined data from 386 companies listed on the Indian BSE 500 index between 2007 and 2016, noting that ESG initiatives sometimes impose financial burdens that outweigh their benefits in the short term.

The moderating role of firm size in the ESG-financial performance relationship has also been widely discussed. Studies by Ahmad et al. (2021) and Shakil (2021) emphasize that larger firms tend to benefit more from ESG engagement due to their resource availability and ability to integrate sustainability into long-term strategic planning. Conversely, smaller firms, constrained by limited financial resources, may struggle to realize immediate financial benefits from ESG adoption. However, Bahadori et al. (2021) argue that when controlling for firm size and debt levels, companies with stronger ESG performance tend to achieve higher profitability, suggesting that ESG initiatives may contribute to financial success under specific conditions.

Beyond firm size, other factors influencing the ESG-financial performance nexus have been explored. Studies by Van Linh et al. (2022), Chouaibi et al. (2022), and Sinha Ray & Goel (2022) examine ESG's impact on firms' market value, concluding that while ESG investments may enhance reputation and stakeholder trust, their financial implications depend on industry characteristics and regulatory environments. Despite these insights, the reverse causality—how financial performance influences ESG commitments—remains underexplored. Hamdi, Guenich, and Ben Saada (2022) highlight this gap, noting that few studies explicitly analyze whether firms with strong financial performance are more likely to enhance their ESG activities. Their research on 504 U.S. companies (2000–2020) supports stakeholder theory, demonstrating that firms with robust financial results tend to allocate greater resources to sustainability initiatives.

The bidirectional nature of the ESG-financial performance relationship cannot be overlooked. While financial strength influences a company's ability to invest in ESG initiatives, ESG engagement can simultaneously enhance financial results by improving corporate reputation, increasing risk resilience, and optimizing operational efficiencies (Ahmad et al., 2021; Shakil, 2021). However, financial constraints, particularly among SMEs, present significant barriers to ESG investment. Research by Cuerva, Triguero-Cano, and Córcoles (2014) indicates that SMEs, often characterized by their risk-averse nature, hesitate to adopt new technologies due to concerns about prolonged return-on-investment periods. Similarly, findings from Fleiter, Schleich, and Ravivanpong (2013) suggest that high initial costs deter SMEs from implementing energy-efficient solutions, despite the long-term financial benefits. Thus, while ESG integration can yield advantages, financial limitations may hinder smaller enterprises from fully capitalizing on its potential.

Overall, while ESG practices can enhance corporate value in the long run, their financial implications vary depending on firm size, industry sector, and resource availability. Further research is necessary to explore the dynamic and bidirectional nature of this relationship, particularly within different economic contexts and regulatory frameworks.

This study contributes to filling the research gap by examining the relationship between financial standing and the willingness of SMEs to invest in green economy solutions. While much of the existing literature focuses on large corporations, fewer studies address the financial determinants of sustainability-driven investments among SMEs. This research specifically investigates how the size of an SME influences its inclination to adopt environmentally friendly business practices. The findings provide insights into the challenges that smaller enterprises face when integrating sustainability into their business models and highlight the role of financial stability in shaping investment decisions related to the green economy.

Human resources also play a key role in the process of implementing sustainable development. Employees with the right skills and environmental awareness can initiate and execute pro-environmental projects, contributing to the achievement of sustainability goals (Martínez-Conesa, Soto-Acosta, Palacios-Manzano, 2017). SMEs, despite being aware of the potential benefits of improved environmental management, face significant resource constraints, skill shortages, and a lack of knowledge in this area (OECD, 2018). Even when enterprises recognize the potential for improving competitiveness through pro-environmental initiatives, a lack of competencies and specialized knowledge often prevents their implementation (Nicoara, Kadile, 2023). Therefore, training and skill development in ESG are essential for the effective implementation of these strategies, particularly in the context of managerial barriers and limited access to experts (De Haas et al., 2021).

However, in practice, many SMEs encounter barriers such as limited resources for training and a lack of access to sustainability experts. Therefore, support from public institutions and industry organizations in terms of education and advisory services for SMEs is crucial (Bassi, Guidolin, 2021).

Access to financing is one of the key factors determining the ability of SMEs to implement sustainable development strategies. Financial institutions are increasingly considering ESG performance when assessing the creditworthiness of enterprises, offering better financing conditions to companies that meet specific standards. In Poland, support programs such as the "Circular Economy in SMEs" initiative, offered by the Polish Agency for Enterprise Development (PARP), aim to assist companies in transitioning towards a sustainable business model. However, despite the availability of such programs, many SMEs do not fully utilize them, often due to a lack of information or complicated application procedures (OECD, 2021). Additionally, De Haas et al. (2021) indicate that limited access to financing and regulatory uncertainty are significant obstacles to accelerating the ESG transition in the SME sector.

An essential challenge hindering the ecological transformation of SMEs is the difficulty in accessing financial resources. McDaniels and Robins (2017) emphasize that financial constraints remain a fundamental barrier, identifying several critical factors limiting capital availability. These include insufficient data on the specific financial needs of SMEs, asymmetry in information between enterprises and financial institutions, a lack of customized financial products suited to different business growth stages, bureaucratic and institutional restrictions, as well as a general lack of knowledge and expertise among SMEs regarding the effective use of available funding instruments.

Furthermore, a study by the European Commission (2018) underscores the extent of these financial limitations, revealing that over a quarter (27%) of SMEs across the EU regard inadequate financial resources as a significant challenge to implementing sustainability initiatives—an issue that is less pronounced among larger firms, where only 21% express similar concerns. Additionally, a shortage of specialized skills required for green transition poses another obstacle, with 15% of SMEs citing a lack of expertise as a limiting factor, compared to 13% of larger enterprises. These findings highlight the disparities between different business sizes in terms of their ability to secure funding and acquire the necessary competencies to transition towards environmentally sustainable models.

The combination of financial constraints and skill deficiencies suggests that SMEs face greater hurdles than larger corporations in adapting their business models to meet sustainability goals. Addressing these challenges requires targeted policy measures, improved financial instruments tailored to SMEs, and enhanced educational programs aimed at equipping smaller businesses with the knowledge and skills necessary to leverage green financing opportunities effectively.

In the Silesian region, there is a moderate utilization of available funds, which may be due to bureaucratic barriers and low awareness of financial support opportunities. Additionally, the lack of adequately qualified personnel and difficulties in accessing ESG experts and advisors represent significant obstacles to the development of sustainable practices in SMEs.

An analysis of research findings also shows that small and micro-enterprises are less likely to invest in green technologies compared to medium-sized firms, a trend confirmed by the existing literature. This is primarily due to limited access to capital and the smaller scale of their operations. In contrast, medium-sized firms are more inclined to invest in eco-innovations, which may be attributed to better access to EU funding and greater market pressure to integrate ESG principles.

Moreover, companies aligned with ESG standards gain access to more attractive financial instruments, such as green loans or transition bonds, which positively impact their financial performance. Research by Drempetic, Klein, and Zwergel (2020) found that large firms achieve higher ESG scores than smaller entities, likely due to their ability to invest in ESG reporting and sustainability strategies. Small firms, on the other hand, may encounter barriers related to limited financial and human resources (Drempetic, Klein, Zwergel, 2020).

In this context, implementing strategies that support SMEs in adopting ESG, such as certifications and tax incentives, is crucial. OECD (2021) suggests that improving access to financing and simplifying reporting procedures could facilitate the implementation of ESG strategies by smaller firms.

ESG certification and reporting are becoming increasingly important for SMEs, especially in the context of collaboration with larger entities and financial institutions. Transparency in ESG activities can enhance customer and business partner trust while also opening access to new markets and funding sources (Garrido-Ruso et al., 2024). Additionally, Kusuma, Muafi, and Kholid (2023) emphasize that the use of innovative IT solutions can improve the efficiency of ESG processes in SMEs, particularly in the context of ESG reporting and data analysis.

Despite the benefits of implementing ESG strategies, the SME sector still faces significant challenges related to access to financing, organizational barriers, and a lack of competencies and specialized knowledge. To support the ecological transformation of SMEs, coordinated actions from governments, financial institutions, and organizations supporting SME development are essential. These efforts should include simplifying financing procedures, promoting training programs, and developing an ecosystem that supports ecological innovation.

Research findings confirm that the implementation of a green economy in the SME sector in Silesia largely depends on access to financing, employee competency levels, and company size. Another favorable factor is the increasing regulatory and societal pressure to adopt ESG strategies. To accelerate this transformation, it is crucial to simplify financing procedures and provide educational support for entrepreneurs regarding the implementation of environmental solutions. Additionally, increasing the availability of ESG experts and advisors is essential to enable companies to effectively implement sustainable development strategies.

5. Conclusions and recommendations

Poland's accession to the EU has opened the possibility of benefiting from a wide range of financial assistance, which has contributed to the dynamic socio-economic development of the country. The success of the decisions taken to stimulate entrepreneurship with the help of aid funds is particularly evident in the Silesian Region, which has gone from being a region in economic decline to being one of the regions with the highest potential and GDP dynamics in Poland.

The results of the research conducted confirmed the propensity of entrepreneurs, regardless of the size of the SME, to implement the principles of the green economy in their business models (RQ1). The transformation of the economy in the Silesian Region resulting from the transition away from coal is profound and affects many sectors. Experts emphasise that its effectiveness depends on the attitude of entrepreneurs and the effectiveness of support

instruments. SMEs show interest in green solutions, which can accelerate the development of the green economy in the region, the raising of environmental awareness and the development of technical and social infrastructure. The financial condition of enterprises plays a key role in their willingness to implement green solutions (RQ2). More than 60% of employers with the potential to create green jobs rate their financial situation as good, which increases their willingness to invest in green solutions. Companies with average financial condition are less decisive on this issue, and those who cannot assess their situation are often not interested in environmental issues. The decision to change the business model is also influenced by the estimated changes in the future financial condition of the SME (RQ3). Entrepreneurs with the potential to create jobs are generally optimistic about the future financial condition of their enterprise in 2027, predicting stability (40.1%) or improvement (35.9%). Medium-sized enterprises are more likely to expect improvement than micro enterprises. Similar trends can be seen among companies in the green sector, with medium sized companies more confident in the future improvement of their financial condition.

Enterprises that expect their financial situation to improve are the most likely to express an interest in green measures, while those that expect their financial situation to worsen are less likely to do so.

According to respondents from both groups, the development of the green economy will be promoted above all by simple and clear procedures for accessing public funding for environmentally friendly economic activities and by increasing public knowledge and awareness of ecology.

Preferential prices for green technologies and solutions will also be important. Factors hindering the development of the green economy were identified as high prices for environmentally friendly technologies and solutions, complicated procedures for public funding of pro ecological economic activities, legal regulations hindering green economy activities, and low levels of public knowledge and awareness of ecology.

Based on the results of the study, the following conclusions were drawn:

- For an effective green transformation in the region, it will be crucial to implement various incentives for entrepreneurs, especially in the SME sector, to encourage them to adopt green solutions. The JTF is an important source of support for SMEs in the Silesian Region, enabling companies to modernise technology, automate production and improve energy efficiency.
- Investments made under the JTF are expected to contribute to increasing the competitiveness of the regional economy and improving the quality of life of the population by creating new jobs and developing innovative solutions.
- Despite significant financial support, it will also be crucial to change the attitude of entrepreneurs towards the green transition, including in the SME sector, which will have a significant impact on the success and effectiveness of the implementation of the green economy.

Observation of market phenomena allows us to conclude that the green economy is becoming a factor of structural change in the economy and social life. The process of development of the green economy is accompanied by significant changes in the structure of production, changes in the share of individual sectors of the economy in the creation of GDP, changes in the structure of employment, new directions of investment and the role of specialisation of the economy of the regional, national and international aspect (Markandya et al., 2016).

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References

1. Ahmad, N., Mobarek, A., Roni, N. (2021). Revisiting the impact of ESG on financial performance of FTSE350 UK firms: Static and dynamic panel data analysis. *Cogent Business & Management*, Vol. 8, Iss. 1, <https://doi.org/10.1080/23311975.2021.1900500>
2. Akhtar, F., Senadjki, A., Kumaran, V. (2023). Unearthing the nexus between ESG and financial performance: Does company size and age matter? Proceedings of the 11th International Conference on Business, Accounting, Finance and Economics (BAFE 2023). *Advances in Economics, Business and Management Research*, Vol. 272, pp. 543-560. https://doi.org/10.2991/978-94-6463-342-9_30
3. Antetomaso, A., Brunello, R., Roubini, N. (2018). *Ten years after the global financial crisis: Causes, outcomes, lessons learnt. SRC Special Paper, No. 15, Special Paper Series The London School of Economics and Political Science, Systemic Risk Centre*, ISSN 2055-0375.
4. Bahadori, N., Kaymak, T., Seraj, M. (2021). Environmental, social, and governance factors in emerging markets: The impact on firm performance. *Business Strategy & Development*, Vol. 4, Iss.4, pp. 411-422. <https://doi.org/10.1002/bsd2.167>
5. Bassi, F., Guidolin, M. (2021). Resource Efficiency and Circular Economy in European SMEs: Investigating the Role of Green Jobs and Skills. *Sustainability*, Vol. 13, Iss. 21, p. 12136. <https://doi.org/10.3390/su132112136>

6. Blundel, R., Monaghan, A., Thomas, C. (2013). SMEs and environmental responsibility: A policy perspective. *Business Ethics: A European Review*, Vol. 22, Iss. 3, pp. 246-262. <https://doi.org/10.1111/beer.12020>
7. Chouaibi, S., Chouaibi, J., Rossi, M. (2022). ESG and corporate financial performance: The mediating role of green innovation: UK common law versus Germany civil law. *EuroMed Journal of Business*, Vol. 17, Iss. 1, pp. 46-71. <https://doi.org/10.1108/EMJB-09-2020-0101>
8. Cramer, H. (1946). *Mathematical methods of statistics*. Princeton University Press.
9. Creswell, J.W. (2008). Mapping the Field of Mixed Methods Research. *Journal of Mixed Methods research*, Vol. 3, pp. 95-108.
10. CSDD, European Parliament and Council of the European Union (2024). Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on corporate sustainability due diligence and amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859. *Official Journal of the EU*, <https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=OJ:L-202302772>
11. CSRD, European Parliament and Council of the European Union (2022). *Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU), No 537/2014. Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU with regard to corporate sustainability reporting*, <https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=OJ:L:2022:322:FULL>.
12. Cuerva, M., Triguero-Cano Á., Córcoles D. (2014). Drivers of green and non-green innovation: empirical evidence in Low-Tech SMEs. *Journal of Cleaner Production*, Vol. 68, pp. 104-113, <http://dx.doi.org/10.1016/J.JCLEPRO.2013.10.049>
13. De Haas, R., Martin, R., Muûls, M., Schweiger, H. (2021). Managerial and Financial Barriers to the Net-Zero Transition. *BOFIT Discussion Paper*, Vol. 6. <http://dx.doi.org/10.2139/ssrn.3848393>
14. Del Brío J., Junquera, B. (2003). A review of the literature on environmental innovation management in SMEs: implications for public policies. *Technovation*, Vol. 23, Iss. 12, pp. 939-948. DOI: 10.1016/S0166-4972(02)00036-6
15. Drempetic, S., Klein, C., Zwergel, B. (2020). The Influence of Firm Size on the ESG Score: Corporate Sustainability Ratings Under Review. *Journal of Business Ethics*, Vol. 167, pp. 333-360. <https://doi.org/10.1007/s10551-019-04164-1>
16. Earnhart, D., Lizal, L. (2006). Effects of corporate environmental strategies on firm performance. *Journal of Comparative Economics*, Vol. 34, Iss. 1, pp. 111-129. <https://doi.org/10.1016/j.jce.2005.11.007>
17. European Commission (2003). Recommendation 2003/361/EC of the European Commission of 6 May 2003 concerning the definition of micro, small and medium sized enterprises. *Official Journal of the European Communities*, Vol. L 124, pp. 36-41.

18. European Commission (2018). SMEs, resource efficiency and green markets. *Flash Eurobarometer, Vol. 456*. Brussels: European Commission, <https://europa.eu/eurobarometer/surveys/detail/2151>
19. European Commission (2019). *The European Green Deal. Communication from the Commission*, COM (2019) 640 final, [https://eur-lex.europa.eu/legal-content/PL/TXT/?uri=CELEX: 52019DC0640](https://eur-lex.europa.eu/legal-content/PL/TXT/?uri=CELEX:52019DC0640).
20. European Parliament and Council of the European Union (2021). Regulation (EU) 2021/1056 of the European Parliament and of the Council of 24 June 2021 establishing the Fair Transition Fund. *Official Journal of the European Union, Vol. L 231/1*, pp. 1-22.
21. Fahad, P., Busru, S. (2021). CSR disclosure and firm performance: evidence from an emerging market. *Corporate Governance, Vol. 21, Iss. 4*, pp. 553-568. <https://doi.org/10.1108/CG-05-2020-0201>
22. Fatemi, A., Glaum, M., Kaiser, S. (2018). ESG performance and firm value: The moderating role of disclosure. *Global Finance Journal, Vol. 38*, pp. 45-64. <https://doi.org/10.1016/j.gfj.2017.03.001>
23. Fleitera, T., Schleich, J., Ravivanpong, P. (2012). Adoption of energy–efficiency measures in SMEs An empirical analysis based on energy audit data. *Energy Policy, Vol. 51*, pp. 863-875. <https://hal.archives-ouvertes.fr/hal-00805748>
24. Frączkiewicz-Wronka, A.K., Kozak, A., Porc, R. (2020). Ocena rozwoju instytucjonalnego jednostek samorządu terytorialnego w Polsce Barometr 2017 (Assessment of Institutional Development of Local Government Units in Poland Barometer 2017). In: P. Antonowicz, P. Galiński, P. Pisarewicz (Eds.), *Perspektywa ekonomiczna, finansowa i prawna kreowania wartości w gospodarce (Economic, Financial, and Legal Perspective on Value Creation in the Economy)* (pp. 89-106). Gdańsk: University of Gdańsk Press.
25. Friede, G., Busch, T., Bassen, A. (2015). ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment, Vol. 5, Iss. 4*, pp. 210-233. <https://doi.org/10.1080/20430795.2015.1118917>
26. Garrido-Ruso, M., Otero-González, L., López-Penabad, M., Santomil, P. (2024). Does ESG implementation influence performance and risk in SMEs? *Corporate Social Responsibility and Environmental Management, Vol. 31, Iss. 5*, pp. 4227-4247. <https://doi.org/10.1002/csr.2783>
27. Gholami, A., Murray, P.A., Sands, J. (2022). Environmental, Social, Governance & Financial Performance Disclosure for Large Firms: Is This Different for SME Firms? *Sustainability, Vol. 14, Iss. 10*, p. 6019. <https://doi.org/10.3390/su14106019>
28. Goswami, M. (2018). Crisis economics: Keynes and the end of empire. *Constellations, Vol. 25, Iss. 1*, pp. 18-34, <https://doi.org/10.1111/1467-8675.12355>
29. Greenacre, M. (2021). *Correspondence analysis in practice* (3rd ed.). Chapman and Hall/CRC Press, <https://doi.org/10.1201/9781315369983>
30. GUS (2023). *Yearbook of International Statistics 2023*, Warsaw.

31. GUS (2024). *Bank Danych Lokalnych*, <https://bdl.stat.gov.pl>
32. Hamdi, K., Guenich, H., Ben Saada, M. (2022). Does corporate financial performance promote ESG: Evidence from US firms. *Cogent Business & Management*, Vol. 9, Iss. 1. <https://doi.org/10.1080/23311975.2022.2154053>
33. Higgs, C.J., Hill, T. (2018). The role that small and medium sized enterprises play in sustainable development and the green economy in the waste sector, South Africa. *Business Strategy and Development*, Vol. 1, Iss. 1, pp. 1-7, <https://doi.org/10.1002/bsd2.39>
34. Khan, M., Serafeim, G., Yoon, A. (2016) Corporate Sustainability: First Evidence on Materiality. *The Accounting Review*, 91(6), 1697-1724. <http://dx.doi.org/10.2139/ssrn.2575912>
35. Kozak, A. (2023), Application of ICT in the co production of social services. *Journal of Economics and Management*, 45, 441-467.
36. Kucęba, R., Ulewicz, R. (2016). Europejski sektor MSP w wymiarach działalności proekologicznej (The European SME Sector in the Dimensions of Pro Environmental Activities). *Przedsiębiorczość i Zarządzanie (Entrepreneurship and Management)*, Vol. 17, Iss. 1, pp. 45-56.
37. Kusuma, H., Muafi, M., Kholid, M.N. (2023). Pro–Environmental MSMES Performance: The Role of Green it Adoption, Green Innovative Behavior, and Financial Accounting Resources. *Journal of Law and Sustainable Development*, Vol. 11, Iss. 4, p. e0673. <https://doi.org/10.55908/sdgs.v11i4.673>
38. Love, J.H., Roper, S. (2015). SME innovation, exporting and growth: A review of existing evidence. *International Small Business Journal*, Vol. 33, Iss. 1, pp. 28-48, <https://doi.org/10.1177/0266242614550190>
39. Magdziarczyk, M., Widera, K. (2024), Analysis of the characteristics conditioning the implementation of the GDPR by micro, small and medium sized entrepreneurs. *Annales Universitatis Mariae Curie Skłodowska, Section H – Oeconomia*, Vol. 58, Iss. 2, pp. 79-100, <https://doi.org/10.17951/h.2024.58.2.79-100>
40. Magdziarczyk, M. (2023). *Wdrożenie RODO przez mikro, małe i średnich przedsiębiorców jako przykład zarządzania zmianą (Implementation of GDPR by Micro, Small, and Medium Sized Entrepreneurs as an Example of Change Management)*. Gliwice: Silesian University of Technology Press.
41. Markandya, A., Arto, I., Gonzales Eguino, M., Roman, M. (2016). Towards a green energy economy? Tracking the employment effects of low–carbon technologies in the European Union. *Applied Energy*, Vol. 179, pp. 1342-1350, <http://dx.doi.org/10.1016/j.apenergy.2016.02.122>.
42. Martínez-Conesa, I., Soto-Acosta, P., Palacios-Manzano, M. (2017). Corporate social responsibility and its effect on innovation and firm performance: An empirical research in SMEs. *Journal of Cleaner Production*, Vol. 142, Part 4, pp. 2374-2383. <https://doi.org/10.1016/j.jclepro.2016.11.038>

43. McDaniels, J., Robins, N. (2017). *Mobilizing sustainable finance for small and medium sized enterprises: Reviewing experience and identifying options in the G7*. United Nations Environment Programme (UNEP). <https://www.cbd.int/financial/2017docs/unep-smefinance2017.pdf>
44. Momtaz, P., Parra, I. (2024). Is sustainable entrepreneurship profitable? ESG disclosure and the financial performance of SMEs. *Small Business Economics*, Vol. 64, pp. 1535-1564 <https://doi.org/10.1007/s11187-024-00981-5>
45. Nicoara, C., Kadile, V. (2023). Drivers and outcomes of CSR engagement in UK SMES. *Journal of Small Business Management*, Vol. 62, Iss. 6, pp. 2806-2846. <https://doi.org/10.1080/00472778.2023.2277274>
46. OECD (2018). *Environmental Policy Toolkit for SME Greening in EU Eastern Partnership Countries*. OECD Green Growth Studies. Paris: OECD Publishing. <https://dx.doi.org/10.1787/9789264293199-en>
47. OECD (2021). No net zero without SMEs: Exploring the key issues for greening SMEs and green entrepreneurship. *OECD SME and Entrepreneurship Papers*, 30, Paris: OECD Publishing. <https://doi.org/10.1787/bab63915-en>
48. Osborne, S. (2020). *Public Service Logic: Creating Value for Public Service Users, Citizens, and Society Through Public Service Delivery* (1st ed.). Routledge, <https://doi.org/10.4324/9781003009153>.
49. Parliament of Poland (2024). *Act of 6 March 2018 Entrepreneurs' Law*. Journal of Laws 2024.236.
50. PARP (2023). *Raport o stanie sektora małych i średnich przedsiębiorstw w Polsce (Report on the State of the Small and Medium Sized Enterprise Sector in Poland)*. Warsaw: PFR Group.
51. *Regional Innovation Strategy of the Silesian Voivodeship 2030 – Intelligent Silesia (Regionalna Strategia Innowacji Województwa Śląskiego 2030 – Inteligentne Śląskie)* (2021). Board of the Silesian Voivodeship, Resolution No. 1554/246/VI/2021, <https://scp-slask.pl/file/download/2301>
52. Shakil, M. (2021). Environmental, social and governance performance and stock price volatility: A moderating role of firm size. *Journal of Public Affairs*, Vol. 22, Iss. 3, p. e2574. <https://doi.org/10.1002/pa.2574>
53. Sinha Ray, R., Goel, S. (2022). Impact of ESG score on financial performance of Indian firms: static and dynamic panel regression analyses. *Applied Economics*, Vol. 55, Iss. 15, pp. 1742-1755. <https://doi.org/10.1080/00036846.2022.2101611>
54. Stiglitz, J.E. (2010). *Freefall: America, free markets, and the sinking of the world economy*. WW Norton & Company.
55. Szreder, M. (2004). *Metody i techniki sondażowych badań opinii (Methods and Techniques of Survey Opinion Research)*. Warsaw: PWE.

56. *The Labour Market in the Field of Green Economy in the Silesian Voivodeship (Rynek pracy w obszarze zielonej gospodarki w województwie Śląskim)* (2024). Voivodeship Labour Office in Katowice. https://fewe.pl/wp-content/uploads/2024/03/M.-Laczmanski_Rynek-pracy-w-obszarze-zielonej-gospodarki-w-woj-slaskim-na-29022024.pdf
57. United Nations Environment Programme (2011). *Towards a green economy: Pathways to sustainable development and poverty eradication – A synthesis for policy makers*. UNEP. www.unep.org/greeneconomy.
58. Van Linh, N., Hung, D., Binh, T. (2022). Relationship between sustainability reporting and firm's value: Evidence from Vietnam. *Cogent Business & Management*, Vol. 9, Iss. 1. <https://doi.org/10.1080/23311975.2022.2082014>
59. Voulgaris, F., Asteriou, D., Agiomirgianakis, G. (2004). Size and determinants of capital structure in the Greek manufacturing sector. *International Review of Applied Economics*, Vol. 18, Iss. 2, pp. 247-262. DOI: 10.1080/0269217042000186714
60. Wach, K. (2014). Małe i średnie przedsiębiorstwa w gospodarce narodowej (Small and Medium Sized Enterprises in the National Economy). In: J. Targalski (Ed.), *Przedsiębiorczość i zarządzanie małym i średnim przedsiębiorstwem (Entrepreneurship and Management of a Small and Medium-Sized Enterprise)* (pp. 48-52). Warsaw: Difin.
61. Wasiuzzaman, S., Ibrahim, S., Kawi, F. (2022). Environmental, social and governance (ESG) disclosure and firm performance: does national culture matter? *Meditari Accountancy Research*, Vol. 31, Iss. 5, pp. 1239-1265. <https://doi.org/10.1108/MEDAR-06-2021-1356>
62. Wellalage, N.H., Fernandez, V. (2019). Innovation and SME finance: Evidence from developing countries. *International Review of Financial Analysis*, Vol. 66, 101370, <https://doi.org/10.1016/j.irfa.2019.06.009>.
63. Whelan, T., Atz, U., Van Holt, T., Clark, C. (2021). *ESG and Financial Performance: Uncovering the Relationship by Aggregating Evidence from 1000 Plus Studies Published between 2015-2020*. NYU Stern Center for Sustainable Business and Rockefeller Asset Management. <https://www.stern.nyu.edu/sites/default/files/assets/documents/ESG%20Paper%20Aug%202021.pdf>

FEMINATIVES IN MARKETING COMMUNICATION: A CASE STUDY OF SELECTED CAMPAIGNS

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Purpose: The aim of this article is to analyze selected Polish marketing campaigns focusing on the use of feminatives.

Design/methodology/approach: To achieve this, a narrative literature review was conducted alongside a qualitative content analysis of examples of marketing campaigns emphasizing feminine noun forms.

Findings: The analysis highlights various strategies employed by companies to incorporate this topic into their communication and addresses broader social contexts, such as conducting studies on feminatives and educating audiences through brand initiatives.

Research limitations/implications: Further research could focus on consumer attitudes towards the use of feminatives by companies in marketing communication, as well as the perception of brand inclusivity by audiences in the context of their addressing the topic of feminatives or inclusive language.

Practical implications: The conclusions drawn from the analysis may serve as guidance for companies in shaping marketing communication strategies based on inclusive language.

Social implications: The article contributes to raising public awareness about feminatives.

Originality/value: The article brings new value by analyzing examples of marketing campaigns in Poland in which feminatives constituted a significant element of the message.

Keywords: feminatives, inclusive language, inclusivity, marketing communication.

Category of the paper: Research paper.

1. Introduction

Broadly understood inclusivity has become an increasingly prominent topic in the context of management and marketing. Its manifestations can be observed in activities related to marketing communication, socially engaged marketing, corporate social responsibility (CSR), femvertising, employer branding, diversity, equity and inclusion strategies (DEI), and diversity management within organizations. Increasing attention is being paid to eliminating

discrimination, promoting equality, and reflecting social diversity across various dimensions, including linguistic ones.

The primary objective of this article is to analyze selected Polish marketing campaigns focusing on feminatives. Several specific goals have also been outlined:

- To compare the concepts of inclusivity, inclusive language, and feminatives.
- To identify examples of actions involving feminine noun forms in marketing communication.
- To review literature and research on feminatives in the Polish language.
- To analyze cases where feminine noun forms serve as a central element of marketing campaigns.

The research problem concerns verifying how feminatives can be utilized in marketing campaigns. Additionally, specific research questions have been posed:

1. What are the concepts of inclusivity, inclusive language, and feminatives?
2. What examples exist of actions utilizing feminatives in marketing communication?
3. What is the current state of research on feminine noun forms in the Polish language?
4. What are some cases where feminatives have been used as a central element in marketing campaigns?

The article is structured as follows: Section 2 reviews key theoretical concepts and previous research on feminatives in Polish and international contexts. Section 3 outlines the research methods. Section 4 presents the main findings from campaign analysis. Section 5 discusses these findings in relation to existing literature and broader implications. Section 6 provides conclusions and future research directions.

2. Literature review

The Polish Language Dictionary PWN defines "inclusive" as "combining or encompassing a whole; intended for everyone" (PWN). Inclusivity broadly refers to practices that involve and consider all individuals regardless of characteristics such as gender, race, sexual orientation, disability status, or age. It also signifies behavior that respects and accepts diversity (Zabratańska, Triuskaite, 2024). According to Dorota Murzyn, social inclusion is "the process of integrating marginalized individuals into mainstream life through full participation in societal activities" (Murzyn, 2018).

Inclusivity can also be discussed in terms of inclusive language – linguistic constructions that do not exclude anyone and reflect social diversity. One definition describes it as:

A way of communicating that aims to include diverse social groups and ensure equal opportunities for each one. It is a tool that helps build an inclusive society where everyone has equal opportunities and access to resources. Inclusive language is free from words or

phrases that reflect prejudice or discriminatory stereotypes about specific individuals or groups. It is also language that does not unintentionally exclude people from feeling accepted (Jankowska-Rangelov, 2024).

Inclusive speech also involves avoiding stereotypes or using offensive terms for certain social groups (Chmura-Rutkowska, Szpyra-Kozłowska, 2022). Examples include using terms like “osoby z niepełnosprawnością” instead of “osoby niepełnosprawne” ("people with disabilities" instead of "disabled people") or „osoby czarnoskóre” instead of „murzyni” ("Black individuals" instead of outdated terms like "Negroes"). Regarding gender specifically, it includes using gender-neutral expressions, such as both masculine and feminine forms i.e. “studentki i studenci” (female and male students) or neutral terms like “osoby studiujące” (studying individuals), and respecting preferences related to gender identity.

Inclusive language also encompasses feminatives and other constructions that emphasize women's visibility. Linguists Małgorzata Karwatowska and Jolanta Szpyra-Kozłowska highlight the phenomenon of women's linguistic invisibility: "The use of masculine nouns as generic terms is often referred to as 'linguistic invisibility of women', as their usage makes general texts, laws and regulations sound like they pertain exclusively to men" (Karwatowska, Szpyra-Kozłowska, 2005). This invisibility can be countered by using feminatives – feminine personal nouns referring specifically to women (Latos, 2020). The use of feminatives aims to enhance linguistic precision and acknowledge women's roles across various domains.

In Polish society, attitudes toward feminatives vary widely. The Polish Language Council at the Presidium of the Polish Academy of Sciences has addressed this issue twice. In 2012, it stated that while feminatives might be permissible linguistically, their lack of widespread use stems from negative reactions among speakers. The position was concluded with the statement:

Language cannot be imposed upon; no legal regulation will make Poles begin using forms like „inżyniera” or „inżynierka” (female enginner), „docentka” bądź „docenta” (female docent), „ministra” or „ministerka” (female minister), „maszynistka pociągu” (female engine driver), „sekretarza stanu” (female secretary of state) or anything such as these (Polish Language Council, 2012).

In turn, in 2019, in another position of the Polish Language Council on the discussed issue, it was emphasized that the arguments of opponents of using feminine personal nouns are mostly unfounded. Linguists stated that it is up to the speakers to decide whether to use feminatives or not. Approval was also expressed for linguistic symmetry:

greater, possibly full symmetry of masculine and feminine personal names in the vocabulary is needed in Polish. The use of feminatives in statements, for example, the alternating repetition of feminine and masculine nouns “Polki i Polacy” (Polish women and Polish men) is a sign that speakers feel the need to increase the visibility of women in language and texts (Polish Language Council, 2019).

It can therefore be noted that there are some differences in both opinions expressed by the Polish Language Council over the course of several years. In the newer position, greater understanding for the use of feminatives or even support for the symmetrical use of personal forms in the Polish language is visible (Latos, 2020).

In the context of marketing communication, understood as "the process of interaction and dialogue between a company and its target market" (Wiktor, 2013), inclusivity refers to a strategy aimed at incorporating social diversity into the brand's message, so that as many recipients as possible can identify with it, regardless of gender identity, psychosexual orientation, ethnic origin, social status, and other diverse characteristics. Inclusivity is becoming an increasingly important element in building authentic relationships with customers and increasing brand loyalty.

One of the most important elements of building inclusive communication is inclusive language, including the use of feminine noun forms. According to Marta Jarosz, the themes of Instagram activities of inclusive language activists focus on women, non-heteronormative and non-cisgender people, people excluded due to appearance, and people with disabilities (Jarosz, 2021). Feminatives themselves are relatively rarely the main element of marketing campaigns – although such examples can be found – but brands can increase the inclusivity of their messages by using symmetrical personal forms.

The use of feminatives in brands' marketing communication falls within the scope of activities from various areas such as:

- Corporate Social Responsibility (CSR).
- Cause Related Marketing (CRM).
- Employer Branding (EB).
- Diversity, Equity, and Inclusion strategy (DEI).
- Diversity management in the organization.
- Femvertising, i.e., an advertising strategy aimed at women and promoting gender equality.

Examples of activities that include the use of feminatives include: their use in broadly understood content marketing (e.g., in content published on social media, newsletters, messages sent directly to a given customer), internal communication with employees, job advertisements, job titles and roles performed in the organization, advertisements targeted not only at women, creating social campaigns, or organizing training for employees on inclusive language.

Research on feminatives is conducted in various areas – feminine noun forms are analyzed linguistically, cases of their occurrence in the history of the Polish language are sought, and declarations regarding their use and opinions on the subject are also examined.

As early as 2011, research was carried out that showed that at least half of Polish women do not see the need to use feminatives in everyday life. Additionally, Katarzyna Hołojda writes that "the vast majority have no greater knowledge about feminatives and associate the creation

of feminine names of professions and functions with a 'fight against an imaginary enemy'" (Hołojda, 2011).

According to a study "Język ofert pracy" ("Language of job offers") conducted in 2021 by the "Pracuj.pl" portal together with the "Sukcesu Pisanego Szminką" Foundation, 83% of respondents support the use of feminine job titles, and 78% expect feminatives in job advertisements. 3/4 of respondents want to have an impact on the name of the position they hold, while less than 30% believe that feminine noun forms do not fit some professions (Pracuj.pl, 2021).

In 2022, as part of the larger campaign "Wystarczy słowo, by zacząć zmianę" ("All it takes is a word to start the change"), Bank BNP Paribas also conducted research on feminatives "Jak język kształtuje rzeczywistość" ("How language shapes reality"). 58% of adult Poles believe that language should keep up with changes in the world. In turn, almost 40% show "at least moderate enthusiasm for feminatives". Women show greater openness and willingness to use feminine noun forms. The conclusion that emerges from the research results is that the key factor in openness to feminatives is openness in general (BNP Paribas, 2022).

According to the PSMM Monitoring & More report "Feminatywy w mediach" ("Feminatives in the media") from 2023 on the occurrence of feminatives in the media in the previous three years, the frequency of the word "prezeska" (female president) doubled, "menedżerka" (female manager) – tripled, "wykładowczyni" (female lecturer) – quadrupled, while the word "naukowniczyni" (female scientist) increased sixfold, compared to the previous study from 2020. However, the authors of the report draw attention to the still existing disproportion and the much more frequent use of male forms (PSMM Monitoring & More, 2023).

A report from a survey "Czy kobiety używają feminatywów?" ("Do women use feminatives?") by the Center for Research on Social Relations of the SWPS University from 2024 indicates that 46% of respondents used feminatives to describe their role. The use of feminine noun forms was more common among professionally inactive respondents, while among those professionally active, only one in three used feminatives to describe their professional role (Leszko, Formanowicz, 2024).

There is a lack of research on the use of feminatives in marketing communication on the Polish market. Only a relatively small number of publications devoted to inclusive language in social media or more broadly to inclusivity in marketing campaigns can be found. In 2021, Marta Jarosz examined the social perception of language that does not discriminate on the basis of gender, focusing on the assessment of the activities of inclusive communication activists on Instagram. 60% of respondents agreed with the statement that some features of the Polish language may negatively affect the pursuit of gender equality. When it comes to the use of feminatives, 19% of respondents declared that they always create them when the statement concerns a female person, and 39% chose the answer "sometimes" (Jarosz, 2021).

In turn, according to the report “Marka jest kobietą” (“Brand is a Woman”) from 2023 presented by the Streetcom agency, 71% of respondents believe that brands offering products for women should use feminatives. 61% of them, however, are in favor of using feminine noun forms in practice – in the names of professions, functions or positions (Streetcom, 2023).

3. Methods

This study employed a qualitative research design combining a narrative literature review with qualitative content analysis. The narrative literature review was conducted to compile key concepts and assess the current state of research on feminatives within the Polish language. It covered academic publications, institutional reports, and media texts on feminatives and inclusive language. The qualitative content analysis was applied to examples of marketing campaigns emphasizing feminine noun forms. It focused on four Polish marketing campaigns: Free Now (2021), Solar (2023), Your Kaya (2021), and BNP Paribas (2022). These cases were selected based on their explicit use of feminatives in marketing communication. The analysis identified how feminatives were incorporated into campaign narratives, language, and communication with customers.

The method is exploratory in nature, aiming to identify patterns of feminine use in marketing communication rather than establish causal relationships. Limitations of this approach include the small sample size, qualitative character of analysis, and focus on the Polish context.

4. Analysis of selected campaigns

An example of marketing communication incorporating inclusive language and feminatives can be seen in Free Now's 2021 campaign, which aimed to emphasize the brand's declared values: inclusivity, equality, and freedom. One element of this campaign was the introduction of the service “Dla niej” (“For her”), which provided taxi rides exclusively for women, driven only by female drivers. They also started using the term “kierowczynie taxi” (female taxi drivers) in their communication, referring to women working with the platform (Nowy Marketing, 2023).

As part of Free Now's campaign “Dla różnych i równych podróżnych” (“For Different and Equal Travelers”), promotional materials juxtaposed what the creators considered two opposing groups of customers to emphasize that, despite their differences, they are equally important to the company (Nowy Marketing, 2021). One of the graphics posted on social media featured the

text “Dla pań doktor i doktorek” (“For lady doctors and female doctors”). On the one hand, this demonstrates an attempt to reach female audiences who support the use of feminatives, and on the other, women who prefer to use masculine forms of nouns with the addition of “pani” (lady) before them.

In 2023, Solar launched the project „Przejdźmy na FeminaTYwy!” („Let's Switch to Feminatives!”). As part of it, several ambassadors of the campaign were selected from among the employees, as well as one ambassador – a man who volunteered as a feminist supporting women and feminatives. The company emphasizes that it wants to mark the presence of women, their contribution to the development of the brand, and their roles in the industry and society. The project description states: “We want feminine grammatical forms of job titles to become an expression of respect for women's work”. Part of the campaign was, among others, the collection “FeminaTYwy” (“Feminatives”) (Solar, 2023).

Brands can refer to the topic of inclusive language, including feminatives, not only by creating comprehensive marketing campaigns, but also, for example, in individual content posted on social media. An example is a post by Your Kaya from February 6, 2021, published on Instagram, which explains what inclusive language is and why it is worth using. The brand emphasized that the post was intended to answer questions from the audience that arose after it began using inclusive language in its communication. They also focused on education and encouraging discussion, instead of just informing about their activities, and recommended specific Instagram profiles whose creators deal with content in the field of inclusive language (Your Kaya, 2021).

In 2022, BNP Paribas, which describes itself as “a bank of a changing world”, conducted the campaign „Wystarczy słowo, by zacząć zmianę” (“All it takes is a word to start a change”) in the field of social marketing. It consisted of several parts – a study, a podcast, and a dictionary (BNP Paribas, 2022). It aimed to promote feminatives as a tool to combat gender stereotypes in the labor market. Its message was based on the idea that language has enormous power in shaping the perception of the world and can contribute to equalizing opportunities between the sexes. On the website dedicated to the campaign, you can learn about its elements in the form of the following tabs:

- Why feminatives – a brief explanation of the reason for addressing the topic of feminine forms of nouns in the campaign, which emphasized the aspect of equal opportunities in career choice.
- Study – a report from the research “Jak język kształtuje rzeczywistość?” (“How language shapes reality?”) conducted among two groups – children and adults, the aim of which was to show the impact of using masculine or gender-neutral job titles on their perception by children and the perception of personality in adults; the results showed that children more often associate specific professions with men if masculine forms of nouns are used.

- Read – articles prepared by the research partners, including the "Pracuj.pl" portal, whose research on feminatives has already been mentioned in this article.
- Podcast – a conversation with four experts in the field of feminatives (Ewelina Moron – linguist, trainer of simple Polish and effective writing, Janina Bąk – statistician, author of a bestselling book, Joanna Czczott – political scientist and reporter, and Agnieszka Konarzewska – Director of Marketing Communications Department at Bank BNP Paribas), who commented on the results of the conducted research and talked about feminatives and their impact on women's lives.
- Dictionary – the possibility of using an interactive dictionary of feminine job titles, in which, after entering the masculine form, the appropriate feminine appears along with a comment; you can also vote for the preferred variant if a given profession has several possible feminine forms, and report a missing job title.
- Partners – a tab with campaign partners.

Bank BNP Paribas' campaign included several different activities, including social research, for the discussion of which experts in the field of feminatives were invited. It is also worth paying attention to the active tab with a dictionary of feminine job titles. These elements can be an example of good practice in creating social campaigns, which are part of a broader marketing communication of companies.

5. Discussion

The findings of this study align with existing research indicating growing support for feminatives in Poland (Pracuj.pl, 2021; BNP Paribas, 2022; PSMM Monitoring & More, 2023). However, this support does not always translate into everyday language use, particularly among women themselves (Leszko, Formanowicz, 2024). This ambivalence mirrors the gradual linguistic normalization of feminatives in public discourse.

In marketing, feminatives can support inclusive communication strategies, strengthening a brand's image as socially responsible. This aligns with broader international trends in gender-inclusive branding (Eisend, 2019; Schroeder, 2020). However, unlike some Western markets, where gender-inclusive communication has become mainstream, the Polish context remains more polarized.

This study highlights the potential for feminatives to serve not only as linguistic forms but as strategic tools that align with CSR goals, DEI strategies, and femvertising. Nevertheless, the limited number of campaigns indicates that many brands still avoid explicit engagement with gendered language.

6. Conclusion

Feminatives are a popular topic, both as a subject of scientific research and as part of the marketing communication of brands. Scientific publications indicate that their use is supported by the majority of Poles, but women are not always as willing to use them for themselves. Most respondents also believe that feminine forms of nouns should be visible in job advertisements, names of positions, roles and functions, and professions, as well as in the communication of brands offering products for women. It should also be noted that, according to some people, not all words are suitable for creating feminatives. It should be emphasized that despite the growing social support for feminine forms of nouns, there is still a noticeable gender inequality in the Polish language.

Companies can address the topic of feminatives or, more broadly, inclusive language in marketing communication in various ways. Creating comprehensive social marketing campaigns can be one strategy. Activities aimed not only at influencing the brand image and creating it as inclusive, but also those that bring a real effect for society, such as conducting social research or educating audiences, seem important. In this light, the campaign „Wystarczy słowo, by zacząć zmianę” ("All it takes is a word to start the change") by Bank BNP Paribas, which consisted of various activities on several levels, was well-received. Another example of good practice in the area of feminine noun forms is simply using them in practice – in communication in social media, towards their female employees, clients, or all female recipients.

It is worth paying attention to the challenge that, in the context of feminatives and inclusivity in general, can be for companies to effectively combine marketing strategies with a social mission. One must also not forget about a key aspect in the evaluation of all activities in the field of corporate social responsibility, which is the consistency between declarations and practice. Instrumental treatment of feminine forms of nouns, devoid of a broader context of activities for equality, may meet with negative consumer reception.

The analysis revealed several ways in which feminatives were incorporated into brand communication strategies. Free Now used feminatives in the context of female taxi drivers as part of its inclusivity-focused campaign. Solar launched an internal and external communication initiative emphasizing feminine forms of job titles. Your Kaya applied inclusive language education through social media, explaining and normalizing feminatives. BNP Paribas conducted a large-scale campaign combining research, education, and interactive tools to promote feminatives.

The campaigns demonstrated different levels of engagement with inclusive language. Some focused on explicit linguistic representation, while others framed feminatives within broader social narratives, including gender equality and empowerment. Feminatives served both as linguistic markers and as symbols of brand values. The theoretical implications of this

study emphasize the link between language and social representation. Practically, brands can integrate feminatives through their communication strategies in a way that supports authenticity and inclusion.

Undoubtedly, further research on the topic addressed in this article is needed. It is worth conducting research on consumer attitudes towards the use of feminatives by companies in marketing communication, as well as the perception of brand inclusivity by audiences in the context of their addressing the topic of feminatives or inclusive language. An analysis of the long-term impact of using feminatives and inclusive language on the brand image and comparative analyses with international contexts would certainly also be valuable.

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References

1. BNP Paribas (2022). *Jak język kształtuje rzeczywistość?* Raport z badania ilościowego na temat feminatywów.
2. BNP Paribas (2022). *Wystarczy słowo*. bnpparibas.pl/wystarczyslowo, 14.03.2025.
3. Chmura-Rutkowska, I., Szpyra-Kozłowska, J. (2022). *Nierówności w płci. Poradnik dla nauczycielek i nauczycieli*. Warszawskie Centrum Innowacji Edukacyjno-Społecznych i Szkoleń, Urząd m.st. Warszawy Biuro Edukacji.
4. Eisend, M. (2019). Gender Roles. *Journal of Advertising*, 48(1), 72-80.
5. Hołojda, K. (2011). Jak Polki postrzegają feminy i dlaczego jest tak źle? In: *Poradnik równościowy* (pp. 190-197). Fundacja Grejpfrut.
6. Jankowska-Rangelov, M. (2024). Język inkluzyjny. Nowy trend czy konieczność? In: *Diversity, Equity & Inclusion: Trendbook* (pp. 89-95). SENSE consulting.
7. Jarosz, M. (2021). Działania aktywistów języka inkluzyjnego w mediach społecznościowych a społeczne postrzeganie feminatywów. *Studia Medioznawcze*, 3(86), 995-1014.
8. Karwatowska, M., Szpyra-Kozłowska, J. (2010). *Lingwistyka płci. Ona i on w języku polskim*. Lublin: Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej.

9. Latos, A. (2020). Feminatywy w stanowiskach Rady Języka Polskiego. Język a ewolucja normy społecznej. *Postscriptum Polonistyczne*, 2(26), 227-242.
10. Leszko, M., Formanowicz, M. (2024). *Czy kobiety używają feminatywów?* Raport z sondażu Centrum Badań nad Relacjami Społecznymi. Uniwersytet SWPS.
11. Murzyn, D. (2018). Spójność społeczna i inkluzywność jako priorytety polityki spójności UE. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 537, 66-75.
12. Nowy Marketing (2021). *Najnowsza kampania FREE NOW odnajduje podobieństwa w różnicach i promuje inkluzywność*. nowymarketing.pl/najnowsza-kampania-free-now-odnajduje-podobienstwa-w-roznicach-i-promuje-inkluzywnosc, 14.03.2025.
13. Nowy Marketing (2023). *Trendbook 2023: Marketing inkluzywny, czyli jak marki wyróżniają „niewidzialne” społeczności*. nowymarketing.pl/trendbook-2023-marketing-inkluzywny-czyli-jak-marki-wyrozniaja-niewidzialne-spolecznosci, 14.03.2025.
14. Pracuj.pl (2021). *Język ofert pracy*. <https://media.pracuj.pl/149349-jezyk-ofert-pracy-kobiety-o-feminatywach-badanie-pracujpl>, 14.03.2025.
15. PSMM Monitoring & More (2023). *Feminatywy w mediach*. Raport.
16. PWN. *Słownika języka polskiego*, hasło: inkluzywny. sjp.pwn.pl/slowniki/inkluzywny, 14.03.2025.
17. Rada Języka Polskiego (2012). *Stanowisko Rady Języka Polskiego w sprawie żeńskich form nazw zawodów i tytułów*, https://rjp.pan.pl/index.php?option=com_content&view=article&id=1359:stanowisko-rady-jzyka-polskiego-w-sprawie-eskich-form-nazw-zawodow-i-tytuow, 14.03.2025.
18. Rada Języka Polskiego (2019). *Stanowisko Rady Języka Polskiego przy Prezydium PAN w sprawie żeńskich form nazw zawodów i tytułów*. https://rjp.pan.pl/index.php?option=com_content&view=article&id=1861:stanowisko-rjp-w-sprawie-zenskich-form-nazw-zawodow-i-tytulow, 14.03.2025.
19. Schroeder, J.E. (2020). Reinscribing gender: social media, algorithms, bias. *Journal of Marketing Management*, 37(3-4), 376-378.
20. Solar (2023). *Przejdźmy na FeminaTYwy*, solar.com.pl/przejdzmy-na-feminatywy, 14.03.2025.
21. Streetcom (2023). *Marka jest kobietą*. Raport.
22. Wiktor, J.W. (2013). *Komunikacja marketingowa. Modele, struktury, formy przekazu*. Warszawa: PWN.
23. Your Kaya (2021, 6 lutego). *Instagram*, [instagram.com/p/CK9atS5sEUs](https://www.instagram.com/p/CK9atS5sEUs), 14.03.2025.
24. Zabratańska, K., Triuskaite, V. (2024). *Różnorodność, równość i inkluzywność od teorii do praktyki. Perspektywa Polski i Cypru*. Inna Fundacja, Dorea Educational Institute.

ANALYSIS OF THE TRANSPORT ROUTE SELECTION OF A SELECTED LOGISTICS OPERATOR IN THE ORGANIZATION OF CLOTHING TRANSPORT AT THE LAST MILE STAGE

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Purpose: The main goal of this article is to optimize transportation processes to reduce financial losses resulting from inefficient fleet utilization at the "last mile" stage. The research problem focuses on finding an optimal solution that would reduce losses while maintaining a high level of customer service and timely delivery.

Design/methodology/approach: The study combines a comprehensive literature review with empirical research. The literature review included an analysis of literature concepts related to transportation and an analysis of the fast fashion sector. The empirical study used an analytical method - the transport routes of the selected logistics operator were analyzed.

Findings: The low cost-effectiveness of the "last mile" route was noted, requiring precise planning and resulting in highly variable delivery conditions. On some routes, cargo weight exceeds the allowable weight for smaller vans, forcing the use of larger, more expensive vehicles. As a result, vehicle capacity is not fully utilized, and the company incurs losses. Destinations such as Nowy Sącz, Tarnów, Opole, Ostrava, and Rzeszów generate the lowest profits, and often even losses. It was also noted that the logistics operator's client (the fast-fashion sector) requires regular transport, even for small volumes of goods, which generates losses for the logistics operator.

Research limitations/implications: The main implications of the conducted research are focused on increasing the profitability of the logistics operator's operations and optimizing transport processes at the "last mile" stage, especially in the context of routes generating financial losses.

Practical implications: Both the analyzed entity and other companies should prioritize the implementation of dynamic route planning (routing on demand) and consolidation of low-volume deliveries, as well as negotiate individual rates with their customers for routes characterized by a high unit cost.

Originality/value: The value of the work is utilitarian, because based on the diagnosis, it was proposed to increase the profitability of service activities by changing the structure of routes and connecting unloading points in a way that allows for a fuller use of the vehicle's cargo space.

Keywords: transport, logistics operator, last mile, transport routes, clothing industry, fast fashion.

Category of the paper: research paper.

1. Introduction

Contemporary civilizational progress and dynamic economic development are largely the result of the intensification of digital information flow, which is an integral component of globalization processes. The transformation of communications, based on free access to data exchange channels, not only enables more efficient management of commercial transactions, but also contributes to increased competitiveness on the international stage. In this context, digital infrastructure appears to be a key element supporting the functioning of global supply chains. The development of information and communication technologies (ICT) and their integration with logistics systems enable the synchronization of activities between economic entities from different regions of the world. Electronic forms of contact, such as B2B platforms, ERP systems, and cloud solutions, are becoming not only an operational tool, but also a strategic resource supporting the coordination of production, distribution, and warehousing processes. As a result, digital communication channels should be seen as an integral part of an extensive point-to-point and linear infrastructure, built over decades to ensure effective cooperation between importers, exporters, and logistics operators (Christopher, 2016).

The modern global economy no longer functions in isolation from the mechanisms of globalization. On the contrary, it is shaped by them. A dense network of transport, ICT, and institutional connections forms the foundation for the flow of goods, services, capital, and information (World Bank, 2023). The increase in the number of market participants, both on the supply and demand sides, generates the need for continuous improvement in the quality of logistics services offered (Neider, 2008). Consumer expectations, growing time pressure, and variability in order volumes require companies to be flexible, innovative, and adaptable (Ghemawat, 2018).

In response to these challenges, it is crucial to streamline transport processes, with particular emphasis on the selection of appropriate means of transport (Grabowska, 2023). Technical parameters, load capacity, infrastructure availability, and compliance with international regulations determine the operational and cost efficiency of orders (Jóźwiak, 2019). In this context, international logistics is no longer just a function supporting commercial activity — it is becoming a strategic area of management, determining the competitive position of a company on the global market.

The primary goal and research problem of this article is to analyze the transport route selection of a selected logistics operator in organizing clothing transport at the last mile stage. The discussion includes a portion of the transport activity within the "last mile" dimension. The analysis covers destinations in Poland and partially in the Czech Republic. Particular attention is paid to the implementation of services for the warehouse in Pyskowice. The aim of the analysis is to determine the profitability of transport routes and propose improvements.

2. Literature review - the concept of transport, methods of cargo transport and last-mile transport

Transport has contributed to the development of civilization and the economy around the world. It plays a key role in the proper functioning of every city and country. Every day, transport meets the needs of both people and all kinds of goods. Everything that is transported constitutes cargo and is the basis of all logistics systems (Urbanyi-Popiołek, 2013).

One definition describes transport as a set of activities whose task is to move goods, including material goods, in time and space. All this can be done with the use of appropriate technical means (Skowronek, 1995). Another definition is supplemented with the information that transport not only includes activities related to the movement itself, but also many other things that are necessary for transport to be carried out properly (Stochaj, 2017). Such activities include, for example, handling and loading.

Transport service is the process of continuous and physical movement of cargo or people (Ciesielski, 2005). It is constantly changing as a result of the needs reported on the market by service users, as well as growing and increasingly fierce competition on the market. When providing a transport service, four phases must be taken into account, namely: the preparatory and organizational phase, the implementation phase, the control phase, and the post-control phase. A very important factor is that there is a strong link between the service provider and the service recipient, and the entire process takes place in constantly changing market conditions.

The demand for the service is related to the globalization of the economy and the development of information technology, which allows for accurate planning, ordering, and tracking of the transport service provided. An important factor in the field of logistics is cost reduction. Transport costs are one of the main categories of logistics costs, so efforts are made to eliminate them. The costs of transport services include, among other things, the cost of producing the transport service and the external cost incurred as a result of paying for losses and damage occurring in the area of the transport service provider. The elements that directly influence the formation of transport costs are: the technology of the transport service provided, the weight of the goods, the volume of the goods, the distance of transport, the danger associated with the transport of goods, the transport susceptibility of the goods, and the value of the goods.

In addition, the continuous expansion of the range of goods produced is associated with an increase in demand for transport services. The process of creating supply chains has also contributed to the increased demand for transport. Transport services are a natural part of the outsourcing process. Logistics is an element of cost optimization in a company, and the selection of transport service providers is an integral part of this process.

The processes involved in transport are closely interlinked. The participants in the transport market are (Tarski, 1985):

1. Shippers – appearing on the demand side for transport services. These are buyers purchasing the service of moving goods. Shippers can be direct producers of various goods, as well as commercial enterprises professionally involved in the purchase and sale of goods of various sizes, values, and degrees of processing.
2. Carriers – appearing on the supply side of transport services. They produce and simultaneously perform the transport services offered. Due to their strong bargaining position on the market, carriers can dictate their terms regarding prices, more specifically transport rates and the manner in which transport activities are performed.
3. Intermediaries – appearing on the demand and supply side of the transport market. This is a group of companies that is very diverse in terms of the tasks and functions it performs in the transport market.

Each component of a country's economic policy, including transport policy in the context of foreign trade, has specific entities and subjects of action, strategic objectives, operational tasks, and a set of implementation methods and tools (Witkowski, 2020). Within this policy, the main decision-makers are central government authorities responsible for shaping and implementing systemic solutions.

The most general and overarching objective of the state's transport policy is to create and maintain a coherent and effective transport system that functions harmoniously on a national scale and remains integrated with the international logistics environment. Specific objectives include, among others, the modernization of transport infrastructure, the development of organizational structures, and the adaptation of the transport system to the needs of the national economy and social expectations.

In the context of transport classification, a division according to the environment in which transport operations are carried out is commonly used, covering the following branches:

- road transport (motor vehicle),
- inland waterway transport,
- maritime transport,
- air transport,
- pipeline transport,
- rail transport.

An alternative criterion for classification is the type of cargo transported, which allows us to distinguish between passenger and freight transport (Skowron-Grabowska, 2019). Depending on the characteristics of the cargo, transport conditions, safety requirements, and the degree of automation of loading and unloading operations, three basic transport technologies can be identified (Rucińska, 2017): a) universal transport – covering the transport of standard cargo that does not require specialized means of transport; b) unified (container) transport – based on standardized cargo units, such as containers; c) specialized transport – dedicated to the transport of cargo requiring special conditions, e.g., refrigerated, oversized, dangerous (ADR), or fragile, such as glass.

Transport services are also characterized by three types of vulnerability (Gołembska, 2010): a) natural vulnerability – resulting from the physicochemical properties of the cargo, such as sensitivity to time, moisture, temperature, light, or susceptibility to damage, spontaneous combustion, or explosion; b) technical vulnerability – related to the physical characteristics of the cargo, such as shape, size, unit weight, or state of aggregation; c) economic vulnerability – determined by the unit value of the cargo, which affects the profitability of its transport.

From the point of view of transport organization and transshipment methods, the following forms of transport can be distinguished (Kautsch, 2018; UNCTAD, 2022):

- intermodal transport – carried out using at least two means of transport belonging to one branch,
- multimodal transport – involving transport using different modes of transport, without a specific method of transshipment, under a single transport contract and with a single operator responsible for the entire process (Bławat, 2012),
- intermodal transport – involving the movement of cargo in the same loading unit (e.g., container) using different modes of transport, also under a single contract and with a single operator (Borucka, 2017),
- combined transport – a type of intermodal transport in which the loading unit is transported by at least two modes of transport, using road transport at the beginning and end of the route and delivery and collection services (Woźniak, 2007).

Taking into account the aforementioned contemporary trends and tendencies, the purpose of transport is not only to ensure the flow of goods or people within the specified spatial and temporal framework, but also to provide features such as (Woźniak, 2011):

- efficient synchronization of related flows,
- good value for money,
- large volume of organized deliveries,
- the possibility of sending shipments of various sizes, including small consignments,
- access to up-to-date information on the status of orders,
- environmentally sustainable transport.

In order to demonstrate the flexible nature of the modern transport industry, the concept of transport can be presented in a more systematic and detailed form of classification. The basic classification criteria include those that differentiate transport based on the characteristics of the cargo being transported (passenger or freight transport) and those that focus on the spatial environment of cargo transport, i.e., road, rail, air, sea, inland waterway, and transmission (Kulpa, 2009). Each of these modes of transport has its own specific advantages and additional requirements, and thus limitations for the customer. An important aspect of transport is the question of its organization in space and time.

The concept of multimodal transport remains closely linked to the issue of the so-called “last mile”, understood as the final stage of the distribution process, consisting in the delivery of goods directly to the end recipient. When using solutions such as multimodal, intermodal, combined, or split transport, there is a challenge associated with the need to deliver to the “specified address”, which can be particularly difficult when using global means of transport, such as sea transport (Cichosz, 2020).

The issue of the “last mile” applies to both e-commerce logistics and retail supply (Kołata, 2020). Depending on the context, the end customer can be defined as an individual consumer receiving a shipment at their place of residence or as a commercial entity, e.g., a brick-and-mortar store. From the perspective of a logistics operator, the “last mile” means the point of completion of a transport order, while for the customer it may be an intermediate stage in the process of purchasing a product from a retailer. Estimates indicate that the “last mile” stage generates the highest costs in the entire delivery process, accounting for as much as 40-50% of total logistics expenses. Paradoxically, although this is the shortest section of the route, its implementation requires the use of smaller vehicles, such as delivery vans, which entails greater operational intensity, the need for precise planning, and highly variable operating conditions (Sieć Badawcza Łukasiewicz, 2023).

In the case of multimodal transport, involving the use of different modes of transport or a change of transport mode within a single mode, one of the decisive factors influencing the choice of logistics solution is the length of the route. Over shorter distances, the same load could be transported by a single vehicle, without the need for transshipment or a change of transport mode.

The entire transport process can be divided into three main stages: the so-called “first mile”, the main transport phase, and the “last mile”. The initial stage is usually planned taking into account a time reserve resulting from the length of the route, the specific nature of the cargo being transported (e.g., its transport susceptibility), and the availability of logistics infrastructure. The customer assesses the quality of this stage, among other things, through the prism of the contractor's response time to the order – the so-called reactive services – which may influence the decision to continue cooperation.

The “last mile” is the final stage of the delivery process, which is a consequence of the previous stages. In practice, this means that any delays that occur at the initial or main stage can accumulate at this stage. From the customer's point of view, however, it is crucial to ensure timely delivery, even if this requires additional operating costs (Dąbek, 2013).

Both the initial and final stages of the logistics process – referred to as the “first mile” and “last mile” – play a significant role in shaping the customer's perception of the quality of order fulfillment. However, particular importance is attached to the final phase, which marks the completion of the entire service and must be carried out in a timely, environmentally friendly, and economically justified manner – both from the perspective of the recipient and the logistics operator (Guzowski, 2025).

This stage is characterized by a high degree of operational complexity, resulting, among other things, from the need to use vehicles with limited load capacity, which are less cost-effective compared to long-range means of transport. In addition, due to the cyclical nature and high frequency of deliveries, the “last mile” generates a significant infrastructure and organizational burden (Boichuk, 2022).

All these constraints fit into the broader context of sustainable transport, which is increasingly at the center of customer expectations, both individual and institutional. In urbanized areas, logistics operators must adapt their activities to local regulations, which increasingly restrict the access of large vehicles to city centers. These regulations are expected to become even stricter, including the introduction of additional fees for conventional delivery vehicles to enter city centers (Róžański, 2024).

Therefore, it is necessary to optimize delivery routes, with particular emphasis on reducing empty runs and reorganizing the fleet (Ocicka, 2020). The response to these challenges is increasingly the implementation of electric vehicles, which, thanks to the possibility of using privileged infrastructure, such as bus lanes, allow for shorter delivery times in urban agglomerations. The nature of the “last mile” favors the use of alternative power sources, as short distances allow for effective battery range management and eliminate the risk associated with limited vehicle autonomy.

3. Literature review - conditions for development and specific characteristics of the fast-fashion sector in the clothing industry

Contemporary industry is not limited to satisfying existing consumer needs, but actively participates in shaping them through intensive promotional and marketing activities. Companies' pursuit of dynamic growth and profit maximization results in the implementation of operating models based on rapid response to changing market conditions. In the context of the increasing pace of social life and intensifying competition, sectors operating within the “fast” concept are becoming particularly important, currently playing a key role in global trade (Centrum Analiz PKO BP, 2024).

The clothing industry is a clear example of such a model – it is thanks to its strategy of rapid design, production, and distribution that the “fast fashion” sector has achieved a dominant position in the international market (Sales Intelligence, 2020). However, it is worth noting that the increase in sales does not only apply to the fast fashion segment. The entire textile and clothing industry is showing an upward trend, as confirmed by consumer demand data (Czajkowski, 2023).

In Poland, in 2025, compared to the same period in 2024, the textile, clothing, and footwear sector recorded sales growth in every month of the analyzed period. In January 2025, the value of clothing sales was 8.8% higher than in the previous year. In February, the growth rate was slightly lower, but still amounted to 6%, while in March there was an increase of 6.7% compared to March 2024. These data indicate a continuing high market absorption and a lack of saturation in the clothing sector, which confirms its stable position in the consumption structure (Dynamika sprzedaży detalicznej..., 2025).

According to information published by the Central Statistical Office, the value of clothing sold in Poland in 2010-2023 shows a systematic increase (Figure 1). Despite the dominance of large entities such as LPP, the leader in the domestic clothing trade, small and medium-sized enterprises continue to have a significant share in the industry structure and play an important role in local and regional trade.

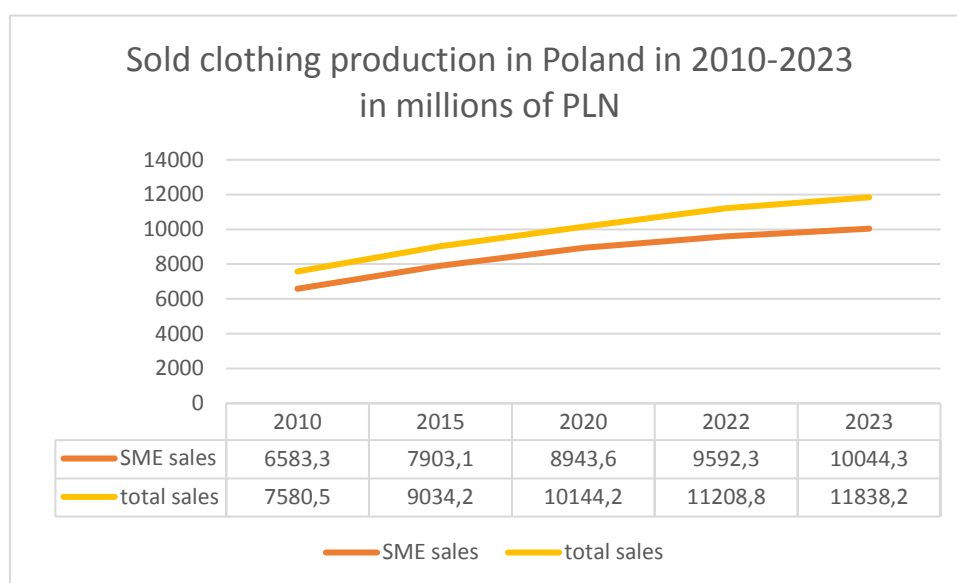


Figure 1. Clothing sales in Poland between 2010 and 2023.

Source: Own study based on: *Rocznik Statystyczny Przemysłu 2024* (2024). Warszawa: Główny Urząd Statystyczny.

From a global perspective, the clothing sector continues to show a steady upward trend (Boichuk, 2022). According to data published by Statista, despite the difficulties associated with the COVID-19 pandemic, the industry recorded growth of 1.9% between 2020 and 2022 (Statista, 2024). In the following year, i.e. 2023, this growth accelerated significantly, reaching a sales growth rate of 7.4%, and the positive trend continues. Asia has the largest share in global clothing production, accounting for 38.9% of the total global supply. Translating this data into financial terms, the global clothing market achieved sales of €1.6 trillion in 2023, of which €622 billion was generated by Asian countries. Clothing production also involves the movement of goods within supply chains, which directly affects transportation issues (KPMG, 2023). In terms of clothing exports outside the country, China was the leader in 2023, with a share of 29.6%. The largest importer of clothing was the United States, which accounted

for 18.2% of global imports. In terms of consumer spending on clothing, the average annual amount spent on this by the world's population in 2023 was €209. In Europe, this figure was significantly higher, reaching €520. In Poland, the average per capita expenditure on clothing was €328 (Centrum Analiz PKO BP, 2024).

It is estimated that the coming years will see an increase in the volume of clothing sold. These figures will grow not only in Europe, Asia, and North America, but on all inhabited continents¹. However, the chart shows a significant advantage for the Asian market. China will see the strongest growth trend in the coming years in national terms.

The dynamic growth of e-commerce has significantly influenced the transformation of contemporary sales models, making online shopping an integral part of consumers' everyday lives. Both SMEs and global leaders in the clothing industry, such as LPP S.A., H&M (H&M Group, Annual and Sustainability Report, 2023; H&M Group, Sustainability Performance Report, 2023), and Inditex S.A. (Inditex Group, 2023), are implementing omnichannel sales strategies, combining brick-and-mortar operations with an extensive logistics infrastructure supporting digital channels. Stores are increasingly operating in the virtual space, and customer service is provided through models such as dropshipping or distribution based on the concept of cross-docking. These companies are among the leaders in the global clothing market (LPP S.A., Over...). Financial data for 2023 shows that Inditex achieved the highest revenues – €36 billion, followed by H&M – €20.6 billion, and LPP – as the largest retailer in Central and Eastern Europe – generated €5.5 billion (Inditex, Annual Report, 2023; LPP S.A., 2024). These figures confirm consumers' growing interest in quick access to clothing, which poses a number of logistical and ethical challenges for the industry.

Globalization, improved information flow, and the development of transport infrastructure have enabled companies to implement offshoring strategies, moving production to countries in the Global South. As a result, Asian countries play a key role in global clothing production and exports. Low manufacturing costs in these regions contrast with the high margins achieved by companies in retail sales, raising questions about the ethical aspects of the fast fashion sector.

This model is based on shortening the life cycle of products, intensifying the rotation of trends, and stimulating consumption. Instead of physical wear and tear, the main factor determining wardrobe replacement is becoming the volatility of aesthetics and fashion. Products are made from low-quality raw materials, which reduces their durability and increases the amount of waste generated. As a result, reverse logistics cannot keep up with the pace of consumption, as evidenced by the growing textile landfills, including in the Atacama Desert.

In addition, the fast fashion sector is sometimes criticized for perpetuating social inequalities in manufacturing countries by maintaining low wages and a lack of regulations on working conditions. These controversies are driving the development of sustainable logistics,

¹ Own study based on the PKO Bank Polski report International Markets: Clothing. Current situation and forecasts until 2028. Economic Analysis Department August 2024.

which aims to reduce carbon footprints, improve supply chain transparency, and build consumer trust.

The growth in clothing sales is generating an increasing demand for efficient warehousing and transportation services. Logistics operators, in order to remain competitive, must demonstrate operational flexibility and the ability to expand the range of services they provide. Establishing long-term cooperation with clothing companies within the framework of joint supply chain management is the foundation for stable revenues and long-term development in this dynamically evolving industry.

4. Methods – Analysis of transport route selection by a selected logistics operator

This section uses an analytical approach – the transport routes of the selected logistics operator were analyzed. Using the analysis of the selected logistics operator's transport routes in the empirical study allowed for:

- Obtaining actual data – analysis of specific routes enabled the assessment of operational efficiency based on actual volumes, distances, and fleet utilization, which increases the reliability of the results.
- Identifying problems and optimization potential – the analysis allowed for the identification of unprofitable routes, unsuitable delivery models, and inefficient resource utilization.
- Adapting recommendations to practice – conclusions and proposed solutions were based on the operator's actual operating conditions, increasing their usefulness and implementation potential.

The entity analyzed in the empirical part of this study is a company acting as a logistics operator. The scope of services provided by the company includes comprehensive transport services, including full truckload (FTL) and less than truckload (LTL) shipments, carried out using semi-trailers and vehicles adapted for local distribution. The cross-docking system plays an important role in the company's operational structure, enabling effective management of the flow of goods, especially in the context of last mile deliveries.

In addition to transport services, the company offers warehouse space rental, full forwarding services, logistics consulting, customs procedures, and support in the area of accounting and bookkeeping. In addition, the company provides comprehensive warehouse services tailored to the individual needs of its customers. The company can be described as a logistics operator which, according to the definition, offers comprehensive logistics solutions in the form of full warehousing, transport, and complementary services (Walasek, 2014).

The logistics operator under analysis mainly handles distribution processes for companies in the clothing industry, but also carries out orders for other customers, usually in the form of groupage transport, temporary storage, or vehicle repairs thanks to its vehicle service facilities.

The customer of the operator in question has stores in many shopping malls throughout Poland. It has seven own brands under its umbrella, which are otherwise referred to as brands. Therefore, there may be several stores of this brand in each shopping center. There are also destinations where there is only one store of this brand.

Deliveries to shopping malls combined with the collection of returns are called rotations. A total of three rotations are carried out during the week, each at night, after the mall closes to customers. The first one takes place on Wednesday night and covers 6 of the 7 brands, while the next day, on Thursday night, goods are delivered to the seventh brand. These two deliveries are collectively referred to as C1. C2, on the other hand, is a weekend rotation, in which transport to stores is organized on Sunday night. This is the delivery with the largest volume of goods, due to the fact that products for all 7 brands are shipped at the same time. From the point of view of logistics specialists, the process of organizing the first rotation of the week begins on Tuesday, when employees at the headquarters in Spain receive data from the customer regarding the volume of goods that will be delivered to Poland from Spain. This data is available in the Extranet system. The information is then entered into the IT system, which acts as a module for creating transport documentation, collecting data on rotations, and entering services for which the customer is invoiced. The turnover volume consists not only of goods arriving in Poland from, among others, Arteixo, Meco, Zaragoza, and Tordera, but also shipments from Lelystad in the Netherlands. In the case of data from Spain, specialists rely on values that largely correspond to the actual volume of goods shipped, while in the case of data from the Netherlands, they rely on forecasts that may differ significantly from actual volumes. After the Spanish side adds actual and probabilistic data to the system, logistics specialists from the distribution department download a report from the system that includes the quantities of clothes and shoes for a given store. By the end of the day, employees also receive orders from customers for items such as packaging materials or furniture stored in the temporary storage warehouse. This data is also added to the system, providing a complete overview of the quantities for a given rotation. Next, the warehouse stocks are updated. The task of the distribution department is to plan the distribution of these quantities, most of which will arrive on semi-trailers, for loading onto smaller delivery trucks. After the volume has been distributed, the demand for trucks is sent by email to specific carriers. The customer also sends files with the quantities of returns for individual stores directly to the branch in Pyskowice. These quantities are assigned to specific routes and checked to see if all returns will fit on the planned vehicle. If not, the customer is notified by email. The distribution department creates documents, which it prints and forwards to the warehouse coordinator: checklists, loading orders, delivery notes for individual stores, and return collection orders.

The implementation of transport processes depends on a number of constraints, including time, capacity, and vehicle load capacity. The most important organizational challenges include: synchronizing warehouse operations with the schedule of trailer arrivals, the effective distribution of goods volumes between vehicles, taking into account their load capacity and the availability of the carrier fleet, monitoring drivers' working hours in the context of the obligation to complete deliveries by 6:00 a.m., adapting to the individual requirements of specific shopping malls and stores, and responding to unforeseen traffic events.

The operational efficiency of the analyzed branch is influenced by both external factors, such as volatility in consumer demand, and internal constraints, which include, among others, the available parameters of the transport fleet and the specific requirements of receiving facilities. The amount of goods transshipped and transported is subject to cyclical changes resulting from seasonal fluctuations in demand for clothing and product range diversity. For example, in the fall and winter, there is an increase in the tonnage of transported cargo relative to its volume, which is due to the characteristics of products such as thicker fabrics and heavier footwear ([https://retailnet.pl/...](https://retailnet.pl/)). A comparison of volume data over time reveals regular fluctuations characteristic of seasonal cycles, as shown in Figure 2.

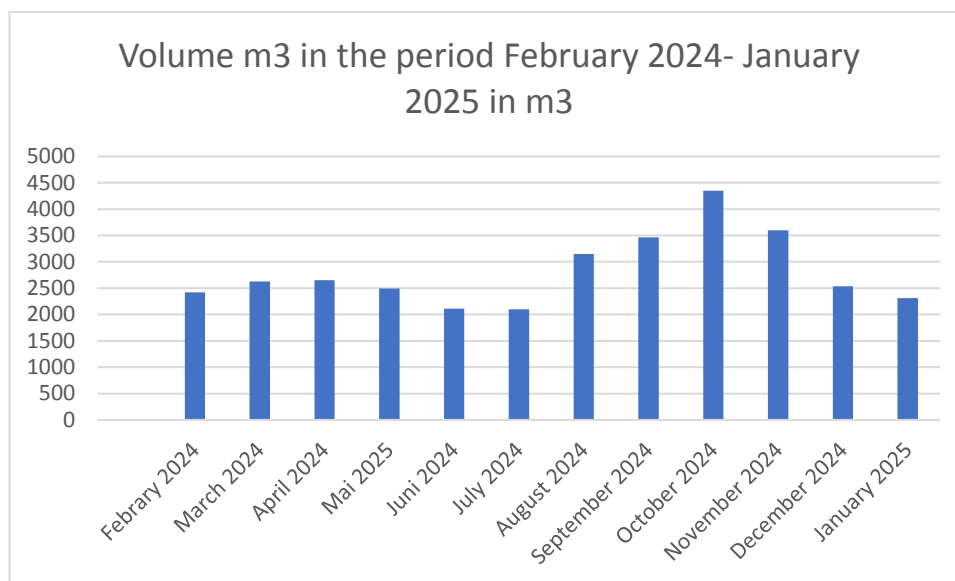


Figure 2. Volume in m3 for the period February 2024 - January 2025.

Source: Study based on Gandawska, 2025; Delimata, 2023, pp. 22-34.

The highest transport demand in the analyzed branch occurs between August and November. In the following months, until the beginning of the next year, there is a significant decrease in the volume of shipments. Therefore, the company increases its demand for carrier services every year to meet customer requirements during peak traffic periods. The billing model assumes that the customer pays for each cubic meter of goods transported, at an average rate of PLN 121.50/m³. In turn, the company settles accounts with carriers based on the cost of renting a vehicle with a specific load capacity, assigned to a specific route. This system creates difficulties in situations where the weight of the goods transported is relatively high while the

volume remains similar. In such cases, vehicles are not fully utilized in terms of load capacity, which leads to cost inefficiency and losses on the part of the logistics operator.

Among the vehicles used by carriers, there are four basic load capacity classes: VS (7 m³, 800 kg), S (12.5 m³, 1250 kg), B (25 m³, 3250 kg), and VB (30 m³, 4000 kg). There is a noticeable difference between the capacity of smaller units (VS and S) and larger ones (B and VB), which makes it difficult to optimally select the means of transport for a specific route — especially when it is necessary to meet the requirements for both the volume and weight of the transported cargo at the same time. In the company's operational practice, there are situations where the weight of the goods exceeds the permissible load for bus-type vehicles, even though their volume would fall within their range. In such cases, it becomes necessary to use larger single-axle vehicles (e.g., 15 EP or 18 EP), which, however, does not translate into full utilization of their cargo space. An analysis of the vehicle load utilization rate indicates that some routes are characterized by a relatively low level (see Table 1), which is often associated with lower profitability of transport on these routes. The destinations generating the lowest margins, and sometimes even losses, include Nowy Sącz, Tarnów, Opole, Ostrava, and Rzeszów.

Table 1.

Summary of the average vehicle load utilization rate and average profit for the period from February 2024 to January 2025, broken down by route

Route	Average vehicle load factor	Average profit
Bielsko-Biała	71%	984,17
Bielsko-Biała + Katowice	89%	1472,44
Bielsko-Biała + Rybnik	81%	1427,21
Częstochowa	65%	839,41
Częstochowa + Kielce	81%	845,09
Katowice	82%	1489,69
Kielce	76%	820,14
Kraków	75%	999,13
Nowy Sącz + Tarnów	52%	-469,81
Opole	62%	224,00
Ostrawa	44%	-101,66
Rybnik	69%	391,26
Rybnik + Katowice	76%	1307,84
Rzeszów	74%	90,10

Source: Own study based on Gandawska, 2025.

Similarly, if we look at which vehicles are more often fully loaded, some of them have a much lower average load factor, which translates into lower profits on a given route (Table 2). The data shows that the lower the load capacity of a truck on a route, the greater the losses for the company.

Table 2.

Summary of the average vehicle load utilization rate and average profit for the period from February 2024 to January 2025, broken down by delivery vehicle size

	Average load percentage	Average profit on a given route
B	69%	638,6545393
S	55%	14,70367113
VB	84%	1459,063648
VS	44%	-435,3734746

Source: Own study based on Gandawska, 2025.

The company's use of VS and S vehicles is primarily due to infrastructure limitations that prevent cars with larger load capacities from entering certain shopping malls. In addition, selected routes have significantly lower delivery volumes compared to other locations. Despite the small amount of goods, the logistics operator's customer expects regular service to these points, which is a consequence of the adopted “fast-fashion” production model. This method of organizing deliveries generates losses for the operator due to the underutilization of cargo space.

At the same time, cooperation with this customer is one of the most profitable for the company — due to long-term business relations and effective communication between the parties, this contractor is a stable source of revenue. The “last mile” stage remains the most sensitive element of the entire transport process in terms of costs, which is why the logistics operator focuses on identifying the causes of the difficulties and optimizing the activities carried out on the route between the warehouse and the shopping mall. The most advantageous solution would be to implement an operational model that would reduce financial losses while maintaining a high standard of customer service and timely deliveries.

The volume of goods transported for the customer shows clear seasonal characteristics. The highest values are observed in the period from August to November, when monthly shipments exceed 3000 m³, with a record level recorded in October 2024 — over 4348 m³. It is worth noting that during this period, both the volume and weight of cargo are significantly higher than in other months. This is probably due to the nature of the product range — from August onwards, stores prepare for the fall and winter season, which involves deliveries of heavier products made of thicker materials.

In the remaining months of the year, the volume of goods transported remains at a level slightly above 2000 m³. The lowest values were recorded in June and July, 2112.97 m³ and 2099.42 m³ respectively. Higher volumes translate directly into higher revenues for the company, mainly because vehicles with greater load capacity can be used on these routes. As previously shown, they are more cost-effective. They enable deliveries to be made with one vehicle instead of several smaller ones, which significantly reduces the unit cost of transport per cubic meter.

An analysis of the regular routes served by a given logistics operator indicates that some of them are critical points in the operational structure, generating high costs while generating low revenues. In the case of these locations, deliveries are primarily aimed at maintaining positive customer relations rather than maximizing profits. They are more of a financial burden than

a source of income, but their presence in the service portfolio is crucial for maintaining stable cooperation and the ability to serve more profitable routes. There are several reasons for the limited economic efficiency of deliveries to these locations. For example, vehicles with lower load capacities must be used for deliveries to Ostrava, which significantly reduces the profitability of transport over longer distances. In the case of Opole and the Nowy Sącz-Tarnów route, the problem is the small volumes of goods transported, which do not allow for the full utilization of logistics potential.

The route to Rzeszów is characterized by low revenues, mainly due to its long distance from Pyskowice. The cost of renting a vehicle for this route is relatively high, which is at odds with the uniform rate per cubic meter that applies to all locations. It is worth noting that, regardless of the destination, the problem of low transport efficiency intensifies during periods of reduced volume, as confirmed by the data for the Nowy Sącz-Tarnów route presented in Table 3.

Table 3.

Summary of profits and load factor broken down by month for the Nowy Sącz-Tarnów route

Route	Average load percentage	Average profit
NOWY SĄCZ + TARNÓW	52%	-469,81
Styczeń	47%	-619,8225
Luty	43%	-735,3950057
Marzec	45%	-661,5975
Kwiecień	45%	-638,655
Maj	51%	-618,1475
Czerwiec	49%	-620,7725
Lipiec	47%	-664,185
Sierpień	64%	-152,005
Wrzesień	62%	-104,345
Październik	65%	-12,175
Listopad	58%	-253,96
Grudzień	49%	-556,6425

Source: Own study based on Gandawska, 2025.

The greatest operational challenges in transport occur between December and July, when the efficiency of logistics processes drops significantly. Similar difficulties occur on less profitable routes, such as Ostrava, Opole, and Rzeszów. For this reason, these months and the indicated directions should be prioritized in optimization efforts. In the case of Rzeszów, the main factor affecting low profitability is the considerable distance from the warehouse. Carriers expect higher rates for deliveries on this route, which is due to the costs associated with the distance. Meanwhile, the customer pays a uniform rate per cubic meter, regardless of the location of the destination. Therefore, it would be reasonable to attempt to renegotiate the financial terms with the carrier in order to reduce costs. In the case of other less profitable destinations, such as Ostrava or the Nowy Sącz-Tarnów route, the main problems are low cargo volumes and the need to comply with tonnage restrictions when entering shopping malls. This forces the use of vehicles with lower load capacities, which translates into higher unit transport costs. Importantly, in each of these locations, the operator delivers to only one shopping center, which further limits consolidation opportunities and increases the cost burden.

Table 4 shows a summary of transport efficiency indicators and measures for the Pyskowice-Nowy Sącz-Tarnów-Pyskowice route, and Table 5 shows a summary of transport efficiency indicators and measures for the Pyskowice-Ostrava-Pyskowice route.

Table 4.

Summary of transport efficiency indicators and measures for the Pyskowice-Nowy Sącz-Tarnów-Pyskowice route

Indicator	average load factor	average profit level	route length	cost per 1 km	cost per 1m ³	transport time
value for the route	52%	-469,81 zł	494 km	3,04 zł	218,66	6,23 h

Source: Own study based on Gandawska, 2025.

Table 5.

Summary of transport efficiency indicators and measures for the Pyskowice-Ostrava-Pyskowice route

Indicator	average load factor	average profit level	route length	cost per 1 km	cost per 1m ³	transport time
value for the route	44%	-101,66 zł	185km	4,59 zł	131,38	2,15 h

Source: Own study based on Gandawska, 2025.

As can be seen, the Pyskowice -Nowy Sącz – Tarnów - Pyskowice route is currently unprofitable, as indicated by the calculations of selected indicators. The average cargo space utilization rate is only 52%, which means that the available cargo space is not being used efficiently. The average cost of transporting 1 m³ is PLN 218.66 (taking into account the price of the most commonly used vehicle on this route, an S-type truck with a load capacity of 12.5 m³), which, considering the rate paid by the customer per m³ (PLN 121.50), means an average loss of PLN 97.16 per 1 m³. For the Pyskowice-Ostrava-Pyskowice route, the results of the calculations are better than for the previously analyzed route, but they are still unfavorable in terms of transport process efficiency. The average cargo space utilization rate is only 44%, which means that more than half of the vehicle's cargo space remains empty and unused for rotation purposes. The cost per 1 km in this case is higher, at PLN 4.59/km, while the cost of transporting 1 m³ is PLN 131.38, which still indicates losses for the company.

5. Results

An analysis of the two least profitable routes indicates that the key factor in improving their profitability is to increase the utilization rate of vehicle capacity. Optimizing this indicator would reduce the unit cost of transport per cubic meter, which, with a billing model based on volume transported, would directly translate into increased revenue. Importantly, these measures are also in line with sustainable development principles. Better use of cargo space

means fewer trips needed to make deliveries, thereby reducing fuel consumption and CO₂ emissions. Reducing the number of vehicles on the road not only improves cost efficiency, but also contributes to reducing the company's carbon footprint, which is an increasingly important element of responsible logistics and the expectations of customers and business partners.

To reduce losses resulting from underutilization of load capacity and varying delivery volumes, the following solutions should be implemented:

1. Consolidation of deliveries within micro-networks: grouping low-volume destinations within a single route or creating local transshipment hubs (e.g., near Tarnów or Rzeszów), from which distribution to several shopping centers would be carried out.
2. Dynamic route planning (routing on demand): use of TMS systems with dynamic route planning based on current data on volume, vehicle availability, and infrastructure constraints, and automatic assignment of vehicle type to a route based on an algorithm that takes into account tonnage, volume, and delivery time.
3. Introduction of time windows with a flexible buffer: negotiation with shopping centers for wider delivery time slots (e.g., 6:00-9:00 a.m. instead of a fixed 6:00 a.m.), which allows for better utilization of the fleet and cost reduction.
4. Use of vehicles with variable bodywork: implementation of a fleet with adaptable cargo space (e.g., modular containers or box bodies), allowing for better adaptation to variable volumes.

To increase operational efficiency and reduce losses resulting from unprofitable routes, it is worth implementing the following measures:

1. Segmenting routes by profitability: routes can be divided into three groups: Highly profitable – high volume, full capacity utilization, and short distances (e.g., Katowice, Wrocław); Medium-profitable – variable volume, partial fleet utilization, moderate distances; and Low-profitable – low volume, long distances, requiring the use of smaller vehicles (e.g., Rzeszów, Ostrava).
2. Introducing flexible delivery models: this involves reducing the frequency of deliveries to low-volume locations while maintaining the SLA (Service Level Agreement) and consolidating deliveries with neighboring points (e.g., Nowy Sącz + Tarnów as a single route). In the context of logistics and B2B cooperation, an SLA means a formal agreement between the logistics operator and the customer that defines the scope of services, quality parameters, performance indicators (KPIs), communication and escalation procedures, and financial consequences. In the case analyzed, the SLA could regulate, for example, the obligation to deliver to shopping malls at specific times, regardless of volume, which impacts route profitability.

3. Revision of rates per cubic meter for selected destinations – negotiating individual rates with the customer for routes with high unit costs (e.g., Rzeszów), instead of applying a flat rate.
4. Sharing resources with other contractors – utilizing the "shared transport" model for low-occupancy routes – sharing a vehicle with the operator's other customers.

To reduce losses resulting from underutilized capacity and fluctuating delivery volumes, it's worth implementing delivery consolidation into micro-networks, dynamic route planning, flexible time windows, and variable-body vehicles. To increase operational efficiency, segment routes based on profitability, limit the frequency of deliveries to low-volume locations while maintaining SLAs, and negotiate individual rates for high-cost destinations. Additionally, sharing resources with other contractors can improve fleet utilization on low-occupancy routes.

6. Discussion and Conclusion

Transport processes carried out by a logistics operator for a customer are carried out according to a strictly defined schedule and on pre-determined routes, with no possibility of ongoing modifications. While the schedule remains unchanged, the route structure can be subject to flexible adjustments, particularly in response to seasonal fluctuations in demand. Decisions in this regard rest with the operator and do not require direct consultation with the customer. Based on the analysis of the current delivery model, it seems justified to implement measures aimed at improving service profitability by redesigning the route system. Particular attention should be paid to routes generating the highest financial losses. One possible solution is to combine unloading points to enable better utilization of vehicle cargo space, which would reduce unit transport costs and increase operational efficiency. A key aspect in this context is the seasonality of transported goods volumes, which should be taken into account when planning routes. Systematic monitoring of key performance indicators (KPIs), such as vehicle capacity utilization and transport cost per cubic meter, is also necessary. It's worth emphasizing, however, that despite the potential benefits of improved cargo space utilization and cost reduction, the proposed changes may pose operational risks. For years, the operator has operated based on a fixed route network, which may lead to resistance from employees at the transshipment warehouse in Pyskowice and regular carriers accustomed to the current work model. Implementing a new system may result in organizational challenges, including adjusting route lengths and unloading time windows. Therefore, it is recommended to supplement the proposed actions with FMEA (Failure Mode and Effects Analysis) and PHA (Preliminary Hazard Analysis), which will allow for the design of a new routing model that takes into account potential threats and operational risks. This will be the subject of further research and implementation.

References

1. Bławat, D., Kalkowski, K. (2012) *Transport intermodalny w Polsce. Teraźniejszość i przyszłość*. Łódź: Wydawnictwo Politechniki Łódzkiej.
2. Boichuk, N. (2022). *Fast fashion – wpływ na środowisko i społeczeństwo*. ResearchGate.
3. Boichuk, N. (2022). *Logistyka ostatniej mili jako najdroższy odcinek łańcucha dostaw*.
4. Borucka, A., Jednas, M. (2017). Transport intermodalny w Polsce w świetle europejsko-azjatyckich szlaków przewozowych. *Systemy Logistyczne Wojsk*, nr 47.
5. Centrum Analiz PKO BP (2024). *Branża odzieżowa: Sytuacja bieżąca i prognozy rozwoju rynku do 2028*.
6. Centrum Analiz PKO BP (2024). *Branża odzieżowa: Sytuacja bieżąca i prognozy rozwoju rynku do 2028*. <https://centrumanaliz.pkobp.pl>
7. Christopher, M. (2016). *Logistics & Supply Chain Management (5th ed.)*. Pearson Education.
8. Cichosz, M. (2020). *Drony w logistyce ostatniej mili – innowacja wspierająca zrównoważoną logistykę*. Szkoła Główna Handlowa w Warszawie.
9. Ciesielski, M. (2005). *Rynek usług logistycznych*. Warszawa: Difin.
10. Czajkowski, M. (2023). Zmiany w polskim sektorze tekstylno-odzieżowym. In: *Zarządzanie i Finanse*. Uniwersytet Łódzki.
11. Dąbek, A. (2013). Pierwszy/ostatni kilometr w transporcie. *Zarządzanie Innowacyjne w Gospodarce i Biznesie: czasopismo naukowe o problemach współczesnego zarządzania*, 2.
12. Delimata, O. (2023). Marki Zara i Reserved jako przykłady rozwoju e-commerce. In: P. Hanczar, N. Szozda (eds.), *Logistyka i transport* (pp. 22-34). Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.
13. *Dynamika sprzedaży detalicznej w styczniu – marcu 2025 r.* (2025). Warszawa: Główny Urząd Statystyczny.
14. Gandawska, M. (2025). *Problemy organizacji procesów transportu wyrobów odzieżowych przez wybranego operatora logistycznego*. Praca magisterska napisana pod kierunkiem dr inż. Jadwigi Grabowskiej, Zabrze.
15. Ghemawat, P. (2018). *Redefining Global Strategy: Crossing Borders in a World Where Differences Still Matter*. Harvard Business Review Press.
16. Gołębska, E. (ed.) (2010). *Kompendium wiedzy o logistyce*. Warszawa: PWN.
17. Grabowska, J. (2023). Realizacja procesów logistycznych w logistyce międzynarodowej z uwzględnieniem roli operatorów logistycznych. *Management and Quality*, vol. 5.
18. Guzowski, M., Szpilko, D. (2025). *Nowoczesne technologie i rozwiązania usprawniające logistykę ostatniej mili w e-commerce*. Akademia Zarządzania PB.

19. H&M Group. *Annual and Sustainability Report 2023*. <https://hmgroup.com/wp-content/uploads/2024/03/HM-Group-Annual-and-Sustainability-Report-2023.pdf>, 1.09.2025.
20. H&M Group (2023). *Sustainability Performance Report 2023*. <https://hmgroup.com>
21. Inditex Group (2023). *Annual Report 2023*. <https://www.inditex.com>
22. Inditex. *Annual Report 2023*. <https://annualreport2023.inditex.com/en/2023-en-cifras>, 1.09.2025.
23. Józwiak, K. (2019). Problematyka doboru pojazdów do zadań w przedsiębiorstwach. *Systemy Logistyczne Wojsk*, no. 50.
24. Kautsch, A. (2018). *Organizacja transportu oraz obsługa klientów i kontrahentów. Część I*. Warszawa: Wydawnictwa Komunikacji i Łączności.
25. Kołata, D. (2020). Ostatnią milą do automatu paczkowego. *Logistyka*, no. 5.
26. KPMG (2023). *Zrównoważony rozwój w branży mody – oczekiwania konsumentów i wyzwania dla firm*. Warszawa: KPMG Polska.
27. Kulpa, T. (2009). Transport ładunków – klasyfikacja i przegląd modeli podróży. *Zeszyty Naukowo-Techniczne SITK RP*. Kraków.
28. LPP S.A. (2024). *Raport roczny 2023/2024*. Gdańsk: LPP. <https://www.lpp.com>
29. LPP S.A. *Over PLN 17bn in sales revenue and a record profit – LPP summarises financial results for 2023*, komunikat prasowy z 27.03.2024. <https://www.lpp.com/en/press-releases/over-pln-17bn-in-sales-revenue-and-a-record-profit-lpp-summarises-financial-results-for-2023>, 1.09.2025.
30. Neider, J. (2008). *Transport międzynarodowy*. Warszawa: PWE.
31. Ocicka, B. (2020). Role interesariuszy w rozwoju transportu multimodalnego w świetle wyników badań w Projekcie ChemMultimodal. *Gospodarka Materialowa i Logistyka*, no. 2.
32. *Own study based on the PKO Bank Polski report International Markets: Clothing. Current situation and forecasts until 2028*. Economic Analysis Department, August 2024.
33. Różański, M. (2024). Wybrane trendy w branży motoryzacyjnej a przyszłość logistyki ostatniej mili. *Zeszyty Studenckie „Nasze Studia”*, 14. Gdańsk.
34. Rucińska, D., Wojewódzka-Król, K. (2017). *Polityka transportowa*. Warszawa: PWN.
35. Sales Intelligence (2020). *Raport e-commerce: Rynek fashion w Polsce*. https://salesintelligence.pl/wp-content/uploads/2020/07/Raport_ecommerce_rynek_fashion_2020_Sales_Intelligence.pdf
36. Sieć Badawcza Łukasiewicz. Poznański Instytut Technologiczny (2023). *Efektywna ostatnia mila – Cykl „Obok logistyki”*. Podcast i analiza. <https://pit.lukasiewicz.gov.pl/o-technologie-na-glos-odcinek-109-efektywna-ostatnia-mila-cykl-obok-logistyki/>
37. Skowron-Grabowska, B. (2019). *Logistyka międzynarodowa*. Częstochowa: Wydawnictwo Politechniki Częstochowskiej.
38. Statista (2024). *Apparel Market – Global Revenue Growth 2020-2023*. www.statista.com

39. Stochaj, J., Śliżewska, J. (2017). *Podstawy logistyki*. Warszawa: WSiP.
40. UNCTAD (2022). *Review of Maritime Transport. United Nations Conference on Trade and Development*.
41. Urbanyi-Popiołek, I. (2013). *Ekonomiczne i organizacyjne aspekty transportu*. Bydgoszcz: Wydawnictwo Uczelniane Wyższej Szkoły Gospodarki w Bydgoszczy.
42. Walasek, J. (2014). Logistyczna obsługa klienta na przykładzie operatora logistycznego. *Zeszyty Naukowe Politechniki Śląskiej. Transport*. Gliwice.
43. Witkowski, J. (2020). *Zarządzanie łańcuchem dostaw*. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.
44. World Bank (2023). *Logistics Performance Index*. Retrieved from: <https://lpi.worldbank.org>
45. Woźniak, D. (2007). Bezpieczeństwo przewozu paliw płynnych w cysternach. *Przegląd Wojsk Lądowych, 1*.
46. Woźniak, D., Kukielka, L. (2011). Niektóre aspekty logistyki transportu. *Autobusy. Technika, Eksploatacja, Systemy Transportowe, 5*.

IN UNIFORM WITHOUT COMMITMENT? GENERATIONAL FACTORS CONTRIBUTING TO QUIET QUITTING FROM MILITARY SERVICE

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Purpose: The phenomenon of quiet quitting has been the subject of focused analysis for several years, serving as a starting point for a deeper understanding of contemporary employment mechanisms. In the context of the Polish Armed Forces, as a public institution with a mission-driven character, this issue takes on particular significance, affecting morale, operational effectiveness, and personnel stability. The aim of the conducted research was to identify and monitor indicators that support the strengthening of soldier engagement in service. These studies not only enhance the understanding of organizational loyalty mechanisms within the military but also enable the diagnosis of potential risks associated with psychological disengagement from service.

Design/methodology/approach: The article presents the results of empirical studies conducted in 2019/2020 and 2023, aimed at identifying factors that may contribute to the phenomenon of quiet quitting in the military.

Findings: A comparative analysis revealed a high degree of consistency in the cluster structure of resignation reasons, independent of generational affiliation. The factors were categorized into two groups: those related to the employer and those related to the nature of the work. The results confirm that the decision to continue military service depends not only on financial aspects, but also on a sense of purpose, available career paths, the quality of interpersonal relationships, and the alignment of organizational values with individual attitudes and generational expectations. The identified indicators provide a foundation for designing effective human resource management strategies in the military, particularly in the context of increasing security threats and the need to maintain a high level of personnel engagement.

Research limitations/implications: Due to the non-representative nature of the research sample, the results have limited generalizability.

Social implications: The obtained results were analyzed with consideration of generational differences among the surveyed soldiers, which led to the rejection of the hypothesis that the reasons for leaving military service vary depending on generational affiliation (Generations X, Y, Z).

Originality/value: The research findings hold both cognitive and practical value. They enhance the understanding of the psychosocial determinants behind decisions to leave military service,

which in turn may inform the development of effective human resource management strategies within the armed forces.

Keywords: quiet quitting, military service, engagement.

Category of the paper: Research article.

1. Introduction

The phenomenon of quiet quitting, understood as the withdrawal of employees from active engagement in professional duties while formally remaining within the organization, has garnered increasing attention across both private and public sectors. In the case of public institutions such as the Polish Armed Forces, this issue assumes particular significance due to their mission-driven nature, hierarchical structures, and the critical importance of personnel continuity and high morale for national security. Unlike market-based organizations, public institutions are characterized by limited flexibility in human resource management, strong regulatory constraints, and the necessity to fulfill tasks regardless of staffing conditions.

Considering the war in Ukraine and the tangible threat of destabilization along Poland's eastern border, the resilience of the Polish Armed Forces as a public organization has become increasingly vital. This necessitates not only the expansion of human resources but also the sustained commitment of military personnel. One of the potential threats to the operational effectiveness of the armed forces is a decline in soldier motivation, particularly in the context of structural changes following 2015, which saw an almost complete turnover of command staff. These transformations may have influenced perceptions of organizational stability, trust in leadership, and the meaningfulness of service, especially among younger generations of soldiers.

This article presents the findings of two empirical studies conducted by the author at the turn of 2019/2020 and 2023. The aim of these studies was to identify and monitor indicators conducive to strengthening soldiers' engagement in military service. These investigations not only enhance our understanding of the mechanisms underlying organizational loyalty within the military but also facilitate the diagnosis of potential risks associated with psychological disengagement from service.

The research findings possess both cognitive and practical value. They contribute to a deeper understanding of the psychosocial determinants influencing decisions to leave the service, which in turn may inform the development of effective human resource management strategies within the armed forces. Identifying risk factors associated with quiet quitting enables the implementation of preventive measures, such as the adjustment of career development pathways, command support programs, and strategic internal communication. In the context of growing demand for highly qualified and motivated military personnel, the application of the findings presented in this article may provide substantial support for the long-term personnel policy planning of the Polish Armed Forces.

2. Quiet Quitting - Literature review

Since 2022, the issue of quiet quitting has increasingly attracted scholars from various disciplines, who have sought to explain and assess the scale of this phenomenon across different sectors. The term quiet quitting gained widespread attention on social media following the viral TikTok video posted in July 2022 by 24-year-old software engineer and musician Zaid Khan (Scheyett, 2022; Çimen, Yılmaz, 2023). Since then, the popularity of the concept, particularly within corporate environments, has evolved into a broader cultural phenomenon (Salvucci, 2023). The heightened interest in quiet quitting can be attributed to the pandemic period and the accompanying shift in employee value systems (Christian, 2022).

The term quiet quitting is often used interchangeably with silent resignation (Lipiński, Koczy, 2023), which underscores that the phenomenon should not be mistaken for actual employee turnover, but rather for a decline in engagement with professional responsibilities (Anand et al., 2023). Although these individuals do not formally resign, they psychologically distance themselves from discretionary tasks (Rugiubei, Cruceanu, 2024). As Z. Khan emphasized: “I recently learned about the term ‘quiet quitting,’ where you’re not outright quitting your job, but you’re quitting the idea of going above and beyond. You’re still performing your duties, but you’re no longer subscribing to the mentality that work is life. The reality is that work is not life. Your worth as a person is not defined by your job” (Khan, 2022).

As work ceases to be a central value, it no longer provides satisfaction, and employees increasingly seek to delineate the boundaries between their personal and professional lives (Jackowska, 2023). Lu et al. (2023) define quiet quitting as a situation in which employees perform only the minimum required tasks and are psychologically detached from their work. Similarly, Öztürk et al. (2023) highlight the reduction of responsibility for work outcomes, while Galanis et al. (2023) emphasize the absence of formal resignation despite inappropriate workplace behavior. Molchan & Clore (2023) associate quiet quitting with a loss of motivation, lack of communication with colleagues, and organizational isolation, describing it as a scenario in which the employee “slips out the back door” at the end of the workday.

Although quiet quitting has become a subject of focused research in recent years, it would be erroneous to consider it a completely new or previously unnoticed phenomenon. Yasemin & Sürmeli (2023) identify its roots in the need to improve work-life balance, with employees adopting quiet quitting as a strategy for maintaining well-being (Bakotic, 2023). Niko (2022) also points to employees’ experience of a lack of meaning, usefulness, and agency in their work. Some researchers interpret quiet quitting as a manifestation of occupational burnout (Hamouche et al., 2023), while others link it to excessive work-related stress (Morrison-Beed, 2022; Loewy, Spintge, 2022). Moczyłowska (2024) emphasizes the emotional dimension of the phenomenon, noting that quiet quitting is reflected in a decline in emotional engagement with tasks and

interpersonal relationships. Emotional involvement is replaced by rational calculation: “I do only what is required - nothing more” (Bell, Kennebrew, 2023), which aligns quiet quitting with the concept of social loafing (Bell, Kennebrew, 2023).

A high proportion of employees experiencing quiet quitting signals a crisis in management, not only in the areas of motivation and employee experience, but also in recruitment and development practices. It is also important to consider the potential for quiet quitting to spread from one employee to others, particularly when it involves supervisors whose lack of motivation and engagement often contributes to diminished commitment among subordinates. Researchers confirm that leadership positively influences work engagement (e.g., Decuypere, Schaufeli, 2021), thereby serving as a potential remedy for quiet quitting. This was corroborated by Gigol, who demonstrated the positive impact of servant leadership on work engagement and reduced turnover intention. Furthermore, the author noted that servant leadership, through its effect on engagement, mitigates both quiet quitting and the intention to leave the organization. He also emphasized that quiet quitting does not directly lead to turnover intention, thereby challenging its association with occupational burnout (Gigol, 2023).

Not only servant leadership but also transformational leadership may contribute to reducing turnover intention among employees (Saira et al., 2020), further underscoring the importance of supervisor-subordinate relationships and the need to enhance leadership competencies. As Mousa et al. (2020) point out, job satisfaction is directly linked to managerial behavior, and leadership that neglects the emotional context of work contributes to shifts in employee behavior. This leads to what is referred to as a leadership crisis (Zenger, Folkman, 2022). Additionally, quiet quitting can be associated with a loss of trust in supervisors and a reluctance to exert effort when employers fail to prioritize employee well-being (Caldwell et al., 2023).

Gigol (2023), based on the results of his empirical research, defined quiet quitting as a phenomenon of active disengagement from work, stemming from a deliberate employee attitude. He conceptualizes it as a strategy of aligning one’s professional activity with working conditions and personal preferences, which corresponds with Detert’s perspective that frames quiet quitting as a form of calibrated contribution (Detert, 2022).

Referring to Gigol’s findings, it is pertinent to invoke the *Job Demands-Job Resources Theory* developed by Bakker and Demerouti. According to this framework, every job entails risk, both in terms of professional demands (*demand factors*) and the availability of resources necessary to perform the work (*resource factors*). Job demands and resources are two key dimensions influencing organizational performance and employee well-being, particularly in the context of burnout and work engagement (Bakker, Demerouti, 2017). Demands are associated with physical, emotional, and cognitive effort, often leading to stress, whereas aspects such as social support, autonomy, and development opportunities are considered job resources. These resources help employees cope with demands, support learning and growth, and facilitate goal achievement. Therefore, investing in job resources can be viewed as a strategic approach to mitigating the prevalence of quiet quitting (Rahmadara, Rachmawati, 2025).

The causes of quiet quitting can also be interpreted through the lens of *Social Exchange Theory*, which posits that employees reduce their level of engagement when they perceive an imbalance between their contributions and the benefits received. Arar et al. (2023) highlight the phenomenon of trust and engagement erosion, often resulting from perceived injustice related to workload, compensation, or recognition, despite adherence to social norms of fairness.

In professions that rely heavily on teamwork, quiet quitting poses an even greater threat. Employees exhibiting this behavior may show limited interest in assisting colleagues, reduced engagement in their own responsibilities, and a tendency to perform only the minimum required by their job descriptions. Furthermore, the negative consequences of quiet quitting include diminished motivation for professional development and learning, weakened organizational ties, and a decline in loyalty toward the employer (Ng, Stanton, 2023).

Quiet quitting can thus be linked to *toxic organizational cultures*, where relationships based on mutual respect and shared values deteriorate (Lyons, 2022). In such environments, employees may fear coming to work, feel unable to be honest with their supervisors, and perceive the organization as treating them unfairly (Mirza, 2019). This treatment undermines the organization's ability to retain top talent and contributes to dysfunctional behaviors (Appelbaum, Roy-Girard, 2007).

However, it is important to note that quiet quitting may also have positive aspects. Its emergence on a larger scale reflects employees' growing need to safeguard their mental health and prevent burnout (Zhang, Rodrique, 2023). Serenko (2022) argues that by maintaining a healthy balance between work and other life domains, employees become more assertive and consistently set boundaries, which serves as a preventive measure against pathological organizational dynamics. As Moczydłowska & Moczydłowska emphasize: "Quiet quitting does not exclude greater engagement or the willingness to devote additional time to tasks when employees believe in the value of a specific project or the mission of the organization, care about the people they work with or serve, or genuinely enjoy solving the problems their work presents" (2024, p. 34).

Therefore, a key strategy for reducing the incidence of quiet quitting is to improve working conditions and foster a sense of purpose by highlighting the significance of specific tasks and the role of employees in project success.

Certain professions such as those of soldiers, police officers, firefighters, and physicians, require intense physical and psychological effort and may also be emotionally taxing, leading to stress. In these roles, the interaction between job demands and resources is particularly critical. An increase in professional demands, such as workload, cognitive challenges, and emotional requirements, may result in psychological stress, burnout, and psychosomatic symptoms. However, this outcome is not inevitable; it depends on the availability of job resources. Hence, it is essential to equip employees with diverse skills, provide constructive feedback, and offer *developmental feedback*. Enhancing job resources serves as a buffer against

the adverse effects of demanding work conditions, thereby preventing disengagement and quiet quitting.

It is also crucial to emphasize that without an individualized approach to employees and an understanding of their emotional states, addressing disengagement becomes exceedingly difficult. The expression and scope of quiet quitting vary depending on social norms, cultural context, organizational structures, and perceptions of professional boundaries. The causes of quiet quitting are also individually determined and may stem from internal factors (such as personal values, personality traits, and experiences), environmental factors (such as family circumstances), and organizational factors (such as leadership quality, organizational culture, motivational systems, and development opportunities). Therefore, conducting in-depth research within specific professional groups is essential to identify the primary drivers of quiet quitting and to develop targeted intervention programs tailored to the organization, the nature of the work, and the employees themselves.

3. Methods

The findings presented in this study constitute part of the research material collected within two scientific projects conducted at War Studies University. The first project: *Shaping Soldier Engagement in the Armed Forces: An Organizational Perspective*, was carried out between 2019 and 2020. The second, titled *Changes in Personnel Policy in the Armed Forces and Soldier Engagement in Service*, was implemented in 2023. The primary objective of both projects was to analyze the factors influencing soldier engagement and to identify barriers that may lead to resignation from military service.

Both studies employed the same research procedure. Data were collected using a proprietary questionnaire composed of closed-ended questions. The respondents were soldiers participating in educational programs at War Studies University both in degree programs and specialized training courses. The sample was selected purposefully, based on the assumption that participants had at least several years of service experience and had held command or specialist positions within the structures of the Polish Armed Forces. This approach enabled the collection of perspectives from individuals qualified to assess the organizational conditions of service and personnel policy within the military.

In total, 158 soldiers participated in the first edition of the study (2019/2020), and 159 in the second (2023). In both cases, the sample was predominantly male - 85.4% in 2019 and 84.8% in 2023. The majority of respondents held command positions - 58.2% in 2019 and 66.5% in 2023. In the 2019 study, the average length of service was 17 years (ranging from less than one year to 40 years), while in 2023 it was 13 years (ranging from less than one year to 36 years). These data confirm that the analysis focused on an experienced professional group

capable of accurately diagnosing both the motivations for continuing service and the reasons for resignation.

In the analysis presented in this article, particular attention was given to responses to the question: *What factors could lead you to leave military service in the Armed Forces?* in which respondents could indicate up to five key factors. The results were analyzed with consideration of generational differences among the surveyed soldiers, to test the hypothesis that *the reasons for leaving military service vary depending on generational affiliation (Generations X, Y, Z)*.

4. Results

Statistical analyses were conducted using JASP version 0.19.3 and IBM SPSS Statistics version 29.0. In the first step, a hierarchical cluster analysis was performed to identify the most coherent groups of reasons for leaving military service based on data from 2019/2020 and 2023. The purpose of this clustering was to group similar reasons indicated by respondents, thereby revealing patterns in the factors contributing to resignation from service. The analysis employed the agglomerative *Ward.D2* method, which minimizes the total within-cluster squared distances, promoting the formation of clusters with similar sizes and compact structures. Binary distance was used as the similarity measure, appropriate for dichotomous (0-1) data. The analysis was conducted separately for the datasets from 2019/2020 and 2023.

The survey used in this study was a proprietary tool developed specifically for this project. Its purpose was to obtain descriptive and exploratory data related to the specific research context of reasons for leaving the service. Because the survey is not a standardized tool, full validity and reliability analyses were not conducted.

Based on visual inspection of the dendrograms, a two-cluster solution was selected, as it clearly separated distinct groups of reasons at a higher level of the hierarchy. This approach was deemed to best reflect the structure of similarities among the reasons for leaving military service. The two-cluster division was identified for both the 2019 dataset (Figure 1) and the 2023 dataset (Figure 2).

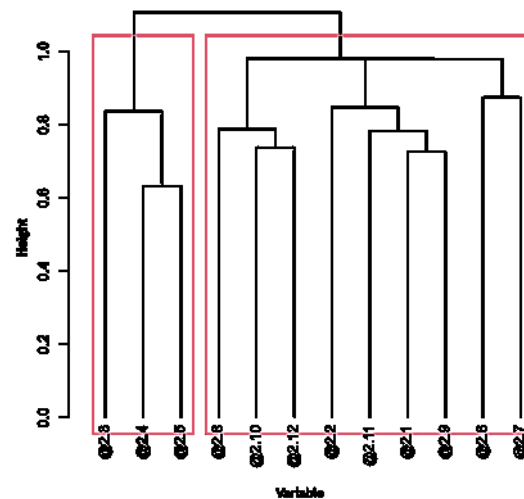


Figure 1. Dendrogram illustrating clusters of resignation factors in military service – data from 2019/2020.

Source: Own research results.

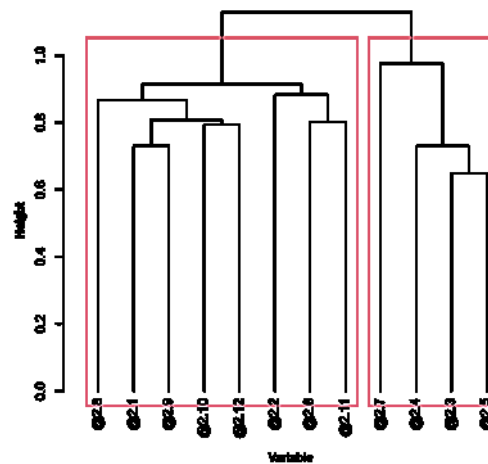


Figure 2. Dendrogram illustrating clusters of resignation factors in military service – data from 2023.

Source: Own research results.

Both cluster solutions proved to be similar. For the 2019 dataset, the division was as follows:

Cluster 1. Employer-related reasons:

- Perception of the Armed Forces as an unattractive employer in the labor market.
- Low base salary relative to military rank.
- Unattractive financial and non-financial benefits (e.g., salary supplements, military pension system).

Cluster 2. Work-related reasons:

- Discrepancy between the declared mission and values of the Armed Forces and their actual implementation.
- Limited organizational development opportunities within the military.
- Lack of career advancement in command roles within the prestigious profession of soldiering.

- Possibility of working in a low-prestige team, as soldiers are perceived in the labor market.
- Low attractiveness of tasks performed by soldiers.
- Uninteresting working conditions and repetitive tasks.
- Unengaging training and unclear rules for acquiring practical military qualifications.
- Lack of career progression and opportunities to attain higher ranks and positions.
- Limited access to contemporary knowledge and modern work tools.

For the 2023 dataset, the division was as follows:

Cluster 1. Employer-related reasons:

- Perception of the Armed Forces as an unattractive employer in the labor market.
- Low base salary relative to military rank.
- Unattractive financial and non-financial benefits (e.g., salary supplements, military pension system).
- Possibility of working in a low-prestige team, as soldiers are perceived in the labor market.

Cluster 2. Work-related reasons:

- Discrepancy between the declared mission and values of the Armed Forces and their actual implementation.
- Limited organizational development opportunities within the military.
- Lack of career advancement in command roles within the prestigious profession of soldiering.
- Low attractiveness of tasks performed by soldiers.
- Uninteresting working conditions and repetitive tasks.
- Unengaging training and unclear rules for acquiring practical military qualifications.
- Lack of career progression and opportunities to attain higher ranks and positions.
- Limited access to contemporary knowledge and modern work tools.

The only difference between the two datasets concerned the classification of the reason “Possibility of working in a low-prestige team, as soldiers are perceived in the labor market”. In the 2019/2020 data, this factor was assigned to the work-related cluster, whereas in the 2023 data, it was included in the employer-related cluster. No other differences were observed. It can be concluded that the first cluster encompassed reasons related to financial and institutional aspects, while the second cluster included reasons associated with the nature of the work.

The comparative analysis of the 2019/2020 and 2023 results demonstrated a high degree of consistency in the cluster structure identifying reasons for leaving military service. In both editions, two main clusters were distinguished. The first group included employer-related factors, primarily financial and institutional in nature, while the second group referred to work characteristics, including the sense of purpose, opportunities for professional development, and the quality of daily work experience. The only difference between the years

was the reassignment of the factor concerning work in a low-prestige team - from the work-related cluster in 2019/2020 to the employer-related cluster in 2023. This may indicate a shift in the social perception of the military as an institution or a change in how sources of professional dissatisfaction are interpreted.

Subsequently, a comparative analysis of the identified clusters was conducted based on generational affiliation. For the 2019 dataset, a chi-square test of independence revealed no significant relationship between the choice of reason cluster and generational affiliation, $\chi^2(2) = 1.82$; $p = 0.403$; $VC = 0.11$. Generation Z respondents selected work-related reasons slightly more often than the other two generations. The results of the analysis are presented in Figure 3.

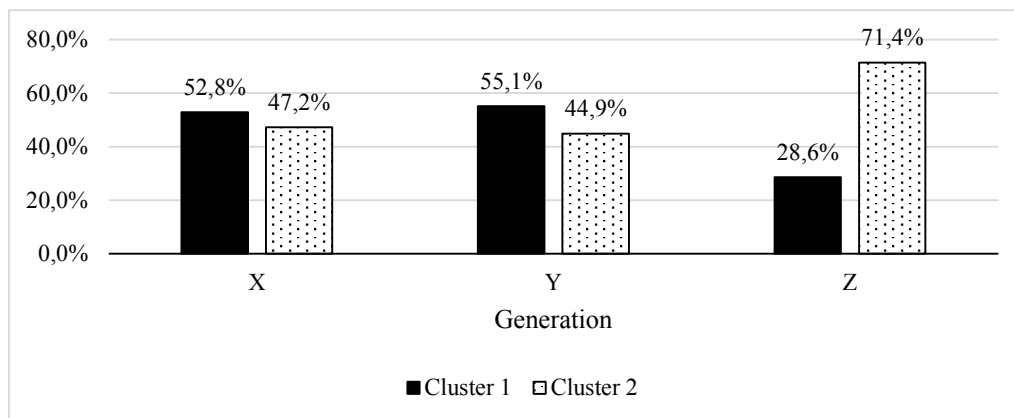


Figure 3. Percentage distribution of resignation reasons by generation – 2019/2020 dataset.

Source: Own research results.

Analogous analyses were conducted for the 2023 dataset. The results again indicated no statistically significant relationship between the selection of resignation reason clusters and generational affiliation, $\chi^2(2) = 0.05$; $p = 0.977$; $VC = 0.02$. Across all generations, respondents slightly more frequently selected reasons related to the employer and slightly less frequently those associated with the nature of the work itself. The results of these analyses are presented in Figure 4.

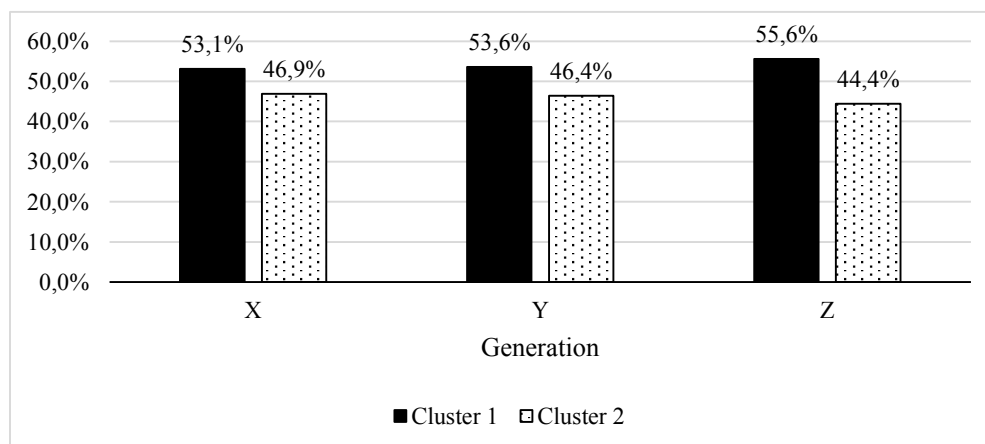


Figure 4. Percentage distribution of resignation reasons by generation – 2023 dataset.

Source: Own research results.

The presented results did not confirm the research hypothesis, generation did not prove to be a significant factor differentiating the structure of reasons for leaving military service. This may indicate the universal nature of the determinants of professional dissatisfaction within the Polish Armed Forces. Accordingly, it is reasonable to adopt the conceptual framework suggesting that the decision to continue or terminate service is influenced by financial factors, the quality of interpersonal relationships, available career paths, and the overall perception of the military institution as a workplace.

The identified indicators capture the complexity of decision-making mechanisms and situate them within a broader organizational and social context, representing a valuable contribution to the development of personnel policy in the defense sector.

The analyzed reasons for leaving military service, if sustained over a longer period, may contribute to actual resignations among soldiers. Nevertheless, it remains indisputable that these factors significantly determine the scale of the quiet quitting phenomenon, which, given the nature of military service as a profession of public trust, constitutes a negative development.

5. Conclusions

The phenomenon of quiet quitting is subject to detailed analysis across various industries and professions. Researchers seek to identify its causes and potential consequences, while also undertaking efforts not only to estimate its scale but to pinpoint changes in the work environment that could reduce or eliminate its occurrence. Quiet quitting manifested through reduced engagement, lower activity levels, and a lack of job satisfaction, is frequently associated with leadership crises and toxic organizational cultures. Referring to *Social Exchange Theory*, it can be argued that employees decrease their level of engagement when they perceive an imbalance between their contributions and the benefits received. Drawing on the *Job Demands-Job Resources Theory*, particular emphasis should be placed on the importance of maintaining adequate job resources in relation to demands. Job resources must be carefully nurtured to enhance employees' capacity to cope with professional demands, while simultaneously supporting their development, learning, and goal attainment.

The research findings indicate that addressing the phenomenon of quiet quitting requires not only personnel-related actions but also the reinforcement of leadership at all levels of command. This involves the development of communication competencies, empathy, and motivational skills within a structure based on discipline and command. In the context of Poland's NATO membership and the ongoing war in Ukraine, the stability of personnel and the maintenance of high morale among soldiers become particularly significant. This calls for an effective system of psychological and organizational support. It is also recommended to implement mechanisms for the early identification of professional withdrawal symptoms,

especially in units with elevated combat readiness. Further research should focus on analyzing the relationship between leadership style and soldiers' engagement levels, as well as evaluating the effectiveness of preventive measures undertaken within NATO structures. Another important direction involves examining how the experience of real military threat influences the redefinition of loyalty, motivation, and the sense of purpose in service among soldiers of different generations.

References

1. Anand, A., Doll, J., Ray, P. (2024). Drowning in silence: a scale development and validation of quiet quitting and quiet firing. *International Journal of Organizational Analysis*, 32(4), 721-743. <https://doi.org/10.1108/IJOA-01-2023-3600>
2. Appelbaum, S.H., Roy-Girard, D. (2007). Toxins in the Workplace: Effect on Organizations and Employees. *Corporate Governance*, 7(1), 17-28. <http://dx.doi.org/10.1108/14720700710727087>
3. Arar, T., Cetiner, N., Yurdakul, G. (2023). Quiet quitting: Building a comprehensive theoretical framework. *Akademik Arastirmalar ve Calismalar Dergisi (AKAD)*, 15(28), 122-138. <https://doi.org/10.20990/kilisiibfakademik.1245216>
4. Bakker, A.B., Demerouti, E. (2008). Toward a model of work engagement. *Career Development International*, 13(3), 209-223. <https://doi.org/10.1108/13620430810870476>
5. Bakotić, D. (2023). Relationship Between Quiet Quitting and Leadership Orientation: The Case of Croatian Employees. *DIEM Dubrovnik International Economic Meeting*, 8(1), 38-45. <https://doi.org/10.17818/diem/2023/1.5>
6. Bell, R.L., Kennebrew, D. (2023). What does Jean-Jacques Rousseau and Chester I. Barnard have to do with quiet quitting? *American Journal of Management*, 23(1), 1-11. <https://doi.org/10.33423/ajm.v23i1.5869>
7. Caldwell, S., Ferguson, H., Mills, R. (2023). The role of cognitive beliefs and emotional attitudes in quiet quitting: An application of the theory of reasoned action. *Human Resource Management Review*, 33(1), 37-55.
8. Christian, A. (2022, August 29). *Why 'quiet quitting' is nothing new*. BBC Worklife. <https://www.bbc.com/worklife/article/20220825-why-quiet-quitting-is-nothing-new>
9. Çimen, A.İ., Yılmaz, T. (2023). How Silent is Silent Quitting? *Sakarya University Journal of Management Institute*, 5(1), 27-33.
10. Decuyper, A., Schaufeli, W. (2021). Exploring the leadership-engagement nexus: A moderated meta-analysis and review of explaining mechanisms. *International Journal of Environmental Research and Public Health*, 18(16), 8592. <https://doi.org/10.3390/ijerph18168592>

11. Detert, J. (2023). Let's call quiet quitting what it often is: Calibrated contributing. *MIT Sloan Management*, 64313.
12. Galanis, P., Katsiroumpa, A., Vraka, I., Siskou, O., Konstantakopoulou, O., Moisoglou, I., Gallos, P., Kaitelidou, D. (2023). The quiet quitting scale: Development and initial validation. *AIMS Public Health*, 10(4), 828-848. <https://doi.org/10.3934/publichealth.2023055>
13. Gigol, T. (2023). Czym jest, a czym nie jest cicha rezygnacja. Wpływ przywództwa służebnego i zaangażowania w pracę na cichą rezygnację i zamiar odejścia z pracy. *Zarządzanie Zasobami Ludzkimi*, 154(5), 11-29. <https://doi.org/10.5604/01.3001.0054.0084>
14. Hamouche, S., Koritos, C., Papastathopoulos, A. (2023). Quiet quitting: relationship with other concepts and implications for tourism and hospitality. *International Journal of Contemporary Hospitality Management*, 35(12), 4297-4312. <https://doi.org/10.1108/IJCHM-11-2022-1362>
15. Jackowska, W. (2023, January 19). *Quiet quitting: Wszystko, co musisz wiedzieć o cichej rezygnacji*. <https://www.karierawfinansach.pl/artykul/wiadomosci/quiet-quitting>
16. Khan, Z. (2022, July 25). *On quiet quitting #workreform*. <https://www.tiktok.com/@zaidleppelin/video/7124414185282391342?q=zaidleppelin&t=1686494681977>
17. Lipiński, F., Koczy, J. (2023). Zjawisko Quiet Quitting wśród polskich pracowników z pokolenia Z. *Academic Review of Business and Economics*, 4(1), 54-72. <https://doi.org/10.22367/arbe.2023.04.04>
18. Loewy, J.V., Spintge, R. (2022). Quiet quitting: Symptomatology and ramifications. *Music and Medicine*, 14(4). <https://doi.org/10.47513/mmd.v14i4.899>
19. Lu, M., Al Mamun, A., Chen, X., Yang, Q., Masukujjaman, M. (2023). Quiet quitting during COVID-19: the role of psychological empowerment. *Humanities and Social Sciences Communications*, 10, 1-16. <https://doi.org/10.1057/s41599-023-02012-2>
20. Lyons, L. (2022). *Toxic Workplace Signs; A Survival Guide How to Survive & Rise Above a Toxic Work Environment, Managing Office Politics, Toxic Personalities, Behaviors, Toxic Coworkers, Bosses, Employees, and Culture*. New York: United Artists Publishing.
21. Mirza, B. (2019 September 25). *Toxic Workplace Cultures Hurt Workers and Company Profits*. *Society for Human Resource Management*. <https://www.shrm.org/ResourcesAndTools/hr-topics/employee-relations/Pages/Toxic-Workplace-Culture-Report.aspx>
22. Moczydłowska, J.M. (2024). *Quiet quitting as a challenge for human capital management – the results of qualitative research*. *Scientific Papers of Silesian University of Technology, Organization and Management Series*, 199, 441-455. <https://doi.org/10.29119/1641-3466.2024.199.33>

23. Moczydłowska, J.M., Moczydłowska Z.S. (2024). Quiet quitting– charakterystyka pojęcia i kierunki badań. *Journal of Marketing and Market Studies*, XXXI(3), 30-36. <https://doi.org/10.33226/1231-7853.2024.3.3>
24. Molchan, D., Clore, G. (2023). From motivation loss to isolation: The psychological impacts of quiet quitting in the workplace. *Journal of Applied Psychology*, 38(2), 203-219.
25. Morrison-Beed, D. (2022). Are we addressing quiet quitting in faculty, staff, and students in academic settings? *Building Healthy Academic Communities Journal*, 6(2), 7-8. <https://doi.org/10.18061/bhac.v6i2.9309>
26. Mousa, M., Massoud, H.K., Ayoubi, R.M. (2020). Gender, diversity management perceptions, workplace happiness and organisational citizenship behaviour. *Employee Relations*, 42(6), 1249-1269. <https://doi.org/10.1108/ER-10-2019-0385>
27. Ng, E., Stanton, P. (2023). Editorial: The great resignation: managing people in a post COVID-19 pandemic world. *Personnel Review*, 52(2), 401-407. <https://doi.org/10.1108/PR-03-2023-914>
28. Niko, G. (2022, wrzesień 12). Polacy też „cicho rezygnują”. „Frustruje mnie, że w pracy wymaga się coraz więcej”. <https://noizz.pl/spoleczenstwo/quiet-quitting-w-polsce-frustruje-mnie-ze-w-pracy-wymaga-sie-coraz-wiecej/w51gpck>
29. Öztürk, E., Arikan, Ö.U., Ocak, M. (2023). Understanding Quiet Quitting: Triggers, Antecedents, and Consequences. *Uluslararası Davranış, Sürdürülebilirlik ve Yönetim Dergisi*, 10(18), 57-79. <https://doi.org/10.54709/jobesam.1299018>
30. Rahmadara, B., Rachmawati, R. (2025). Exploratory Study of the Phenomenon Quiet Quitting: Manager’s Perspective in a Digital Company. *Journal of Theoretical and Applied Management*, 18(1), 156-167.
31. Rugiubei, R., Cruceanu, S. (2024). The Management of Organizational Culture in the Quiet Quitting Phenomenon in Romanian Companies. *Management Dynamics in the Knowledge Economy*, 12(4), 354-370. <https://doi.org/10.2478/mdke-2024-0021>
32. Saira, S., Mansoor, S., Ali, M. (2020). Transformational leadership and employee outcomes: The mediating role of psychological empowerment. *Leadership & Organization Development Journal*, 42(1), 130-143. <https://doi.org/10.1108/LODJ-05-2020-0189>
33. Salvucci, J. (2023, February 16). What Is Quiet Quitting? Is It Actually a New. *Marietta Daily Journal*.
34. Scheyett, A. (2022). Quiet quitting. *Social work*, 68(1), 5-7. <https://doi.org/10.1093/sw/swac051>
35. Yasemin, B., Sürmeli, M. (2023). Quiet quitting: A significant risk for global healthcare. *Journal of Global Health*, 13, 1-4. <https://doi.org/10.7189/jogh.13.03014>
36. Zenger, J., Folkman, J. (2022, October 24). Quiet quitting is about bad bosses, not bad employees. *Harvard Business Review*.
37. Zhang, T., Rodrigue, C. (2023). What if moms quiet quit? The role of maternity leave policy in working mothers' quiet quitting behaviors. *Merits*, 3(1), 186-205. <https://doi.org/10.3390/merits3010012>

STRUCTURAL CHANGES IN THE DYNAMICS OF TAX ARREARS – EVIDENCE FROM POLAND (2003-2024)

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Purpose: The aim of the paper is to conduct a quantitative analysis of trends, turning points, and the impact of global crises on the scale and structure of tax arrears in Poland in the years 2003-2024. The study fills a gap in literature, where in-depth analyses based on long-term time series and econometric tools are still scarce.

Design/methodology/approach: The research employed statistical and econometric methods, including linear regression models and structural stability tests (e.g., Chow test). Annual time-series data covering the number of entities in arrears, the value of overdue tax liabilities, and the value of interest on arrears were analyzed. Special attention was paid to crisis periods: the global financial crisis (2008-2009), the COVID-19 pandemic (2020-2021), and geopolitical disruptions after 2022.

Findings: The analysis confirmed strong and statistically significant relationships between the number of entities, the value of liabilities, and the interest on tax arrears in the long run. However, structural stability tests revealed that crises significantly modified the mechanisms of fiscal debt accumulation – during the pandemic, extended repayment periods played a key role, while after 2022 both liabilities and interest increased simultaneously, reflecting intensifying fiscal pressure. Most of the research hypotheses (H1, H2, H3, H5) were confirmed.

Research limitations/implications: The main limitation is the relatively short time horizon of crisis subperiods (2-3 years), which constrains the power of structural stability tests. Moreover, the analysis relied solely on aggregated data, without incorporating broader macroeconomic variables. Future research should expand the models with additional determinants (e.g., GDP, inflation, energy prices) and include cross-country comparative studies.

Practical implications: The results indicate that during crises the risk of accumulating tax arrears increases significantly, requiring tax administrations to apply flexible tools such as relief programs, restructuring mechanisms, or liquidity support schemes. Identifying turning points helps design more effective preventive and intervention measures, thereby improving the efficiency of the tax system.

Social implications: Tax arrears negatively affect the financial condition of enterprises and households, and on a larger scale, undermine the fiscal stability of the state. The findings may inform public policy aimed at reducing the risk of tax debt accumulation and mitigating its social consequences, including financial exclusion and a decline in quality of life.

Originality/value: The paper contributes to the literature by providing a comprehensive quantitative analysis of long-term tax arrears trends in Poland using structural stability tests. It offers new insights into the mechanisms of tax debt formation under crisis conditions and may serve as a reference point for comparative research and fiscal policy practice in other countries.

Keywords: tax arrears, fiscal policy, economic crises, regression analysis, structural stability.

Category of the paper: Research paper.

1. Introduction

In recent years, the problem of tax arrears has gained significance both in public debate and in analyses concerning the public finance system. This phenomenon is particularly evident in the context of increased macroeconomic volatility, frequent legislative changes, and crises such as the COVID-19 pandemic or the currently observed systematic rise in defense expenditures. The scale and pace of the accumulation of tax arrears constitute an important indicator of the condition of the public revenue collection system as well as the effectiveness of the state's enforcement apparatus.

Tax indebtedness is a complex phenomenon, the causes of which stem from the interaction of multiple interconnected economic, legal, and social factors. At the macroeconomic level, key determinants include business cycle fluctuations, GDP (gross domestic product) growth rates, inflation, and labor market conditions. Periods of recession or economic slowdown typically result in deteriorating financial liquidity of enterprises and declining household incomes, which foster the emergence of tax arrears. High inflation further reduces the real value of taxpayers' incomes, making it more difficult to meet obligations to tax authorities on time.

Legal and institutional factors also play a crucial role. The design of the tax system, its transparency, and legislative stability significantly condition the level of voluntary tax compliance. Frequent amendments, excessive complexity, or a lack of clear interpretations may lead to unintentional breaches of tax obligations or payment delays. Moreover, the effectiveness of tax administration in monitoring and enforcing liabilities, the degree of digitalization of processes, and the availability of taxpayer support tools directly affect the scale of arrears. Social factors are also important, including the level of tax awareness, trust in public institutions, and attitudes toward compliance with tax law.

The problem of increasing tax indebtedness is not limited to Poland. Many OECD countries report a high level of tax arrears, which continue to rise despite the introduction of new enforcement mechanisms (OECD, 2019, 2020). In FTA countries, tax arrears reached approximately EUR 820 billion in 2019. OECD (2019) emphasizes that effective debt management requires both preventive measures and more advanced enforcement methods, as shown by international comparisons. Despite the implementation of innovative analytical

tools and digital control systems, the effectiveness of arrears collection remains limited in many states (OECD, 2024).

Quantitative analyses of taxation in various perspectives and dimensions are particularly important in shaping public policies, assessing the efficiency of state institutions, and creating conditions conducive to entrepreneurship. Tax costs and the high and uneven distribution of tax arrears across business forms, sectors, and industries are of particular importance. The sources of these problems lie both in non-compliance with tax regulations and in inefficient tax payment systems. An additional risk factor is the existence of tax havens and the specific characteristics of countries of the Global South, where weak fiscal institutions contribute to persistent arrears accumulation (Beck, 2021).

At the macroeconomic level, factors such as inflation, increases in minimum wages, and changes in the number of active business entities significantly affect tax indebtedness. Despite the growing importance of this problem, the scientific literature remains limited – there is a lack of in-depth theoretical studies in economics and finance as well as quantitative research based on long-term time series.

The aim of this article is to fill this gap by conducting a quantitative analysis of trends, turning points, and the impact of global crises on the scale and structure of tax arrears in Poland in the years 2003-2024, using statistical and econometric methods, including structural stability tests. The analysis is based on time-series data covering:

1. the total nominal value of tax arrears, and
2. the value of interest on arrears.

The scope of the study includes the identification of trends, turning points, potential structural changes, and the development of forecasting models. A quantitative approach – based on statistical and econometric methods – is not only appropriate but also necessary to draw objective and practically useful conclusions. The results may provide a foundation for further research, both quantitative and qualitative, as well as guidance for fiscal and treasury policy makers.

Tax indebtedness remains a global fiscal problem, requiring not only national but also international solutions. Therefore, a quantitative analysis – even when focused on Poland – can provide insights of broader significance, useful in the context of international comparisons.

2. Tax Debt, Compliance Mechanisms, and Socio-Economic Implications: A Literature Review

The issue of tax indebtedness among citizens and enterprises in Poland over the past two decades has become the subject of growing interest within the academic community. This increase stems from a variety of factors, among which the most significant are: legislative

changes in the tax system, global economic crises, persistent inflationary pressures, the effects of the COVID-19 pandemic, and payment backlogs (Jeżewski, 2021; Kobylski, 2024; Kraska, 2022; Nakonieczny, Nesterowicz, 2021; Sierpińska-Sawicz, 2023). Equally important are rising public expenditures, particularly in defense. A crucial backdrop for these phenomena is the steady growth of public debt and its consequences for the stability and security of public finances (Bożek, 2021; Ciak, 2024; Górniewicz, 2023; Kielin, 2023; Skwarek, 2024). The organization and efficient functioning of the state depend on access to capital, the primary source of which remains tax revenues.

The research presented in this article is not original in terms of the dataset analyzed. Rather, it supplements the limited body of quantitative studies that have attempted to examine the scale, dynamics, and determinants of tax indebtedness in sectoral, temporal, regional, and structural dimensions (Hybka, 2025; Poniatowicz, Jastrzębska, 2021; Walczak et al., 2011).

Debates over the level and distribution of taxation have long been present in the economic, legal, and political literature. However, they remain in the form of discourse without reaching consensus in either theoretical or practical terms. Among the key issues highlighted are: fiscal stability, the organization of tax administrations in terms of operating costs, efficiency in the collection of due levies, as well as protective and preferential systems (Braunerhjelm et al., 2021; Caporale et al., 2024; Djankov et al., 2010; Filipiak, Wyszowska, 2022; Iwin-Garzyńska, 2022; Mantzaris, Fošner, 2024; Radzikowski, 2021a, 2021b, 2022; Wojciechowski, 2021), advancing internationalization (Felis, 2008; Garcia-Bernardo, Janský, 2023), tax havens (Pawlak, 2022), tax crimes (Szymczyk, Szymański, 2022), debt spirals embedded in the behavior of enterprises and individuals not engaged in business activity (Talar, 2019) and finally, the costs of indebtedness (Iwin-Garzyńska, 2016).

2.1. International Evidence on Tax Arrears and Compliance Mechanisms

The analysis of tax debt in Poland gains a fuller dimension when placed in an international context. In many advanced economies, such as Germany, France, and the United Kingdom, mechanisms for monitoring and enforcing tax liabilities are strongly integrated with financial information systems and rely on intensive data exchange between tax administrations, financial institutions, and judicial authorities. Studies show that the digitalization of processes, the use of predictive analytics tools, and early preventive measures are crucial for reducing the scale of tax arrears. Solutions based on automatic information exchange and centralized taxpayer registers make it possible to identify insolvency risks more quickly and respond to them in real time (Bott et al., 2020; Dwenger et al., 2016; Hallsworth et al., 2017; Kleven et al., 2011; Kobylski, 2024; Perez-Truglia, Troiano, 2018; Pomeranz, 2015; Trescher, 2025).

In lower-income countries, including some emerging economies, challenges remain in the form of low levels of voluntary tax compliance, limited digitalization of processes, and insufficient human resources in tax administrations. Research by the World Bank (Hoy et al., 2021) and the International Monetary Fund (Beer, 2022), indicates that the effectiveness

of tax debt management largely depends on the gradual introduction of digital solutions, increased procedural transparency, enhanced data openness, and educational programs directed at taxpayers. OECD analyses (OECD, 2017, 2019, 2022b, 2022a, 2023, 2023, 2024) confirm that combining effective enforcement tools with measures facilitating timely payments—such as installment programs, simplified online payment procedures, and early-warning mechanisms—can significantly reduce the level of arrears and improve the efficiency of tax collection systems.

2.2. Socio-economic effects of excessive tax indebtedness and instruments for its mitigation

Excessive tax debt exerts a significant impact both on the microeconomic condition of individual entities and on the macroeconomic stability of the state. For enterprises, tax arrears often lead to reduced financial liquidity, which in turn results in lower investment expenditures, suspension of development plans, and in some cases the need for restructuring or even liquidation (Janský, Palanský, 2019). At the household level, tax debt may generate increasing financial difficulties, reduce creditworthiness, and heighten the risk of economic exclusion (Perez-Truglia, Troiano, 2018). Negative effects are also observed in the psychological sphere, where tax debt correlates with a decline in well-being and a reduced sense of financial security (Kettle et al., 2016).

At the macroeconomic level, the accumulation of uncollectible tax liabilities weakens the state's ability to finance public expenditures, deepens the budget deficit, and may force either higher tax burdens or borrowing on financial markets. Prolonged persistence of this phenomenon therefore poses a threat to fiscal stability and may undermine the country's creditworthiness in the international arena. A partial aspect of the problem is the statute of limitations on tax obligations, which reduces the effectiveness of tax enforcement and perpetuates arrears. In international literature, the OECD (2020) emphasizes the importance of preventive and intervention tools in managing tax debt, while studies by Bott et al. (2020) and Dwenger et al. (2016) demonstrate that early information campaigns and digital monitoring tools can significantly reduce the scale of indebtedness. It should be noted that the debt spiral amplifies the risk of a self-reinforcing mechanism of fiscal deterioration, particularly when ineffective enforcement instruments coincide with low voluntary tax compliance (Talar, 2019).

The literature identifies a range of solutions aimed at reducing the scale of tax arrears. Legal instruments include simplifying collection procedures, shortening enforcement times, and expanding the scope of asset seizure. Economic tools cover interest relief for prompt repayment, automated reminder systems, and the possibility of renegotiating payment schedules. Increasingly important are interventions based on behavioral economics, such as so-called “nudges” – subtle informational prompts encouraging timely payment. Examples from Australia, Canada, and Scandinavian countries demonstrate that combining traditional enforcement methods with educational initiatives and digitalized taxpayer communication can

substantially reduce tax debt levels and improve the overall efficiency of tax collection systems (Andersson et al., 2024; Biddle et al., 2017; Canada Revenue Agency, 2022; OECD, 2021).

3. Regression Analysis and Structural Stability Tests

The analysis was based on annual data from 2003-2024, covering: the number of entities with outstanding tax liabilities, the total value of overdue obligations (tax debt) and interest on overdue obligations (tax arrears), as well as the average value of liabilities and interest per entity.

The study was conducted in several stages. In the first step, descriptive and index analysis was applied, including year-on-year dynamics, long-term growth rates, and the relationships between the number of entities and liabilities, as well as between liabilities and interest, as a measure of the intensity of arrears. Next, the relationships between variables were examined using correlation coefficients and simple regression models. This made it possible to identify the links between the number of entities and the values of liabilities and interest.

In addition, the analysis accounted for the impact of external crisis events—the global financial crisis (2008-2009), the COVID-19 pandemic (2020-2021), and geopolitical tensions and energy price fluctuations after 2022. For this purpose, structural stability tests (including the Chow test) were applied to verify whether significant changes occurred in the nature of the relationships between variables during these periods.

Based on the literature review and quantitative data observations, the following research questions were formulated:

- 1) How did the dynamics of the number of entities with tax liabilities and the value of liabilities and interest evolve in 2003-2024?
- 2) What relationships exist between the number of entities and the size of tax liabilities and interest on tax arrears?
- 3) Did crisis periods (2008-2009, 2020-2021, post-2022) result in significant structural changes in the relationships between the studied variables?

The following research hypotheses were formulated:

- H1: There is a significant relationship between the value of tax arrears and the number of entities with such arrears.
- H2: During economic crises (e.g., the 2008 financial crisis, the COVID-19 pandemic, the post-2022 energy crisis), tax arrears grow faster than in periods of macroeconomic stability.
- H3: Interest on arrears remains strongly correlated with the total value of tax arrears; however, the nature of this relationship changes during periods of economic disruption.

H4: Legislative changes and increased tax burdens contribute to the growth of tax debt, regardless of economic conditions.

H5: Econometric models based on long-term time series can effectively identify turning points and structural changes in the mechanisms of tax debt formation.

The dependency analysis was carried out using a linear regression model, where in the first case the explanatory variable was the value of liabilities and the dependent variable was interest on overdue obligations, and in the second case the explanatory variable was the number of entities, and the dependent variable was the value of liabilities.

To assess the stability of these relationships over time, the Chow test was applied, which made it possible to verify whether statistically significant changes occurred in the structure of the regression model at selected breakpoints (2009 – financial crisis, 2019 – pre-pandemic period, 2020 – COVID-19 pandemic, 2022 – geopolitical disruptions).

Based on the statistical data analysis for the years 2003-2024, clear long-term trends and strong interdependencies between the studied variables can be identified. During the analyzed period, the number of entities increased more than fourfold—from 3370 in 2003 to 15,202 in 2024. The compound annual growth rate (CAGR) of the number of entities was approximately 7.64%. The value of tax liabilities grew even faster, rising from PLN 7.0 billion to PLN 93.1 billion (CAGR $\approx$ 13.93%). A similar dynamic was observed for interest on arrears, which increased from PLN 8.1 billion to PLN 85.6 billion (CAGR $\approx$ 12.23%). This indicates that both liabilities and the costs associated with late payments grew faster than the number of entities, resulting in an increasing per-entity burden.

The analysis of average values per entity confirms this trend. The average liability per entity rose from PLN 2.08 thousand in 2003 to PLN 6.13 thousand in 2024, while the average interest per entity increased from PLN 2.40 thousand to PLN 5.63 thousand over the same period. This demonstrates that the fiscal burden grew not only in macroeconomic but also in individual terms. This phenomenon can be interpreted as the effect of growing difficulties in settling obligations, which, combined with the rising number of economic entities, led to an increase in both aggregate and per-entity arrears.

Complementing the analysis are correlation results between variables across the entire period. A very strong positive relationship was found between the number of entities and the value of liabilities ($r = 0.994$; $p < 0.001$), and between the number of entities and the value of interest ($r = 0.935$; $p < 0.001$). An equally strong correlation was observed between the values of liabilities and interest ($r = 0.933$; $p < 0.001$), confirming that these phenomena are closely interconnected. The analysis of unit values (liabilities per entity and interest per entity), however, revealed a moderate correlation ($r = 0.700$; $p < 0.001$), suggesting that the intensity of the burden did not always change proportionally. This may indicate that at certain points—particularly during periods of macroeconomic disruption—the structure of relationships between the analyzed variables underwent significant transformations.

3.1. Liabilities–Interest Relationship

The linear regression analysis, in which the dependent variable was interest on tax arrears, and the independent variable was the level of liabilities, revealed very high statistical significance of the model in most of the analyzed subperiods (Tab. 1). The values of the coefficient of determination R^2 indicate that in the stable period 2010-2019, nearly 98% of the variability in interest could be explained by the level of tax liabilities, whereas during the financial crisis of 2003-2009 R^2 reached 0.88. The estimated regression parameters for these years were positive (0.44 and 0.73, respectively) and significant, confirming a strong and stable relationship between the two phenomena under conditions of macroeconomic equilibrium.

Further examination of the stability of this relationship over time, conducted using the Chow test, revealed significant changes during the most recent crises. For the sample split including the year 2009, the F-statistic value was 0.30 ($p = 0.745$), which indicates no significant structural differences in the relationship between interest and liabilities during the global financial crisis. A different picture emerges for the COVID-19 pandemic years (2020-2021), when the R^2 value reached 1.00 and the regression parameter took a negative value (-1.35). This suggests that despite the decline in the nominal level of liabilities, interest continued to rise, and the mechanism of the relationship was distorted by the extension of repayment periods for previously accumulated arrears. In this period, the F-statistics were 41.72 ($p < 0.001$), indicating a significant structural change.

An even more pronounced deviation from previous trends appeared in 2022-2024, under conditions of energy and geopolitical shocks. The average level of liabilities remained high (PLN 95.2 billion), while interest increased even more sharply (PLN 77.2 billion). The coefficient of determination fell to 0.32, and the regression parameter (-2.81) indicated a reversal of the nature of the relationship—interest accumulated independently of changes in the level of liabilities. Although the Chow test could not be formally carried out due to the very small number of observations, qualitative analysis suggests a cumulation of arrears and an intensification of the mechanism of their accumulation.

Table 1.

Analysis of the relationship: liabilities $\rightarrow$ interest

Period of analysis	Econometric results: regression and structural stability tests						
	Average level of liabilities (billion PLN)	Average level of interest (billion PLN)	R^2 of regression*	Regression coefficient (β)**	Chow test (F)	p-value (Chow test)	Significance of structural change
2003-2009 (financial crisis)	10.17	10.58	0.884	0.725	0.300	0.745	Not significant
2010-2019 (stable period)	48.03	26.43	0.979	0.023	25.503	0.000	Significant

Cont. table 1.

2020-2021 (COVID-19 pandemic)	96.44	57.80	1.00	-1.354	41.716	0.000	Significant
2022-2024 (geopolitical disruptions)	95.24	77.20	0.316	-2.814	n.d.	n.d.	n.d.

Note. * Extent to which variability of liabilities explains variability of interest, ** increase in liabilities translated into increase in interest. It is important to emphasize the methodological limitations associated with short time series for the periods 2020-2021 (2 years) and 2022-2024 (3 years). Such a small number of observations may lead to artificially high R^2 values, limited power of the Chow test, and—in the case of 2022-2024—the impossibility of formally performing the test (n.d.). Therefore, the results for these subperiods are exploratory in nature and should be interpreted mainly in the light of the macroeconomic context (COVID-19 pandemic, energy crisis, geopolitical tensions), whereas conclusions drawn from longer periods (2003-2009, 2010-2019) are methodologically more reliable.

Source: own study.

The obtained results show that although in the long run the relationship between liabilities and interest was strong and stable, during contemporary economic crises this dependency underwent profound modifications. During the COVID-19 pandemic, the extension of repayment periods for earlier liabilities played a key role, while after 2022 this mechanism intensified, as the scale of new arrears increased alongside the persistence of existing ones. The stability tests thus confirm that external shocks (the pandemic, the energy crisis, geopolitical uncertainty) contributed to a more rapid increase in both liabilities and the costs of servicing them.

3.2. Entities–Liabilities Relationship

The linear regression analysis, in which the dependent variable was the level of tax liabilities, and the independent variable was the number of entities in arrears, revealed a strong and stable relationship in the long run (Tab. 2). The coefficients of determination R^2 in the stable subperiods were very high, reaching 0.98 in 2010-2019, which means that almost all variability in liabilities could be explained by changes in the number of entities. The regression parameters ($\beta = 0.009$ in the stable period) were positive and statistically significant, indicating a predictable mechanism of liability growth as the number of debtors increased.

The Chow test analysis showed that for the sample split including the year 2009, the F-statistic took the value of 6.82 ($p = 0.006$), confirming a significant structural change in the relationship between the number of entities and liabilities during the global financial crisis. This change suggests that the mechanism of liability accumulation became less proportional—individual entities generated relatively higher arrears than in stable periods.

During the COVID-19 pandemic (2020-2021), the coefficient of determination reached 1.00, and the regression parameter was 0.008. Formally, the model indicates an almost perfect fit; however, due to the very small number of observations, these results should be interpreted with caution. The Chow test did not confirm a significant structural change in this period

($F = 0.45$; $p = 0.644$), although qualitative analysis suggests some deviations in the behavior of the relationship mechanism.

A different picture emerges in the years 2022–2024, when the number of entities in arrears reached the highest levels in the entire time series (an average of 15.2 thousand), while the value of the coefficient of determination dropped to only 0.03. The regression parameter took a very low value (0.001), indicating that in this period the number of entities ceased to be a good predictor of the scale of liabilities. Formal stability tests could not be performed due to the insufficient number of observations; however, empirical observations confirm that the mechanism of tax arrears accumulation weakened significantly and underwent modification during this time.

Table 2.

Analysis of the relationship: number of entities $\rightarrow$ liabilities

Period of analysis	Econometric results: regression and structural stability tests						
	Average level of liabilities (billion PLN)	Average number of entities (thousands)	R ² of regression*	Regression coefficient (β)**	Chow test (F)	p-value (Chow test)	Significance of structural change
2003-2009 (financial crisis)	10.17	3,909	0.914	4.844	6.820	0.006	Significant
2010-2019 (stable period)	48.03	9,287	0.983	8.715	1.111	0.351	Not Significant
2020-2021 (COVID-19 pandemic)	96.44	14,616	1.000	8.305	0.452	0,644	Not Significant
2022-2024 (geopolitical disruptions)	95.24	15,171	0.027	1.318	n.d.	n.d.	n.d.

Note. * Extent to which variability of liabilities explains variability of interest, ** The coefficient (β) represents the change in the total value of liabilities (in million PLN) associated with a unit increase in the number of entities.

Source: own study.

In summary, the obtained results show that in the long run the number of entities in arrears strongly explains the level of liabilities; however, during crisis periods this mechanism underwent transformations. In the global financial crisis, this relationship became more intensive, whereas under the conditions of the pandemic and geopolitical disruption the number of entities ceased to fully determine the value of liabilities. This indicates a differentiated impact of crisis factors on the scale and dynamics of tax arrears accumulation.

3.3. Empirical validation of tax indebtedness mechanisms

The conducted analysis confirmed the existence of a strong relationship between the value of tax liabilities and the amount of interest on arrears, which was reflected in the high level of the determination coefficient of the regression model. However, this relationship proved to be variable over time, as revealed by stability tests performed for crisis periods. The results of the

Chow test indicated no significant structural changes during the global financial crisis of 2008–2009, while in the case of the COVID-19 pandemic (2020–2021) and in the period of geopolitical disruptions after 2022, significant instability of the relationship was demonstrated.

During the pandemic years, a decline in the nominal value of liabilities was observed, accompanied by an increase in interest on arrears and a rise in the number of indebted entities. This phenomenon indicates that under conditions of reduced economic activity and macroeconomic uncertainty, the key factor was not the accumulation of new liabilities per entity, but rather the extension of repayment periods for existing obligations. Interest thus became an indicator of the intensification of liquidity problems, while the growing number of debtors signaled an expansion of the problem's scale.

A different pattern of change occurred after 2022, when a significant increase in interest, the persistence of high levels of liabilities, and the stabilization of the number of entities at record levels were simultaneously recorded. These results indicate that under shocks related to the geopolitical situation and rising energy prices, the relationship between the analyzed categories intensified interest grew faster than could be explained by nominal liabilities, while the high number of entities reinforced the effect of accumulation. It can thus be concluded that the most recent crises were characterized by deeper destabilization of fiscal mechanisms than in previous decades.

The analysis of the relationship between the number of entities and the value of tax liabilities revealed a similarly strong association, especially in longer subperiods. The coefficients of determination reached very high levels ($R^2 > 0.9$), which indicates that the number of debtors largely explained the scale of arrears. The stability of this relationship was confirmed in the years 2003–2009 and 2010–2019, although the Chow test for the financial crisis revealed a significant structural change, suggesting that at that time individual arrears accumulated faster than the number of entities.

During the COVID-19 pandemic (2020–2021), the model formally indicated an almost perfect fit, but with only two observations this result must be treated with caution. Nevertheless, the fact that liabilities remained high while the number of entities increased significantly suggests the spread of debt problems across the economy.

An even clearer departure from earlier trends emerged after 2022. In this period, the number of entities reached the highest values in the series analyzed, while the coefficient determination of the regression dropped sharply. This means that the number of debtors ceased to be a good predictor of the sum of liabilities—besides the quantitative factor, qualitative aspects such as the heterogeneity of arrears and deepening liquidity problems of specific groups of enterprises became increasingly important. This relationship indicates that in the context of contemporary crises, the number of entities did not always reflect the real burden of fiscal debt.

Taken together, the results demonstrate that both the liabilities–interest relationship and the entities–liabilities relationship are characterized by strong and statistically significant links in the long run, yet their mechanisms underwent substantial modifications in times of crisis.

This highlights the need for analyses that simultaneously consider the number of debtors, the volume of arrears, and the costs of servicing them in order to capture the full picture of fiscal system destabilization under external shocks. The conducted study does not address the causes, including the motivations for tax debt, but focuses solely on the scale of the phenomenon. Nevertheless, it constitutes an important contribution to literature, as an accurate diagnosis of the scale of tax arrears is a prerequisite for designing effective preventive and intervention measures. Defining the size of the problem makes it possible to better assess its fiscal consequences, identify the groups most at risk of debt accumulation, and indicate areas requiring more in-depth research into taxpayer motivations. In this way, the study creates a foundation for further qualitative and quantitative analyses that may in the future explain the sources of debt and shape appropriate fiscal policy.

In summary, most of the research hypotheses (H1, H2, H3, H5) were confirmed, which demonstrates the strong influence of macroeconomic and crisis-related factors on the scale and dynamics of tax debt. Only the hypothesis concerning the impact of legislative changes (H4) was not unequivocally confirmed—although the literature points to the important role of tax law stability, in the analyzed period it was difficult to distinguish the effects of legal changes from the influence of economic factors, which prevented full verification of this relationship. Thus, the obtained results suggest that macroeconomic factors and external crises have a more direct and measurable impact on tax debt than legislative changes themselves, which require further, in-depth qualitative research. Furthermore, our inability to isolate the distinct effect of legislative changes (H4) underscores the complexity of tax debt dynamics and suggests that future policy evaluations require more nuanced, qualitative approaches to disentangle the impact of legal reforms from concurrent economic shocks.

4. Discussion of results

Tax burdens reduce the incomes of enterprises, limiting their ability to satisfy needs, pursue development, and remain competitive, and in extreme cases leading to the erosion of assets. It is therefore not surprising that taxpayers attempt to counteract them (Klonowska, 2008). The phenomenon of non-payment of taxes includes both actions contrary to the law and situations arising from internal problems of enterprises, which are often the consequence of external macroeconomic or even global factors. The first category includes deliberate tax avoidance, income concealment, or operating in the shadow economy. The second category involves cases where failure to fulfill tax obligations results from loss of liquidity, declining demand, exchange rate fluctuations, rising input costs, or disruptions in supply chains. According to many studies, global economic crises and geopolitical tensions have a significant impact on the emergence of tax arrears (Alm et al., 2014; Brondolo, 2009; Caldara, Iacoviello,

2022; Haque et al., 2023) and in recent years also energy price volatility (Mousavi et al., 2024) and the COVID-19 pandemic (Athira, Ramesh, 2023; European Parliament. Directorate General for Internal Policies of the Union., 2023; Hartmann et al., 2022; Kobbi-Fakhfakh, Bougacha, 2023; Țibulcă, 2022; Zhu et al., 2023), which directly affected market stability and the capacity to settle fiscal liabilities on time.

The empirical analysis confirmed the existence of strong relationships between overdue tax liabilities, interest on arrears, and the number of entities in arrears. However, these relationships were not stable over time, as evidenced by structural stability tests. In the long-term perspective, regression models showed high explanatory power, with R^2 values exceeding 0.9 in stable periods. Nevertheless, crisis episodes such as the global financial crisis, the COVID-19 pandemic, and post-2022 geopolitical disruptions revealed significant modifications in these mechanisms.

During the COVID-19 pandemic, liabilities decreased while interest levels increased, suggesting that the key mechanism was not the accumulation of new arrears but the extension of repayment periods for existing ones. This finding aligns with international studies (e.g., OECD reports, IMF working papers) that highlight liquidity constraints and payment delays during pandemic-related restrictions. Conversely, after 2022, both liabilities and interest rose simultaneously, reflecting cumulative effects of geopolitical instability and rising energy prices. This observation corresponds with broader literature emphasizing fiscal stress during external shocks.

The relationship between the number of entities and total liabilities was also strong but more sensitive to crisis periods. In stable times, the number of entities was a reliable predictor of total arrears. However, in the most recent crises this link weakened, as liabilities grew faster or slower than the number of entities, indicating a decoupling between the scale of debtors and the value of arrears. This is consistent with empirical evidence from other economies, where shocks altered both the extent and intensity of fiscal burdens. Importantly, the results confirm theoretical findings that arrears should not be seen solely as intentional non-compliance but also as systemic shocks that constrain taxpayers' financial capacity.

From a policy perspective, these findings imply that effective countermeasures should go beyond stricter enforcement and address systemic vulnerabilities—such as liquidity shortages, energy price volatility, or disrupted supply chains—that directly affect taxpayers' ability to meet obligations. Structural breaks identified in the models clearly show that crises not only increase the scale of arrears but also alter the very mechanisms that link liabilities, interest, and the number of indebted entities. As highlighted by comparative studies (Alm et al., 2014; Hartmann et al., 2022), the resilience of the tax system depends not only on enforcement capacity but also on the flexibility of instruments that mitigate the impact of crises on taxpayers. Designing adaptive fiscal tools, including temporary tax reliefs, restructuring schemes, or targeted support measures, could therefore reduce the risk of long-term arrears accumulation and protect both public revenues and enterprise viability. An equally important element is the

early monitoring of liquidity indicators and fiscal pressures in the business sector, enabling authorities to react quickly to emerging risks. Finally, experiences such as the COVID-19 relief packages demonstrate that temporary, targeted interventions at the national and EU levels can play a crucial role in sustaining both compliance and economic stability during systemic shocks.

This study provides insights into the dynamics of tax arrears in Poland, but its limitations should be acknowledged. The analysis relies on aggregated national data, which masks sectoral, regional, and firm-size heterogeneity. Furthermore, the models do not incorporate broader macroeconomic variables (e.g., GDP growth, unemployment, inflation), limiting the ability to fully explain the drivers behind the observed structural changes. Finally, the short time span of the recent crisis sub-periods (2020-2021 and 2022-2024) constrains the statistical power of the stability tests, making these results more indicative.

These limitations suggest fruitful directions for future research. Studies utilizing disaggregated data could identify high-risk sectors and regions. Expanding the models to include macroeconomic determinants would offer a more robust explanation of arrears formation. Finally, comparative cross-country analyses could determine whether the observed structural changes are specific to Poland or part of a broader regional pattern.

5. Conclusions

The results demonstrate that in the long run, relationships between overdue liabilities, interest on arrears, and the number of entities in arrears are strong and statistically significant. However, economic crises trigger structural changes that reshape these dependencies. During the pandemic, the persistence of arrears rather than their volume became the main driver of interest accumulation. After 2022, the simultaneous rise in liabilities and interest revealed intensified fiscal stress.

Research limitations should be emphasized. Short subperiods (2020-2021, 2022-2024) reduce the reliability of statistical inference, particularly in structural stability tests (Chow test). Moreover, the analysis is based solely on aggregated data, without incorporating broader macroeconomic determinants. These constraints suggest that findings for the most recent years should be treated as exploratory.

Practical implications arise for fiscal authorities, who should account for the heightened risk of arrears accumulation during crises, especially due to extended repayment periods and increased unit burdens. Scientific implications include the need to integrate crisis-sensitive factors into models of tax arrears and to test structural stability more systematically.

Future research directions should include expanding the model by introducing additional macroeconomic variables such as GDP dynamics, unemployment, or energy prices. Comparative studies across countries would also allow verification of whether the observed structural changes are specific to Poland or represent a broader pattern of fiscal dynamics under external shocks.

References

1. Alm, J., Hodge, T.R., Sands, G., Skidmore, M. (2014). Detroit Property Tax Delinquency: Social Contract in Crisis. *Public Finance and Management*, 14(3), 280-305. <https://doi.org/10.1177/152397211401400302>
2. Andersson, H., Engström, P., Nordblom, K., Wanander, S. (2024). Nudges and threats: Soft versus hard incentives for tax compliance. *Economic Policy*, 38(116), 771-819. <https://doi.org/10.1093/epolic/eiad017>
3. Athira, A., Ramesh, V.K. (2023). COVID-19 and corporate tax avoidance: International evidence. *International Business Review*, 32(4), 102143. <https://doi.org/10.1016/j.ibusrev.2023.102143>
4. Beck, G. (2021). *The severe problem of tax arrears in Mediterranean countries*. https://www.europarl.europa.eu/doceo/document/E-9-2021-003183_EN.html
5. Beer, S. (2022). How to Evaluate Tax Expenditures. *IMF How To Notes*, 5, 1. <https://doi.org/10.5089/9798400221507.061>
6. Biddle, N., Fels, K., Sinning, M. (2017). Behavioral Insights and Business Taxation: Evidence from Two Randomized Controlled Trials. *Journal of Behavioral and Experimental Finance*, 18, 30-49.
7. Bott, K.M., Cappelen, A. W., Sørensen, E.Ø., Tungodden, B. (2020). You've Got Mail: A Randomized Field Experiment on Tax Evasion. *Management Science*, 66(7), 2801-2819. <https://doi.org/10.1287/mnsc.2019.3390>
8. Bożek, W. (2021). „Stabilność sektora finansów publicznych” w warunkach pandemii COVID-19. *Prawo Budżetowe Państwa i Samorządu*, 9(4), 69-85. <https://doi.org/10.12775/PBPS.2021.022>
9. Braunerhjelm, P., Eklund, J.E., Thulin, P. (2021). Taxes, the tax administrative burden and the entrepreneurial life cycle. *Small Business Economics*, 56(2), 681-694. <https://doi.org/10.1007/s11187-019-00195-0>
10. Brondolo, J. (2009). Collecting Taxes During an Economic Crisis: Challenges and Policy Options. *IMF Staff Position Notes*, 17, 2. <https://doi.org/10.5089/9781462339440.004>
11. Caldara, D., Iacoviello, M. (2022). Measuring Geopolitical Risk. *American Economic Review*, 112(4), 1194-1225. <https://doi.org/10.1257/aer.20191823>

12. Canada Revenue Agency (2022). *Evaluation: CRA management of small business nudge. Government of Canada*. <https://www.canada.ca/en/revenue-agency/corporate/about-canada-revenue-agency-cra/evaluation-reports/evaluation-cra-management-small-business-nudge.html>
13. Caporale, G.M., Tapia, S.G., Gil-Alana, L.A. (2024). Persistence in Tax Revenues: Evidence from Some OECD Countries. *Journal of Quantitative Economics*, 22(2), 475-491. <https://doi.org/10.1007/s40953-024-00386-x>
14. Ciak, J.M. (2024). Konsekwencje zadłużenia publicznego dla bezpieczeństwa finansów publicznych. *Studia i Prace Kolegium Zarządzania i Finansów*, 193, 9-30. <https://doi.org/10.33119/SIP.2023.193.1>
15. Djankov, S., Ganser, T., McLiesh, C., Ramalho, R., Shleifer, A. (2010). The Effect of Corporate Taxes on Investment and Entrepreneurship. *American Economic Journal: Macroeconomics*, 2(3), 31-64. <https://doi.org/10.1257/mac.2.3.31>
16. Dwenger, N., Kleven, H., Rasul, I., Rincke, J. (2016). Extrinsic and Intrinsic Motivations for Tax Compliance: Evidence from a Field Experiment in Germany. *American Economic Journal: Economic Policy*, 8(3), 203-232. <https://doi.org/10.1257/pol.20150083>
17. European Parliament. Directorate General for Internal Policies of the Union (2023). *National tax measures in response to the COVID-19 crisis: Assessment of their impact and results lessons to be learned for future crises*. Publications Office. <https://data.europa.eu/doi/10.2861/46353>
18. Felis, P. (2008). Ryzyko podatkowe podmiotów powiązanych w konstrukcji podatków dochodowych. *Zeszyt Naukowy*, 90. Szkoła Główna Handlowa, 26-44.
19. Filipiak, B.Z., Wyszowska, D. (2022). Fiscal stability in EU countries. *Wiadomości Statystyczne. The Polish Statistician*, 67(8), 17-40. <https://doi.org/10.5604/01.3001.0015.9703>
20. Garcia-Bernardo, J., Janský, P. (2023). *Profit Shifting of Multinational Corporations Worldwide* (Nr arXiv:2201.08444). arXiv. <https://doi.org/10.48550/arXiv.2201.08444>
21. Górniewicz, G. (2023). Dług publiczny krajów Unii Europejskiej w okresie pandemii COVID-19. *Nierówności Społeczne a Wzrost Gospodarczy*, 73, 21-38. <https://doi.org/10.15584/nsawg.2023.1.2>
22. Hallsworth, M., List, J.A., Metcalfe, R.D., Vlaev, I. (2017). The behavioralist as tax collector: Using natural field experiments to enhance tax compliance. *Journal of Public Economics*, 148, 14-31. <https://doi.org/10.1016/j.jpubeco.2017.02.003>
23. Haque, T., Pham, T.P., Yang, J. (2023). Geopolitical risk, financial constraints, and tax avoidance. *Journal of International Financial Markets, Institutions and Money*, 88, 101858. <https://doi.org/10.1016/j.intfin.2023.101858>
24. Hartmann, A.J., Gangl, K., Kasper, M., Kirchler, E., Kocher, M.G., Mueller, M., Sonntag, A. (2022). The economic crisis during the COVID-19 pandemic has a negative effect on

- tax compliance: Results from a scenario study in Austria. *Journal of Economic Psychology*, 93, 102572. <https://doi.org/10.1016/j.joep.2022.102572>
25. Hoy, C., McKenzie, L., Sinning, M. (2021). *Improving Tax Compliance without Increasing Revenue: Evidence from Population-Wide Randomized Controlled Trials in Papua New Guinea*. Washington, DC: World Bank, <https://doi.org/10.1596/1813-9450-9539>
26. Hybka, M.M. (2025). Collecting and Managing Tax Debt in Poland. *Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu*, 69(1), 46-58. <https://doi.org/10.15611/pn.2025.1.04>
27. Iwin-Garzyńska, J. (2016). Tax Aspects of Debt in the Enterprise. *Zeszyty Naukowe Uniwersytetu Szczecińskiego Finanse Rynki Finansowe Ubezpieczenia*, 80, 53-61. <https://doi.org/10.18276/frfu.2016.2.80/1-06>
28. Iwin-Garzyńska, J. (2022). Tax shield depreciation and inflation. *Doradztwo Podatkowe - Biuletyn Instytutu Studiów Podatkowych*, 11(315), 10-12. <https://doi.org/10.5604/01.3001.0016.1217>
29. Janský, P., Palanský, M. (2019). Estimating the scale of profit shifting and tax revenue losses related to foreign direct investment. *International Tax and Public Finance*, 26(5), 1048-1103. <https://doi.org/10.1007/s10797-019-09547-8>
30. Jeżewski, R. (2021). Wpływ koronawirusa SARS-CoV-2 (jako wystąpienie siły wyższej) na zadłużenie Polaków/The impact of the SARS-CoV-2 coronavirus (as an occurrence of force majeure) on the debt of Poles. *The Scientific Journal of the Polish Economic Society*, 8(14), 50-64. <https://doi.org/10.26366/PTE.ZG.2021.191>
31. Kettle, S., Hernandez, M., Ruda, S., Sanders, M. (2016). *Behavioral Interventions in Tax Compliance: Evidence from Guatemala*. Washington, DC: World Bank, <https://doi.org/10.1596/1813-9450-7690>
32. Kielin, Ł. (2023). Limit zadłużenia z art. 216 ust. 5 Konstytucji RP w dobie pandemii wirusa COVID-19 oraz w obliczu agresji Rosji na Ukrainę. *Przegląd Prawa Konstytucyjnego*, 72(2), 39-50. <https://doi.org/10.15804/ppk.2023.02.03>
33. Kleven, H.J., Knudsen, M.B., Kreiner, C.T., Pedersen, S., Saez, E. (2011). Unwilling or Unable to Cheat? Evidence From a Tax Audit Experiment in Denmark. *Econometrica*, 79(3), 651-692. <https://doi.org/10.3982/ECTA9113>
34. Klonowska, A. (2008). Ekonomiczne skutki ucieczki przed podatkiem. *Zeszyty Naukowe / Uniwersytet Ekonomiczny w Krakowie*, 778, 211-244.
35. Kobbi-Fakhfakh, S., Bougacha, F. (2023). The impact of the COVID-19 pandemic on corporate tax avoidance: Evidence from S&P 500 firms. *Journal of Financial Reporting and Accounting*, 21(4), 847-866. <https://doi.org/10.1108/JFRA-06-2022-0216>
36. Kobylski, P. (2024). Zagrożenia i kierunki zmian Polskiego Ładu. *Zeszyty Prawnicze*, 24(3), 71-89. <https://doi.org/10.21697/zp.2024.24.3.04>
37. Kraska, E.M. (2022). Wpływ pandemii COVID-19 na kondycję finansową przedsiębiorstw w Polsce. *Przegląd Prawno-Ekonomiczny*, 2, 79-96. <https://doi.org/10.31743/ppe.13241>

38. Mantzaris, C., Fošner, A. (2024). *Germany's Tax Revenue and its Total Administrative Cost* (Nr arXiv:2411.12543). arXiv. <https://doi.org/10.48550/arXiv.2411.12543>
39. Mousavi, M.M., Gozgor, G., Acheampong, A. (2024). Do oil market shocks affect financial distress? Evidence from firm-level global data. *Journal of Commodity Markets*, 36, 100436. <https://doi.org/10.1016/j.jcomm.2024.100436>
40. Nakonieczny, J., Nesterowicz, R. (2021). Ocena systemu podatkowego w opinii przedsiębiorców z województwa podkarpackiego. *Przedsiębiorczość - Edukacja*, 17(2), 9-26. <https://doi.org/10.24917/20833296.172.1>
41. OECD (2017). *The Changing Tax Compliance Environment and the Role of Audit*. OECD. <https://doi.org/10.1787/9789264282186-en>
42. OECD (2019). *Successful Tax Debt Management: Measuring Maturity And Supporting Change*. OECD Publishing. <https://doi.org/10.1787/e8fdb816-en>
43. OECD (2021). *Behavioural Insights for Better Tax Administration: A Brief Guide*. OECD Publishing. <https://doi.org/10.1787/582c283e-en>
44. OECD (2022a). *Tax Administration 2022: Comparative Information on OECD and other Advanced and Emerging Economies*. OECD Publishing. <https://doi.org/10.1787/1e797131-en>
45. OECD (2022b). *Tax Policy Reforms 2022: OECD and Selected Partner Economies*. OECD Publishing. <https://doi.org/10.1787/067c593d-en>
46. OECD (2023). *Tax Administration 2023: Comparative Information on OECD and other Advanced and Emerging Economies*. OECD Publishing. <https://doi.org/10.1787/900b6382-en>
47. OECD (2024). *Tax Administration 2024: Comparative Information on OECD and other Advanced and Emerging Economies*. OECD. <https://doi.org/10.1787/2d5fba9c-en>
48. Pawlak, M. (2022). Raje podatkowe i ich wykorzystanie przez zagraniczne korporacje działające na terenie Polski. *Nowe Tendencje w Zarządzaniu*, 2, 21-49. <https://doi.org/10.31743/ntz.13961>
49. Perez-Truglia, R., Troiano, U. (2018). Shaming tax delinquents. *Journal of Public Economics*, 167, 120-137. <https://doi.org/10.1016/j.jpubeco.2018.09.008>
50. Pomeranz, D. (2015). No Taxation without Information: Deterrence and Self-Enforcement in the Value Added Tax. *American Economic Review*, 105(8), 2539-2569. <https://doi.org/10.1257/aer.20130393>
51. Poniatowicz, M., Jastrzębska, M. (2021). Zadłużenie jednostek samorządu terytorialnego i jego determinanty. *Studia BAS*, 68(4). <https://doi.org/10.31268/StudiaBAS.2021.40>
52. Radzikowski, K. (2021a). The modern dilemmas of equality and fairness in taxation (Part 3). *Doradztwo Podatkowe - Biuletyn Instytutu Studiów Podatkowych*, 2(294), 36-38. <https://doi.org/10.5604/01.3001.0014.7762>

53. Radzikowski, K. (2021b). Współczesne dylematy równości i sprawiedliwości opodatkowania (cz. 2). *Doradztwo Podatkowe - Biuletyn Instytutu Studiów Podatkowych*, 1(293), 20-23. <https://doi.org/10.5604/01.3001.0014.7017>
54. Radzikowski, K. (2022). Prawo podatkowe w cieniu populizmu (na przykładzie Polskiego Ładu). *Studia Iuridica*, 91, 334-350. <https://doi.org/10.31338/2544-3135.si.2022-91.19>
55. Sierpińska-Sawicz, A. (2023). Przyczyny i skutki zatorów płatniczych w przedsiębiorstwach w sektorze B2B w Polsce i krajach europejskich. in: C. Kochalski (ed.), *Analiza ekonomiczna przedsiębiorstw w warunkach niepewności* (pp. 135-155). Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu. <https://doi.org/10.18559/978-83-8211-195-8/8>
56. Skwarek, A. (2024). Public debt and Poland's financial security. *Studia Administracji i Bezpieczeństwa*, 16(16), 184-193. <https://doi.org/10.5604/01.3001.0054.6833>
57. Szymczyk, P., Szymański, W. (2022). Analiza i ocena regulacji uszczelniających w zakresie podatku od towarów i usług wdrożonych na przestrzeni ostatnich lat. *Doradztwo Podatkowe - Biuletyn Instytutu Studiów Podatkowych*, 3(307), 4-26. <https://doi.org/10.5604/01.3001.0015.8111>
58. Talar, T. (2019). Tax debt spiral. *Journal of Modern Science*, 39(4), 293-307. <https://doi.org/10.13166/jms/96312>
59. Țibulcă, I.-L. (2022). The impact of the COVID-19 pandemic on tax revenues in the EU. *Economic Research-Ekonomska Istraživanja*, 35(1), 2442-2459. <https://doi.org/10.1080/1331677X.2021.1954967>
60. Trescher, B. (2025). L'appréhension de l'intelligence artificielle par la fiscalité française. *Studi Tributari Europei*, 14(1). <https://doi.org/10.6092/ISSN.2036-3583/21289>
61. Walczak, D., Kołosowska, B., Krupa, D. (2011). Dopuszczalny poziom zadłużenia jednostek samorządu terytorialnego w świetle nowej ustawy o finansach publicznych. *Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu*, 173, 692-699.
62. Wojciechowski, K. (2021). Prawo podatkowe w poglądach i polityce Andrew Mellona. *Studia Prawno-Ekonomiczne*, 119. <https://doi.org/10.26485/SPE/2021/119/7>
63. Zhu, J., Ho, K.-C., Luo, S., Peng, L. (2023). Pandemic and tax avoidance: Cross-country evidence. *Economic Modelling*, 124, 106300. <https://doi.org/10.1016/j.econmod.2023.106300>

THE IMPORTANCE OF WASTE AWARENESS FOR OPTIMIZING ADMINISTRATIVE PROCESSES

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Purpose: The purpose of this article was to assess the awareness of waste and the use of Lean Office tools and methods, as assessed by members of the Lean Management Community Poland (LMCP), and to identify key barriers, needs and managerial directions for companies implementing administrative improvements.

Design/methodology/approach: The study was preliminary and based on a structured interview method. It focused on the issue of waste awareness in administrative processes, as assessed by practitioners affiliated with the Lean Management Community Poland, who cooperate with various organizations in the roles of Lean trainers/consultants or employed Lean specialists/experts.

Findings: The study revealed a moderate level of awareness of waste in administrative processes. Errors and corrections, overproduction and waiting were identified as the most common types of waste, while 5S, process mapping and process standardization were the most frequently applied Lean Office tools. The main barriers included insufficient managerial support, low employee awareness of waste and resistance to change, highlighting the need for stronger leadership involvement, Lean Office training and experience sharing among practitioners. The recommendations emphasize adopting a systematic rather than fragmented approach to administrative process optimization, supported by value stream mapping and the thorough preparation among with active involvement of employees at all organizational levels.

Research limitations/implications: The main limitation of this study is its qualitative nature based on the opinions of a limited number of experts, which may not fully capture the diversity of experiences across organizations and sectors.

Practical implications: The recommendations can be used by organizations at the early stages of administrative process optimization to adopt a coherent approach.

Originality/value: So far, there is no empirical research adapting the seven types of waste to non-production contexts, namely office processes and this gap is about to be filled by this article.

Keywords: Lean Office, administrative processes, optimization.

Category of the paper: Research study.

1. Introduction

In the face of the increasing complexity and volatility of the environment in which modern economic entities operate, the search for the most effective ways of functioning and managing organizations has become one of the key determinants of their competitiveness and even a condition for their survival. Over the years, a number of management concepts have been conceived to optimize processes carried out by companies. One of them is Lean Manufacturing, developed on the basis of the Toyota Production System, taking into account the experience of mass production from American Ford factories. Originally, this concept was focused on identifying and eliminating waste exclusively in production processes, but over time it evolved into the concept of Lean Management, also covering non-production operations.

Lean Management applied to office processes is known as Lean Office. Although the history of Lean Manufacturing began in the 1940s, the concept of Lean Office is relatively new – the first article on this topic was published as recently as 2005 (Yokoyama et al., 2019). A considerable body of research has examined this concept, with significant contributions from the United States, the United Kingdom and Brazil (Malacarne et al., 2018), as well as from Sweden (Gupta et al., 2016). The practical applications have predominantly targeted the healthcare, IT, finance, education and public administration sectors (Gupta et al., 2016). Notably, the literature review did not identify any studies on Lean Office implementations in Japan, which is recognized as the origin of the Lean Manufacturing philosophy.

Lean Office approach is gaining popularity year after year for well-founded reasons, as numerous studies indicate that administrative costs account for as much as 70-80% of the total cost of providing a service or product (Ruwanpura et al., 2025), or 60-80% according to Tapping and Shuker (2003). Another example is the cost of national healthcare in the United States - over the last two decades, administrative expenses accounted for 15-25% of total costs (Chernew, Mintz, 2021). A survey of manufacturing companies in Austria, Hungary and Slovakia showed that their indirect costs in 2017 accounted for between 10% and 31% of total costs (Irsa, Szekely, 2021).

The cited sources indicate that administrative costs constitute a significant portion of total expenditures. Nevertheless, there is a clear scarcity of empirical research addressing administrative waste in companies, as the existing literature predominantly focuses on service-oriented and public domains, as described above. Most studies to date have examined the healthcare and education sectors (Ruwanpura et al., 2025), including research by Koromyslova et al. (2018), Monteiro et al. (2015) and Hartanti et al. (2022).

Even though administrative processes do not directly contribute to value creation in manufacturing companies, integrating Lean principles into administrative processes within a manufacturing plant facilitates producing better quality products (Goerke et al., 2015 as cited

in Ruwanpura et al., 2025). Consequently, administrative processes in the manufacturing sector should focus on transitioning towards a lean-oriented approach, although optimizing administrative processes is a much greater challenge than optimizing production. The main difference between Lean Manufacturing and Lean Office is that, while in Lean Manufacturing the work scenarios are highly visible as they involve physical flows, in the Lean Office the processes that add value to the product depend largely on information flows and employee knowledge (Monteiro et al., 2017). As a result, administrative departments within manufacturing plants encounter a number of difficulties in implementing Lean concepts. In some companies, these activities are limited to the application of 5S techniques in the office, without a thorough approach to work standardization, flow creation or balancing the pull system (Locher, 2019). The intangible nature of office work makes it particularly difficult to improve from a Lean perspective.

Systematic reviews of the literature on Lean Office indicate that identifying waste in office processes is difficult, which indirectly confirms the low level of its recognition in office environments. Despite extensive literature on adapting the seven types of waste to non-production contexts, empirical research on this topic remains limited. This gap restricts practical understanding of how lean principles can be effectively applied in administrative processes and other non-production contexts.

Given the findings outlined above, the author of this study decided to conduct a research among practitioners affiliated with the Lean Management Community Poland, aiming to address the following research questions:

- What is the level of awareness regarding the occurrence of waste in administrative processes within organizations?
- Which categories of waste are most prevalent in office processes?
- Which Lean Office tools are most commonly implemented in organizations?
- What organizational barriers and needs influence the effectiveness of Lean Office implementation?

The research questions outlined above were subsequently translated into the main objective of the study. The purpose of this article was to examine the level of awareness of waste in office processes and the degree of application of Lean Office methods from the perspective of lean practitioners belonging to the Lean Management Community Poland (LMCP). At the same time, the article aimed to identify barriers and needs related to the implementation of administrative improvements and outline managerial directions that enterprises should pursue.

The article was divided into five sections. The already presented introductory part provides a concise overview of the relevant literature on optimization of office processes and Lean Office concept, identifies existing research gaps and presents both the rationale for the study and its objectives. The second section outlines the research methodology employed, while the third section presents and discusses the research findings. The final part offers conclusions and suggests potential directions for future research.

2. Method

The study was preliminary and based on a structured interview method. It focused on the issue of waste awareness in administrative processes, as assessed by 6 practitioners affiliated with the Lean Management Community Poland, who cooperate with various organizations in the roles of Lean trainers/consultants or employed Lean specialists/experts. Based on the information gathered, it was possible to answer the research questions and formulate appropriate recommendations for organizations struggling with waste in administrative areas and seeking change.

Structured interview is a research technique that forms part of qualitative, direct methods. It involves a detailed preparation of each question and determining the order in which they will be asked. To ensure the highest degree of objectivity, all interviewees should be asked questions in the same way (Majewska, Główniak, 2024). In practice, this technique involves asking a series of standardized closed questions and analyzing the answers provided. The level of structure of the interview may vary and include intermediate forms with more open-ended questions, but the use of closed-ended questions facilitates the comparison of results from interviews conducted with different respondents. On the one hand, it minimizes the subjective assessment of the interviewer and on the other, it ensures the appropriate quality of the tools used (Institute for Educational Research – National Research Institute, 2025). In order to ensure the reliability of the study, the author decided to use this technique, with closed-ended questions.

The interview consisted of 9 questions and the form has been divided into 3 categories: awareness of waste in office processes, using methods to optimize office processes and demographics. All respondents participating in the study were Lean practitioners. Half of them (50%) are specialists or experts permanently employed within a single organization, while the remaining 50% work as Lean consultants or trainers, providing support to a range of different companies and industries.

The majority of respondents (67%) reported that their primary area of Lean practice is the manufacturing sector, reflecting the strong roots of Lean methodologies in production environments. A smaller share (16%) apply Lean principles mainly within the service sector, while 17% operate across multiple sectors, adapting Lean tools and approaches to various business contexts.

In terms of professional experience, the respondents represent a highly seasoned group. As many as 83% of them have over ten years of experience in Lean management, indicating a deep and long-term engagement with continuous improvement practices. The remaining 17% have between two and five years of experience, which still places them among practitioners with substantial, hands-on exposure to Lean implementation.

Overall, the composition of the sample ensures that the insights collected come from individuals with extensive expertise and a broad, practice-based understanding of Lean principles in diverse organizational settings.

3. Results

Within the interview process respondents were asked a total of 9 questions divided into 3 groups: awareness of waste in office processes, using methods to optimize office processes and demographics. Data collected through structured interviews were systematically compiled and presented in the form of graphical representations.

Firstly, respondents were asked to assess the awareness of waste in the administrative area in the organization or organizations they work with. The answers to this question varied greatly: 33% indicated a moderate level and the remaining answers were evenly distributed between very low, low, high and very high. This means that some companies are taking steps to optimize their administrative processes, but many still do not see the need to do so. The varying levels of awareness of waste in administrative areas may result from differences in the organizational maturity of companies, a lack of tools to identify losses and the invisibility of waste in office processes. The results of this part of the study are presented in Figure 1.

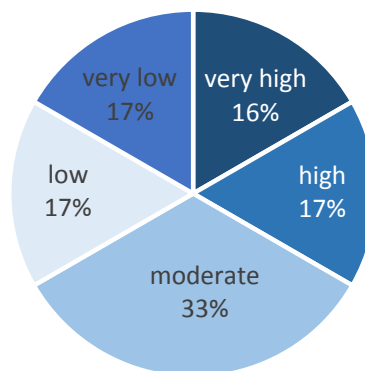


Figure 1. Awareness of waste in the administrative area.

Source: Own study.

Figure 2 presents the results of the study on types of waste most often observed by interviewees in administrative processes. The most frequently cited issues were errors and corrections, overproduction and waiting. Indeed, El-Refai and Mohamademin demonstrated that waiting, corrections and extra processing account for approximately 40% of the total lead time, representing non-value-added activities (2020). Overproduction, also pointed out by the respondents of this study, may be a primary source of above mentioned errors, corrections and waiting. According to Taiichi Ohno, the founder of the Toyota Production System, which later

evolved into Lean Manufacturing, overproduction is considered the primary form of waste from which all other types of waste originate.

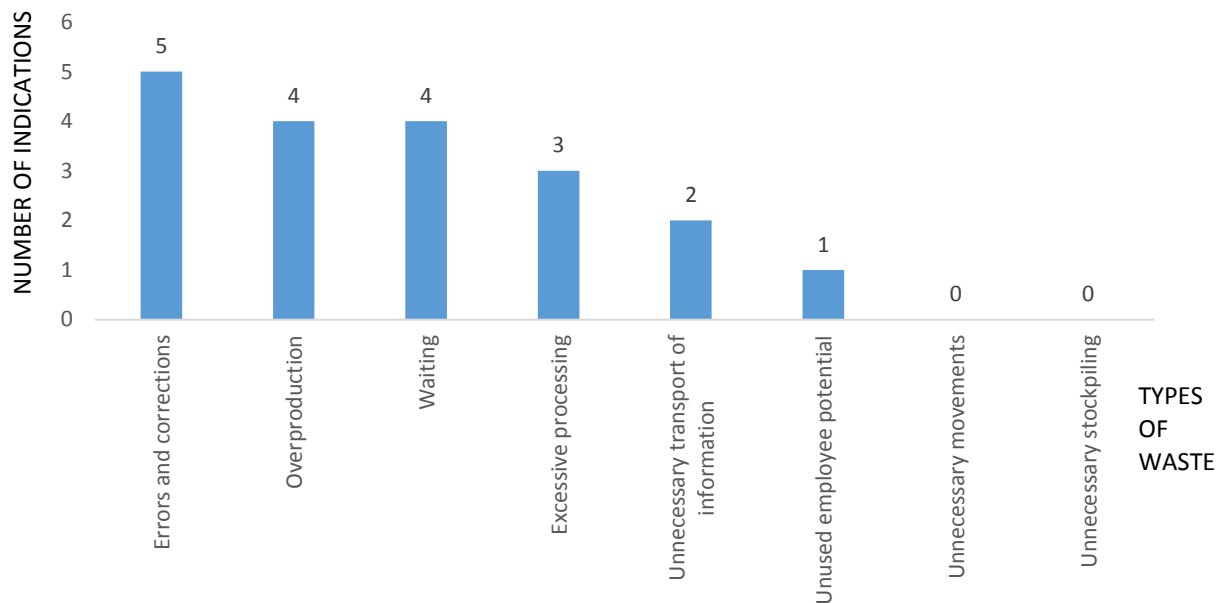


Figure 2. Types of waste in administrative processes.

Source: Own study.

The next topic of interview concerned the frequency with which administrative processes are optimized to eliminate waste in the organizations respondents work with. The results of this part of the study are presented in Figure 3.

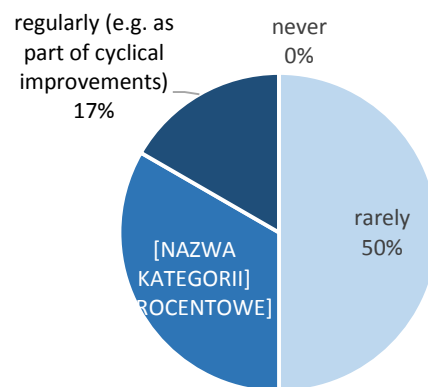


Figure 3. Frequency of administrative process optimization to reduce waste.

Source: Own study.

Half of the respondents believed that such initiatives are rare. In turn, 33% of interviewees stated that they occur only occasionally, mainly in connection with larger projects. Only 17% of respondents indicated that optimizations of administrative processes are carried out regularly. These initiatives operate within the organizations, but they are characterized by irregularity and a strong dependence on specific circumstances. The results therefore indicate potential for their systematic structuring and wider implementation. On this basis, it can be

concluded that the current activities, although valuable, require a clearer framework to ensure their continuity and integration into the organization's strategy.

The next question concerned Lean Office methods or tools used in organizations respondents work with (Figure 4).

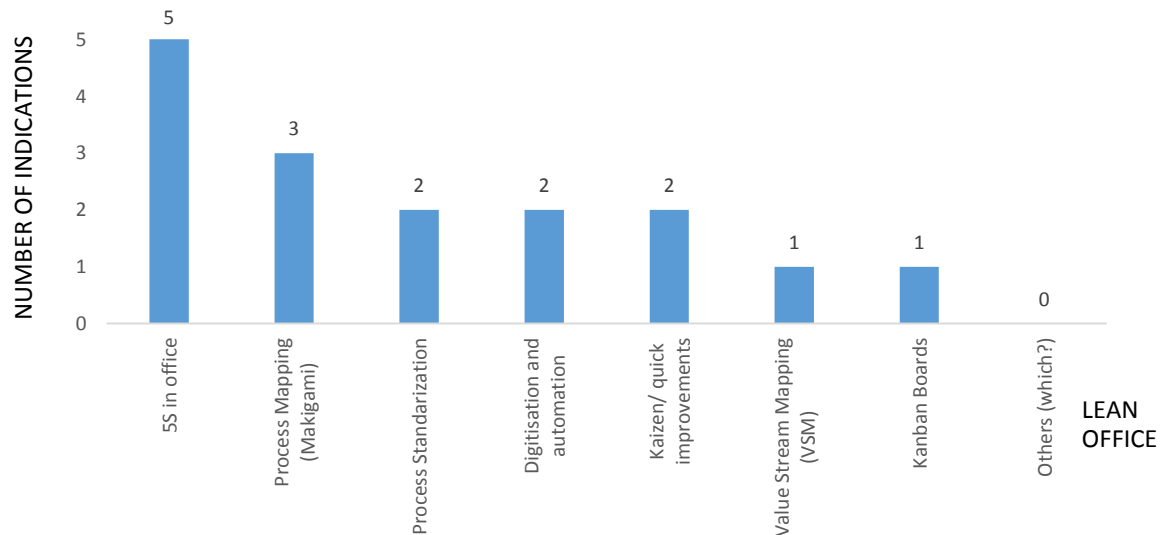


Figure 4. Lean Office methods/tools used in organizations.

Source: Own study.

The tool most frequently indicated by the respondents was 5S, followed by process mapping, which was mentioned slightly less often. In fact, 5S is one of the simplest Lean tools, naturally adapted to the administrative environment as a means of ensuring an organized and orderly workplace. In turn, the popularity of administrative process mapping may reflect organizations' efforts to enhance transparency, standardization and the overall efficiency of their operations. In this context, it is hardly surprising that the third most frequently mentioned response was process standardization. This indicates a growing tendency to apply Lean principles in administrative processes.

In the part of the interview, respondents were also asked about the biggest barriers they encounter or observe when implementing improvements in office processes (Figure 5).

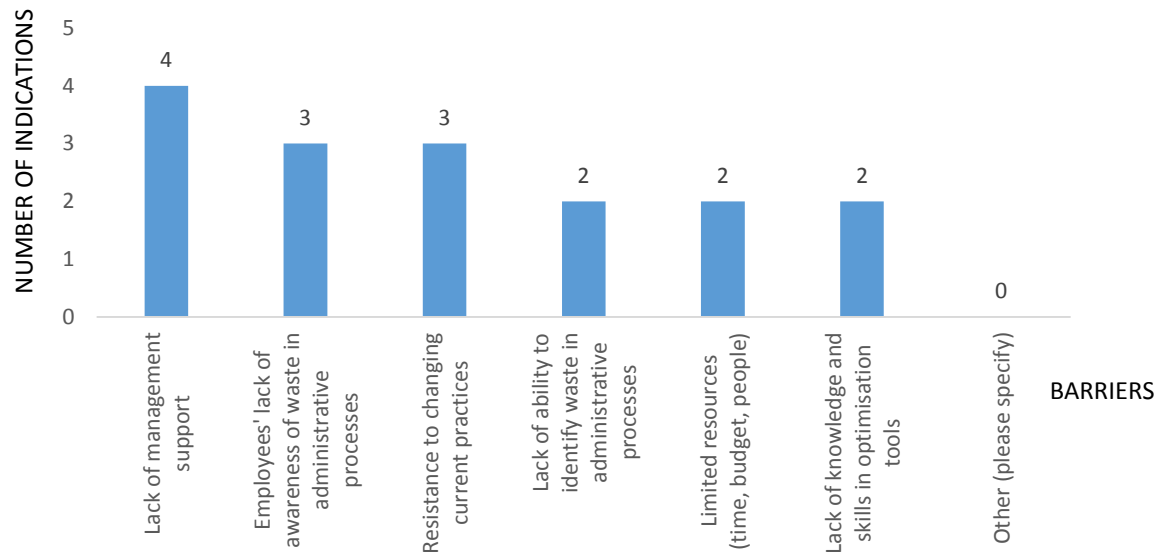


Figure 5. Barriers to implementing improvements in office processes.

Source: Own study.

Among the barriers most frequently identified by the respondents, the lack of managerial support was the most prominent, followed by low employee awareness of waste occurring in administrative processes and resistance to change. This indicates that the successful implementation of Lean principles in administrative processes depends not only on the use of appropriate tools, but also on strong managerial commitment and employee engagement. A lack of leadership support and awareness suggests that cultural and organizational factors remain critical barriers to continuous improvement in office processes.

The next topic of interview concerned support most needed in organizations in order to optimize their administrative processes more effectively (Figure 6).

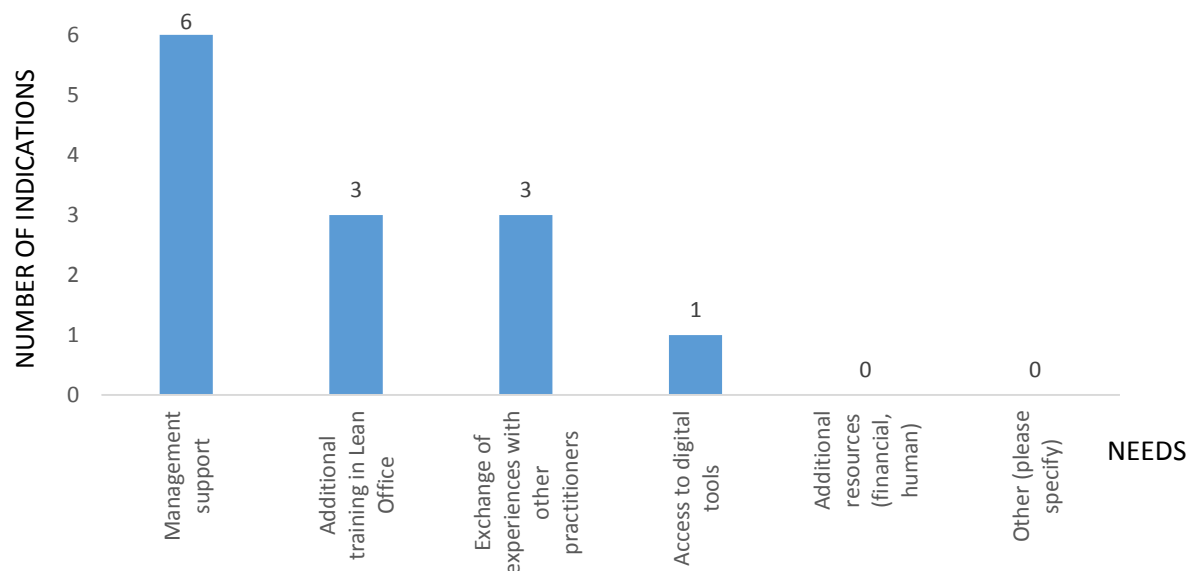


Figure 1. Types of support most needed to optimize administrative processes.

Source: Own study.

The types of support identified by the interviewees closely correspond to the barriers previously mentioned. The most essential factor was managerial involvement and support in optimization activities, followed by training in Lean Office principles and the exchange of experiences with other practitioners. The forms of support indicated by respondents as necessary directly corresponded to the barriers mentioned earlier. This alignment may reflect a growing organizational awareness of the underlying challenges and the mechanisms required to mitigate them.

4. Discussion

The research results indicate that the varying levels of waste awareness across administrative areas may result from differences in organizational maturity and the limited visibility of inefficiencies in office processes. The most frequently observed types of waste, namely errors and corrections, overproduction and waiting, reflect the specific challenges of maintaining flow and quality in administrative environments. The infrequent occurrence of optimization initiatives indicates a lack of systematic improvement approaches and a low maturity of continuous improvement culture in this field. Only routine and systematic action enables organizations to improve their processes systematically, rather than in isolated, individual instances, which constitutes the first recommendation of this article.

The predominance of the 5S tool, followed by process mapping and standardization, suggests that organizations focus mainly on fundamental Lean methods. Using process mapping states a good starting point, but a deeper investigation of value creation flow would make the inefficiencies in office processes more visible, which directly corresponds with the issue described above. The more we know about the value-added creation, the more visible the waste becomes. Moreover, the most common types of waste in office environments - errors and corrections, overproduction and waiting indicate that the main challenge in administration is to ensure the smooth flow of information and the quality of data, rather than that of physical materials. Hence, a systematic mapping of value streams in administrative processes is another recommendation of this article. In order to do that, it is highly recommended to follow the implementation framework developed by Tapping and Shuker, which outlines eight essential steps for planning, mapping and sustaining Lean improvements in administrative areas. These steps include:

1. Commit to Lean - set clear goals and foster a culture of continuous improvement.
2. Choose the Value Stream - select a process or area that delivers customer value and shows strong potential for improvement.
3. Learn about Lean - educate the team on Lean principles, tools and concepts.

4. Map the current state - create a detailed map of the existing process to identify inefficiencies and waste.
5. Identify Lean metrics - define key performance indicators to measure progress and results.
6. Map the future state - design the desired process based on customer demand, continuous flow and workload leveling.
7. Create Kaizen plans - develop specific and actionable improvement initiatives.
8. Implement Kaizen plans - execute the improvements, monitor outcomes and make adjustments as needed to sustain gains (2003).

The identified barriers, particularly the lack of managerial support, low employee awareness of Lean waste in administrative processes and resistance to change, emphasize the critical role of leadership and communication in implementing Lean Office practices effectively. This finding suggests that the primary challenges in implementing Lean Office initiatives are cultural and behavioral rather than technical or financial. The success of such initiatives therefore depends largely on leadership commitment, effective communication and employee engagement, rather than on the availability of tools or financial resources. Indeed, the barriers indicated by the respondents were closely related to above described human factors, rather than to resource-related aspects such as tools or financial means. This confirms the findings of the literature review, which emphasize that the human factor is fundamental and essential for achieving success in the optimization of administrative processes. According to Yokoyama et al. main difficulties encountered in the Lean Office implementations are related to process parameterization and cultural areas (2019). Therefore, the necessity of value stream mapping within administrative processes, as outlined above, together with the requirement for comprehensive preparation and active involvement of personnel at all organizational levels in the implementation of the Lean Office concept, becomes evident. This observation substantiates the rationale for “Commit to Lean” being positioned as the initial step among the eight stages for planning, mapping and sustaining Lean improvements in administrative contexts proposed above.

5. Summary

This paper aimed to examine the level of awareness of waste in office processes and the degree of application of Lean Office methods from the perspective of lean practitioners belonging to the Lean Management Community Poland (LMCP). Moreover, it aimed to identify barriers and needs related to the implementation of administrative improvements and outline managerial directions that enterprises should pursue.

Based on the study, the degree of application of Lean Office methods across companies can be rated as moderate. The respondents indicated specific types of waste occurring in office processes of companies they work with, but at the same time these types of waste are rarely addressed through specific optimization measures. Simultaneously, the use of Lean tools is limited to the basic ones. These findings resulted in a recommendation to introduce routine and systematic measures to optimize the process, rather than isolated and individual measures, with a special focus on mapping the value stream in office processes.

The main barriers related to implementation of Lean Office were indicated: lack of managerial support, low employee awareness of waste occurring in administrative processes and resistance to change. Subsequently, Lean Office implementation needs were also identified and closely correspond to the indicated barriers. Both categories closely relate to the human factor, which is often emphasized in the literature on the subject. As a result, a further recommendation was issued - to ensure thorough preparation and active involvement of staff at all organizational levels in the implementation of the Lean Office concept.

Thus, the research questions were answered as follows:

- The level of awareness regarding the occurrence of waste in administrative processes within organizations is moderate.
- Errors and corrections, along with overproduction and waiting, represent the categories of waste most commonly occurring in office processes.
- 5S, process mapping and process standardization are the most commonly implemented Lean Office tools.
- Lack of managerial support, low employee awareness of waste occurring in administrative processes and resistance to change were indicated as barriers of Lean Office implementation. Subsequently, managerial support in optimization activities, training in Lean Office principles and the exchange of experiences with other practitioners were indicated as main needs in this field.

The contribution of this article is twofold. Firstly, the article proves that both awareness of waste in administrative processes and application of Lean Office tools are at a moderate level, even in companies that employ or collaborate with Lean specialists or consultants. Secondly, the article offers specific recommendations regarding staff preparation and the use of Lean Office tools.

The main limitation of this study lies in its qualitative nature and the reliance on opinions from a limited number of experts. The study involved 6 experts who consented to participate. Although their insights provided valuable qualitative input, the limited number of participants may result in a sampling bias and restrict the broader applicability of the results. As such, the findings reflect subjective perspectives and may not fully represent the diversity of experiences across different organizations or sectors. Therefore, future research should include quantitative studies across different sectors to identify variations in Lean Office maturity and effectiveness. Developing self-assessment tools for organizations would support measuring

progress in Lean Office implementation. Building on the findings of this study, the author of the article plans to undertake future research involving quantitative cross-sector analyses and the creation of practical instrument to assess and strengthen Lean Office maturity. The potential for further development and application of Lean Office principles remains significant and future research may help organizations better realize this untapped potential.

References

1. Chernew, M., Mintz, H. (2021). Administrative Expenses in the US Health Care System. Why so high? *JAMA*, Vol. 326, No. 17, pp. 1679-1680. DOI: <https://doi.org/10.1001/jama.2021.17318>
2. El-Refai, O., Mohamademin, A. (2020). *Applying value stream mapping in office and services – a case study for Lear Corporation*. Chalmers University of Technology. Retrieved from: <https://odr.chalmers.se/server/api/core/bitstreams/94ca094c-7a9f-4fc1-a2a0-7b16d40abb86/content>, 05.10.2025.
3. Gupta, S., Sharma, M., Sunder, V. (2016). Lean services: a systematic review. *International Journal of Productivity and Performance Management*, Vol. 65, No. 8, pp. 1025-1056. DOI: <https://doi.org/10.1108/IJPPM-02-2016-0038>
4. Hartanti, L.P.S., Gunawan, I., Mulyana, I.J., Herwinarso, H. (2022). Identification of Waste Based on Lean Principles as the Way towards Sustainability of a Higher Education Institution: A Case Study from Indonesia. *Sustainability*, Vol. 14, No. 7. DOI: <https://doi.org/10.3390/su14074348>
5. Institute for Educational Research – National Research Institute (2025). *Structured Interview*. Retrieved from: <https://walidacja.ibe.edu.pl/metody/pl/metody-walidacji/wywiad-ustrukturyzowany>, 01.10.2025.
6. Irsa, W., Székely, C. (2021). Analysis of Overhead Costs Management in Companies. *ENTRENOVA - ENTERprise REsearch InNOVAtion, IRENET - Society for Advancing Innovation and Research in Economy*. Vol. 7, Iss. 1, pp. 23-33. DOI: <https://doi.org/10.54820/ZZRU4894>
7. Koromyslova, E., Steinlicht, C., Hall, T., Yordanova, A., Garry, B. (2018). *Implementing Lean Practices in an Academic Department: A Case Study*. Conference: 2018 ASEE Annual Conference & Exposition. DOI: <https://doi.org/10.18260/1-2--30623>
8. Locher, D. (2019). *Lean office and service simplified: The Definitive How-To Guide*. Warsaw: MT Business, pp. 19-29.
9. Majewska, A., Główniak, A. (2024). *Interviews*. *Management Encyclopaedia*. Retrieved from: <https://mfiles.pl/pl/index.php/Wywiad>, 01.10.2025.

10. Malacarne, R.F., Taquetti, L.S., Mourão, M.R., Zattar, I.C., Seleme, R. (2018). *Lean Office and Service – A Bibliometric Research*. Proceedings of the 8th International Workshop on Advances in Cleaner Production (IWACP). Barranquilla, Colombia. DOI: <https://doi.org/10.14521/P2237-5163.2018.0016.0009>
11. Monteiro, M., Pacheco, C., Dinis-Carvalho, J., Paiva, F. (2015). Implementing lean office: A successful case in public sector. *FME Transaction, Vol. 43, No. 4*. DOI: <https://doi.org/10.5937/fmet1504303M>
12. Monteiro, J., Alves, A.C., do Sameiro Carvalho, M. (2017). Processes improvement applying Lean Office tools in a logistic department of a car multimedia components company. *Procedia Manufacturing, Vol. 13*, pp. 995-1002. DOI: <https://doi.org/10.1016/j.promfg.2017.09.097>.
13. Ruwanpura, U., Perera, B., Ranadewa, T. (2025). Lean tools used in administrative processes across sectors: a systematic review and insights for the construction industry. *Construction Innovation: Information Process Management, Vol. 25 No. 4*, pp. 1287-1314. DOI: <https://doi.org/10.1108/CI-03-2023-0057>
14. Tapping, D., Shuker, T. (2003). *Value stream management for the lean office: Eight steps to planning, mapping and sustaining lean improvements in administrative areas*. Productivity Press, p. 1.
15. Yokoyama, T.T., de Oliveira, M.A., Futami, A.H. (2019). A systematic literature review on lean office. *Industrial Engineering and Management Systems, Vol. 18, No. 1*, pp. 67-77. <https://doi.org/10.7232/iems.2019.18.1.067>

ELEMENTS OF CONTROL AND WARNING SYSTEMS FOR ASSESSING AN ENTERPRISE'S FINANCIAL CONDITION

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Purpose: The purpose of this article is to present a conceptual framework for assessing a company's financial condition using financial indicators that inform financial managers about potential deterioration in the enterprise's financial situation through a control-and-warning procedure.

Design/methodology/approach: The article proposes a system of financial condition metrics calculated on the basis of financial statements, which characterize the financial situation of the enterprise in the areas of profitability, liquidity, operational efficiency, and financing. These indicators are subsequently classified into stimulants, destimulants, and nominants, which when combined with statistical methods and dynamic analysis enable an evaluation of the company's performance in terms of improving or worsening financial condition. The article is interdisciplinary in nature, as it integrates elements of accounting, financial analysis, and statistics.

Findings: The study presents a conceptual model for the application of a financial indicator system within the control-warning procedure, which may serve as a foundation for the operationalization of the proposed solutions.

Originality/value: Formulation of the areas of application for the system of financial indicators (measures), classification of indicators into stimulants, destimulants, and nominants, definition of a control-warning procedure; the article could potentially be of interest to financial managers.

Keywords: financial analysis, system of financial condition measures, control-warning procedure.

Category of the paper: Research paper, Conceptual paper.

1. Introduction

In a market economy characterized by advancing globalization and intensifying competition, financial management preceded by financial analysis supported by modern information technologies has gained increasing importance, contributing to enhanced operational efficiency within enterprises. In financial analysis, selected financial ratios play

a pivotal role, forming a system of measures used to assess a company's financial condition and constituting the basis for diagnosing its financial situation.

To this end, one of the functions of the financial condition indicator system discussed in the article namely, the control-warning function is employed. This function classifies indicators into one of three categories (stimulants, destimulants, or nominants), defines desirable values of financial ratios, monitors their levels, and alerts managers to emerging threats associated with a deteriorating financial position of the enterprise.

Furthermore, the article outlines directions for improving and developing the system, aimed at broader use of benchmarking, scenario analysis, simulation, forecasting, and taxonomic methods.

2. Areas of application of the financial condition measurement system

The condition of an enterprise is defined as the organizational, technical, legal-economic, and financial state of an economic entity, which is influenced by favorable and unfavorable internal factors as well as external environmental parameters resulting from the functioning of the global market economy. One distinguishes the economic condition, the technical condition, and the financial condition of an enterprise. Changes in the functioning of an economic entity, resulting from management processes, imply changes in its condition and performance. Therefore, it is commonly said that an entity's condition may be better or worse. Enterprises that are unable to adapt to changing economic conditions and market requirements fall into financial difficulties, and their condition systematically deteriorates, potentially bringing them to the brink of bankruptcy. In contrast, enterprises in good or very good condition can freely meet all their obligations, implement both tangible and capital investment plans, adequately compensate employees, and provide dividends to asset owners or shareholders.

The state of technical and economic condition determines the financial condition (see: Accounting Lexicon, 1996) of the enterprise. Thus, financial condition is both a consequence and a determinant of the technical and economic condition of the enterprise.

The problem of measuring financial condition is extremely complex and may be approached in two ways:

1. through a set of financial measures,
2. through the use of a synthetic measure, i.e., an aggregate indicator that combines various individual measures.

Both types of measures belong to a set of indicators referred to as the system of measures of a company's economic condition. This system can operate in the following areas of application (see Kopiński, 1991, 1992):

1. informational-presentational,
2. structural-warning,
3. dynamic-forecasting,
4. simulation-analytical,
5. consulting decision-making,
6. synthetic-strategic.

Each of these areas can be used in all the modules into which the set of measures has been divided. The structural warning area presents the desired values of indicators of the economic condition, whether in the form of a plan, standards, expert (practitioner) suggestions, or structural ratios and defined permissible ranges for selected indicators. Based on such constructed desired indicator values, the system can emit warning signals when the condition of the enterprise becomes disrupted (unstable). Warning signals should also be triggered when the relationships between economic values or indicators considered natural, normal, or desirable are violated. This is the so-called active technique of monitoring the system's condition. It consists in the fact that when the condition of the entire system or its parts falls below an acceptable tolerance threshold, the system issues a warning signal and automatically determines, along the dendrite pathways, the route leading to the area responsible for the alarm state. There also arises the problem of quickly identifying the appropriate terminal node (condition indicator) within the hierarchical structure. In the structural-warning area, a major challenge is determining which states should be considered normal from the perspective of the observed indicators (i.e., the acceptable lower and upper indicator values). Moreover, in the constantly changing conditions of the enterprise's operation and in the context of economic imbalance, the acceptable lower and upper limits of condition indicators would have to be continuously adjusted.

However, based on meetings and business interviews, one may conclude that such a structural-warning subsystem could serve as a useful tool supporting managerial decision-making alongside the already functioning subsystem serving the informational-presentation area. In this area, interval statistics, forecasting techniques, and other statistical-mathematical methods are used, supported by modern information technology.

The dynamic-forecasting area enables the collection of data on individual indicators on a daily, monthly, quarterly, and annual basis, which creates time series. Based on statistically selected economic series characterizing the company's condition and their smoothing (using a creeping trend or other methods, such as logistic), the dynamic-forecasting area will allow for the identification of threats and unfavorable economic conditions for the company, the development of short-term warning forecasts (using the first and second differences method), taxonomic analysis of the database, and possible attempts at aggregation of time series using both the principal component method and the distance-from-the-development-pattern method. During periods of political transformation, with constant, significant changes from period to period in all economic parameters characterizing the company's operations,

the dynamic-forecasting subsystem could generate forecasts even those with a short-term horizon with a relatively large error. In this situation, the second type of forecasts generated by this subsystem, called warning or cyclical forecasts, have a greater chance of development. A certain stabilization of the economy has been observed recently, which may contribute to the increasingly bold use of statistical and econometric methods in forecasting business operations. For management purposes, two levels of indicator importance are distinguished:

A. Level I indicators, which primarily determine the financial condition of enterprises, should be monitored on an ongoing basis (at least once a month) by top management.

This group includes the following indicators:

1. net return on sales,
2. net fixed asset productivity,
3. total inventory turnover (days),
4. receivables turnover (days),
5. payables turnover (days),
6. debt ratio,
7. investment ratio,
8. current liquidity ratio (level II).

B. Level II indicators, less important, include other indicators not listed in List A.

The values of these indicators, as well as level I indicators, should be monitored by department managers within the company.

All indicators, regardless of level, are presented in the system according to a single standard. After entering the date (period) at the end of which the indicator value is to be calculated, it is necessary to specify whether it will be a planned or actual indicator. Next, the basis for comparison must be provided, which for an actual indicator can be the value of the indicator from the previous period, or the planned indicator value. For a planned indicator, only the value of the planned indicator from the previous period is provided. If selected, the indicator name and its value are provided, the formula used to calculate the indicator, the period for which the indicator was calculated, and information on whether the indicator is planned or executed, as well as whether it was calculated cumulatively or for the period. The user can change the convention, and the histogram will then present the indicator value for the selected periods of the analyzed year and the same periods of the previous year.

3. Classification of financial indicators into categories

The indicators presented in Modules 1 to 3 are divided into three categories based on the warning mechanism used (Kopiński, 2008; Kowalak, 2003):

1. Stimulants - those financial indicators whose increase represents a positive trend in the development of a phenomenon, e.g., profitability and productivity indicators. Simply put, if the value of these indicators increases, the company's financial condition is likely improving. Otherwise, an audible alarm is triggered and the indicator value is displayed in red as a warning of the company's likely deteriorating financial condition.
2. Destimulants - those indicators whose decrease represents a positive trend in the development of a phenomenon, e.g., turnover rates in days. Similarly, if the value of these indicators decreases, the company's financial condition is likely improving. Otherwise, a warning signal is triggered indicating the company's likely deteriorating financial condition.
3. Nominants - those indicators whose value should fall within a specific numerical range, namely the financial liquidity indicators of degree I, II, and III. If these indicators meet the specified conditions, there is no cause for concern and the financial condition is within the norm. However, if the indicator value rises above the upper limit or falls below the lower limit, a warning signal is sent that the company's financial condition is likely to be deteriorating.

The classification of indicators into three categories along with their brief interpretation is provided below.

Table 1.
Financial indicators and their interpretation

No.	Name	Interpretation	Type
1. Operational Efficiency Ratios			
1.1. Profitability Ratios			
1.1.1.	Return on Assets	Net profit attributable to one unit of assets engaged in the enterprise.	Stimulant
1.1.2.	Net Profit Margin	Share of after-tax profit in sales value; the profit margin generated by a given level of sales.	Stimulant
1.1.3.	Gross Profit Margin	Reflects pricing policy and profit generated by sales; independent of income-tax rate.	Stimulant
1.1.4.	Return on Equity	Rate of return on investment in the enterprise; higher value indicates stronger financial position.	Stimulant
1.1.5.	Return on Fixed Capital	"Return on capital." Indicates capacity for development and is a key measure of financial condition.	Stimulant
1.2. Productivity Ratios			
1.2.1.	Productivity of Net Fixed Assets	How much net revenue is generated by 1 PLN of net fixed assets.	Stimulant
1.2.2.	Productivity of Current Assets	How much revenue is generated by 1 PLN of current assets.	Stimulant
1.2.3.	Productivity of Liquid Assets	How much revenue is generated by 1 PLN of liquid current assets.	Stimulant
1.2.4.	Productivity of Total Assets	How much revenue is generated by 1 PLN of total assets.	Stimulant
1.2.5.	Sales per Employee	Sales revenue per employee; indicator of labour efficiency.	Stimulant

Cont. table 1.

1.3. Turnover Ratios			
1.3.1.	Inventory Turnover (days)	Average number of days needed to renew inventory to achieve sales.	Destimulant
1.3.2.	Material Inventory Turnover (days)	Average number of days material inventory remains in warehouses.	Destimulant
1.3.3.	Receivables Turnover (days)	Average number of days of sales for which receivables remain uncollected.	Destimulant
1.3.4.	Payables Turnover (days)	Average time of settling liabilities.	Stimulant
1.3.5.	Trade Payables Turnover (days)	Average duration of settlement cycle with suppliers.	Stimulant
1.3.6.	Inventory Turnover (times)	How many times inventory is renewed during the period.	Stimulant
1.3.7.	Receivables Cycle Ratio (times)	How many times receivables are renewed annually.	Stimulant
1.3.8.	Payables Cycle Ratio (times)	How many times payables are settled annually.	Destimulant
1.3.9.	Cash Cycle (days)	Time between cash outflow for liabilities and inflow from receivables.	Destimulant
2. Enterprise Financing Ratios			
2.1. External Financing Ratios			
2.1.1.	Equity Share in Total Capital	Share of equity financing the enterprise's assets.	Stimulant
2.1.2.	Share of Foreign Capital	Degree to which assets are financed with external capital.	Destimulant
2.1.3.	Debt Ratio	Engagement of foreign capital relative to equity; ability to cover debt with equity.	Destimulant
2.1.4.	Long-term Debt Ratio	"Debt ratio" or "risk ratio"; long-term obligations exceeding one year.	Destimulant
2.1.5.	Fixed Assets Coverage Ratio	Extent to which long-term obligations are secured with tangible assets.	Stimulant
2.2. Internal Financing Ratios			
2.2.1.	Gross Cash Flow	Simplified operating cash flow (based on gross profit).	Stimulant
2.2.2.	Net Cash Flow	Net surplus from operating activity.	Stimulant
2.2.3.	Net Debt	Short-term foreign capital not covered by receivables or cash.	Destimulant
2.2.4.	Debt Dynamics	Share of net debt in financial surplus; fraction of debt covered by cash flows.	Destimulant
2.2.5.	Investment Level	Extent to which fixed assets are renewed via investment.	Stimulant
3. Financial Liquidity Ratios			
3.1.	Current Ratio (Level III)	Degree to which short-term liabilities are covered by current assets.	Nominant
3.2.	Current Ratio (Level II)	Coverage of short-term liabilities with current assets excluding inventories.	Nominant
3.3.	Quick Ratio (Level I)	Coverage of short-term liabilities with cash and equivalents.	Nominant
3.4.	Working Capital in Days	Number of days of operations covered by working capital.	Stim./Dest.
3.5.	Value of Working Capital	Amount of working capital available.	Stim./Dest.
3.6.	Working Capital Coverage of Current Assets	Part of current assets financed with working capital.	Stim./Dest.
3.7.	Working Capital Coverage of Total Assets	Part of total assets financed with working capital.	Stim./Dest.

Source: Author's own elaboration based on Gabrusewicz (2007) and Kopyński (1991).

Indicator presentation and alerts can be implemented in both automatic and conversational modes. In the automatic mode, after entering a date, indicator values are automatically reviewed. If economic conditions within the company have deteriorated, an audible signal is emitted, and the indicator appears in red. This should serve as a warning signal for the company's management and prompt them to take decisions aimed at improving the financial

situation in this regard. In the conversational mode, the user can select any indicator from a single-level or two-level menu and view its value for the most recent period. Furthermore, indicator values from previous periods are presented in a histogram or a double histogram, i.e., against the indicator's value from the previous year. Observing indicator values in the conversational mode is selective; it is not necessary to go through all the branches of the tree structure and review all indicators one by one. This allows complete freedom, and the indicator values should be derived based on the auditor's genuine need to assess the financial condition of the company.

Work on improving and modifying the system should progress toward a broader application of simulations, forecasting, and taxonomy in the following areas:

- the development of short-term forecasts for selected components of cash flows and financial indicators,
- the construction of warning mechanisms within the system based on indicator dynamics,
- the monitoring of the financial condition of business entities in comparison with their industry at the national or regional level,
- the formulation of alternative operational scenarios for the enterprise using the *What-if* rule, as well as Solver and Backsolver tools available in the Excel spreadsheet environment,
- the expansion of the system to include a Du Pont analysis module, sensitivity threshold analysis, and additional elements related to corporate financial management.

The financial condition system should be user-friendly, simple to operate, and highly reliable. Its installation and implementation require only a brief demonstration (training) aimed at familiarizing future users with the system's functional capabilities. The system may be operated autonomously or integrated with the financial and accounting information system already in use within the enterprise.

4. Elements of an early warning system

The foundation of the early-warning subsystem within the financial condition assessment framework consists of calculated indicators typically used primarily for analytical and reporting purposes prepared, depending on informational needs, for daily (d), ten-day (l), monthly (m), quarterly (q), or annual (a) periods. The computed indicator values form time series whose elements correspond, for example, to individual months (monthly time series) or quarters (quarterly time series).

Financial indicators of an enterprise as previously noted which form time series may include:

- planned or target values,
- actual values,
- average indicators for the enterprise sector or a specific industry,
- indicators of competing firms operating in the market, or enterprises with a similar profile of production or services.

An important categorization of financial condition indicators for the purpose of implementing an early-warning procedure is the classification of indicators into *stimulants* and *destimulants*. These two groups differ in the way they influence the level of development of the evaluated objects, in this case enterprises. Stimulants exert a positive, stimulating influence on the enterprise, whereas destimulants have a suppressing or inhibiting effect on the degree of development achieved by the firm.

The requirements imposed on stimulants and destimulants can be formulated as follows (Kopiński, 1991; Siedlecka, 1996):

- for stimulants:

$$\forall (X_{sj} \geq X_{rj}) \Rightarrow \omega_s \xi \omega_r \quad (1)$$

X_{rj}, X_{sj}

which signifies that the object ω_s dominates the object ω_r (or, equivalently, that the object ω_r is dominated by the object ω_s), a relationship that is conventionally denoted as $\omega_s \xi \omega_r$, provided that

$$X_{sj} > X_{rj} \quad (2)$$

where X_{sj} and X_{rj} can be interpreted as the value of the j -th indicator for two different objects (enterprises) or as the value of the j -th indicator for the same enterprise at different points in time,

- for destimulants:

$$\forall (X_{sj} \leq X_{rj}) \Rightarrow \omega_r \xi \omega_s \quad (3)$$

X_{rj}, X_{sj}

There are also occasionally characteristics (indicators) whose impact on the level of development of objects is difficult to specify and often ambiguous. Several such enterprise indicators, included in the financial condition system within Module 3 (Table 1), have been classified under a dual category, meaning that within certain ranges they may be considered stimulants, while in other ranges they may be considered destimulants. The threshold values separating these subranges are difficult to determine. For control and early-warning purposes, only indicators that can be unequivocally classified as either stimulants or destimulants should be considered. Occasionally, in addition to the aforementioned groups of characteristics, another group so-called neutral characteristics is distinguished; these characteristics neither promote nor hinder development. In specific situations, such characteristics may be treated as stimulants.

To complement this classification, as noted earlier, the class of nominants is introduced. It should be recalled that nominants are indicators whose values should remain within a certain numerical range, thereby supporting the development of the enterprise. Each nominant has an established standard in the form of lower and upper threshold values. Examples of such indicators include liquidity ratios, for which both lower and upper limits are defined. If the calculated value of a liquidity ratio falls below the lower limit (established standard), it is considered that the enterprise faces a lack of liquidity, either in general or with respect to current assets excluding inventory. Conversely, if the calculated liquidity ratio exceeds the upper limit (established standard), the enterprise is experiencing excess liquidity, again either in general or in terms of current assets excluding inventory.

The classification of indicators (measures) into stimulants, destimulants, and nominants has been effectively applied to implement the control and early-warning function. Examples of enterprise financial indicators that belong to the stimulant category (see Table 1) include, for instance, the return on assets (ROA), return on equity (ROE), net fixed assets productivity ratio, and inventory turnover ratio (times). Indicators that can be classified as destimulants include, for example, the total cost level ratio, the share of debt in total capital, net debt ratio, cash conversion cycle in days, and inventory turnover ratio in days.

5. Control and early-warning procedure

The properties of stimulants, destimulants, and nominants can be applied in the process of monitoring and generating early-warning signals. Accordingly, the control and early-warning procedure consists of the following steps:

1. First, establishing benchmark values for indicators classified as stimulants in the form of *lower threshold limits*, for destimulants in the form of *upper threshold limits*, and for nominants in the form of both *lower and upper boundary values*.
2. Second, comparing the calculated value of each indicator with the appropriate threshold depending on whether the indicator is classified as a stimulant or a destimulant, with the lower or upper limit respectively; in the case of a nominant, the indicator is compared first with the lower and subsequently with the upper boundary.
3. Third, issuing an early-warning signal if the indicator value falls below the lower threshold (in the case of a stimulant) or increases beyond the upper threshold (in the case of a destimulant). For nominants, a warning signal is generated when the indicator value either exceeds the upper boundary or falls below the lower boundary.

The control-and-warning procedure can be applied within an enterprise provided that a normative database containing benchmark indicator values has been established. The issue of determining threshold values for indicators is not straightforward. Their specification may rely

on average indicator values observed across the national enterprise sector, within the specific industry in which the company operates, or on expert assessments and recommendations formulated by institutions and foundations that collect and analyse data pertaining to the manufacturing, service, and commercial sectors. An alternative method for establishing so-called thresholds that is, normative values of corporate indicators and for generating warning signals is the use of control charts applied in statistical quality control (see Siedlecka, 1996). In order to construct a chart for a time series, one determines, analogously to SQC procedures, a central line (γ) for the indicator at a level that is either predefined or empirically estimated as the threshold value, as well as control lines. These control lines run parallel to the central line at distances of k_1s and k_2s , where the distances depend on the random fluctuations of the indicator, measured by the calculated standard deviation (s). The safety level for a given time series representing the values of an indicator is defined as the value of the central line (γ) that determines the admissible indicator value, beyond which there is no need to generate warning signals. The control lines plotted at $\gamma + s$ and $\gamma + 2s$ are referred to as the first and second safety boundaries, respectively. A warning signal should be issued when $|x_t - \gamma| > ks$ ($k = 1, 2, 3$), indicating a threat of the first, second, or third degree. Another criterion for generating warning signals is the occurrence of two or three indicator values beyond the first boundary, or the appearance of a sequence of values located on one side of the safety level.

Signals generated by the warning system can also be attenuated or amplified through additional mechanisms. In the case of stimulants and destimulants, a warning signal may be triggered, for example, when the value of a stimulant-type indicator decreases three consecutive times (i.e., over three successive periods). If the indicator decreases only once or twice from one period to the next, such fluctuations are considered normal (so-called “random operational deviations”). For destimulants, this rule should be reversed: a warning signal should be generated only when there is a two- or three-period consecutive increase in the indicator’s value. In the case of nominants, the “tunnel” (or band) method may be applied, where the acceptable interval is defined as the arithmetic mean of the indicator increased by one standard deviation or by twice the standard deviation. This approach allows either reinforcing or weakening the intensity of warning signals sent by the system.

The fundamental method for analysing a time series involves examining the dynamics of indicators over a selected period. Measures of dynamics, which demonstrate the changes in current indicator values relative to the indicator's level in a chosen base period, may also be employed in the warning process. Depending on the choice of base, one distinguishes between measures of dynamics with a fixed base (single-base indices) and those with a moving base (chain indices). The most commonly applied measures of dynamics include the absolute change, the rate of change, and dynamic indices of financial indicators. Each of these measures may serve as a criterion for issuing warning signals.

The increment represents the difference between the value of a given measure in two distinct periods. If x_1 and x_2 denote the level of the measure (indicator) X in the current and base period respectively, the increment is expressed by the formula:

$$\Delta = x_1 - x_2 \quad (4)$$

The increment indicates by how many units the value of the measure has increased ($\Delta > 0$) or decreased ($\Delta < 0$) in the analysed period relative to the base period. It constitutes a dimensional measure, expressed in the same units as the indicator under examination. If the indicator is a stimulant, a positive increment is considered desirable, whereas a decrease constitutes grounds for issuing a warning signal. In the case of a destimulant, the procedure is applied in the opposite manner within the control-and-warning system.

The rate of increase is the relative increment of a measure expressed as a percentage, calculated using the following formula (Kopiński, 1992):

$$W = \frac{x_1 - x_2}{x_2} \times 100\% \quad (5)$$

where the notation remains the same as previously.

The rate of increase indicates by what percentage the level of the indicator in the analysed period is higher ($W > 0$) or lower ($W < 0$) than the level in the reference period. For a *destimulant*, a decrease in the rate ($W < 0$) is a desirable phenomenon and positively affects the financial condition of the enterprise, whereas an increase in the rate signals a deterioration of the financial situation. In the case of a *stimulant*, the opposite holds true a positive rate of increase is favourable.

An index is a measure expressing the ratio of numerical values of the same metric (indicator) in two different time periods. The index shows how many times the value of the indicator in the period under study is higher (or lower) than the value of that indicator in the base period. Indices are frequently expressed as percentages. If X denotes the indicator under analysis, with I designating the period under study and 0 the base period, then the index $I_{1/0}$ takes the following form (Kopiński, 2008):

$$I_{1/0} = \frac{x_1}{x_0}, \quad (6)$$

where x_1 and x_0 represent the values of the indicator X in the period under study and the base period, respectively.

Dynamics indices are particularly applicable to:

- describing the dynamics of phenomena, where the measure of dynamics expresses the ratio of the level of a given phenomenon in two different periods the reference period and the period under examination. Depending on whether dynamic indices are calculated for individual units within a population or for the entire set of such units, one distinguishes between individual dynamic indices and aggregate dynamic indices. If the dynamics of the aggregate index reflects positive developmental trends within the economic entity, there is no justification for issuing warning signals.

- description of dynamics of phenomena, where the dynamic measure determines the ratio of the level of a phenomenon in two different periods: the observed period and the base period. Depending on whether the dynamic indices are calculated for individual units of a given population or for the entire set of units, individual dynamic indices and aggregate dynamic indices are distinguished. If the dynamics of an aggregate index correspond to positive trends in the development of an economic entity, there is no basis for issuing warning signals

The previous discussion has focused on the methodology of early-warning systems based on actual, empirical values of enterprise indicators calculated for historical and current periods and recorded as time series. It is also possible to attempt constructing a forward-looking early-warning system by employing a forecasting mechanism. The purpose of the predictive warning is to provide timely information about potential future adverse changes in the enterprise's condition, as expressed through its indicators. As a result, early-warning forecasts constitute a specific type of prediction: they do not concern the future absolute values of selected enterprise indicators that characterize its condition, but rather the fact that these indicators will exhibit declining trends relative to the values observed at the time of the forecast. This approach applies to indicators classified as stimulants, for which a positive state is associated with increasing values. Conversely, for indicators classified as destimulants, warning signals should be issued based on forecasted values that are expected to increase, indicating a potential deterioration in the enterprise's condition.

The values of indicators expressed dynamically, i.e., through time series, typically result from the combined effects of two components: a trend and a random factor; occasionally, a third component appears in the form of periodic fluctuations. Consequently, attempts are made to establish criteria for issuing warning signals based on smoothed time series of indicators, which have been stripped of random fluctuations and represented using a trend function. In this approach, the analysis of sequences of first and second differences of the trend function is employed (see Siedlecka, 1996), limiting warnings to genuinely significant threats, indicated by the persistence of negative differences for at least two periods. If the first differences are negative, this implies a decline in indicator values, which is undesirable in the case of stimulants.

Generally, the first differences alone do not allow for predictions regarding the future behavior of an indicator. However, based on the second differences computed from the trend function, a change in sign from positive to negative allows for the anticipation that the indicator, estimated using this function, will eventually decrease after reaching its maximum.

The enterprise indicator system presented in this study, in addition to its analytical, reporting, and informational functions, can also perform important early-warning functions, alerting management (see Wierzbiński, 1998) to adverse trends or processes that necessitate preventive actions. Furthermore, the indicator system can serve a confirmatory role, reinforcing

management in the implementation of the existing strategy and even supporting decision-making that contributes to the improvement of the enterprise's overall condition.

6. Conclusions

The assessment of a company's financial condition involves demonstrating the development of financial ratios derived from the financial statements, which characterize the enterprise's operations, financial performance, liquidity, profitability, and asset equity structure for the year under review in comparison with two or more preceding years.

The calculated ratios, together with the applied control-and-warning procedure, make it possible to identify symptoms of an unfavorable financial situation that may threaten the entity's ability to continue operations and to achieve satisfactory financial results. Consequently, deteriorating values of specific indicators (stimulants, destimulants, and nominants), when detected sufficiently early during the financial year, may serve as the basis for undertaking appropriate preventive actions aimed at averting further deterioration of the enterprise's financial condition.

A system of financial condition measures based on classical financial ratios calculated from financial statements can continuously perform functions that reinforce managerial commitment to the current strategic direction or prompt modifications in the enterprise's operations. Moreover, it may support the adoption of decisions that contribute to improving the company's financial condition.

References

1. Dudycz, T., (2011). *Analiza finansowa jako narzędzie zarządzania finansami przedsiębiorstwa*. Wrocław: Indygo Zahir Media.
2. Gabrusewicz, W. (2019). *Metody analizy finansowej przedsiębiorstwa*. Warszawa: PWE.
3. Gabrusewicz, W. (2007). *Podstawy analizy finansowej*. Warszawa: PWE.
4. Kopiński, A. (2008). *Analiza finansowa banku*. Warszawa: PWE.
5. Kopiński, A. (1991). Metody oceny kondycji ekonomicznej przedsiębiorstwa. Wrocław: *Prace Naukowe Akademii Ekonomicznej*, nr 590.
6. Kopiński, A. (1992). Obszar symulacyjno-analityczny jako podstawowy element systemu mierników kondycji ekonomicznej przedsiębiorstw. *Badania Operacyjne i Decyzje*, nr 2. Wrocław.
7. Kowalak, R. (2003). *Ocena kondycji finansowej przedsiębiorstwa*. Gdańsk: ODDK.

8. Nowak, E. (1996). *Leksykon Rachunkowości*. Warszawa: PWN.
9. Siedlecka, U. (1996). *Prognostowanie ostrzegawcze w gospodarce*. Warszawa: PWE.
10. Wierzbiński, J. (1998). Systemy wczesnego ostrzegania w przedsiębiorstwie. *Ekonomika i Organizacja Przedsiębiorstw*, 8.

RISK-BASED EVALUATION OF DECISION-MAKING PROCESSES IN BRIDGE OPERATIONS OF SEAGOING VESSELS

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Purpose: This study aims to examine the operational risk factors that influence decision-making by watch officers on a ship's bridge. It focuses on human-related aspects such as stress, fatigue, routine behaviour, communication, and time pressure — elements that collectively shape the quality of decisions made in dynamic maritime environments.

Design/methodology/approach: The research was based on a structured questionnaire completed by deck officers. The survey collected opinions on working conditions, psychological strain, and the organisation of bridge duties. The responses were evaluated using an expert approach supported by fault tree analysis (FTA), which made it possible to design an initial model for assessing human reliability within the “human–ship” operational system.

Findings: The analysis revealed several recurring issues that reduce the reliability of officers on watch. The most significant include fatigue caused by irregular duty schedules, stress linked to safety responsibility, limited communication, and continuous time pressure. Long-term exposure to such conditions lowers focus and increases the risk of human error. The developed model helps to better understand how human factors interact and influence operational safety.

Research limitations/implications: The results are based on self-reported data, which may affect their general validity. Future studies should combine this approach with simulation-based testing or direct observation of bridge teams. Economic and organisational factors were not addressed.

Practical implications: The findings provide a basis for developing risk assessment and training tools centred on the human factor. The proposed reliability model may support bridge resource management and improve the overall safety culture on board.

Social implications: Improving working conditions and fatigue management can enhance both safety and crew well-being, contributing to sustainable maritime operations.

Originality/value: The paper combines human-factor analysis, reliability assessment, and operational risk evaluation in one framework, offering a practical contribution to understanding human performance in maritime navigation.

Keywords: Human Reliability Assessment(HRA), human factors, Rensis Likert scale, risk perception in navigation, workload assessment techniques.
Category of the paper:

1. Introduction

Maritime transport continues to be the backbone of international trade, accounting for almost 80% of global cargo flows (UNCTAD, 2023). Although the shipping industry has adopted advanced technologies and increasingly sophisticated support systems, the number of maritime incidents remains a concern. Current research consistently highlights the human factor as a major cause of maritime accidents (Mu et al., 2024).

Operational decisions made by watch officers are shaped by a variety of internal and external factors, including stress levels, fatigue and environmental complexity (Jaram et al., 2021). While the International Safety Management (ISM) Code introduced by the International Maritime Organisation (IMO) was developed to strengthen the safety management framework, it has yet to fully address the challenges of human error (Bhattacharya, 2012).

Given the evolving threats in the maritime domain, it is crucial to examine the conditions that affect the decision-making ability of navigation officers. A better understanding of these conditions can lead to a more targeted approach to risk mitigation (Kizilay, 2023).

Assessing the competence of watchkeeping personnel should include an integrated view of human performance, including not only procedural knowledge, but also the relationship between the individual, the vessel and the surrounding operational environment (Fan, Yang, 2026). Methods such as Human Reliability Assessment (HRA) and Cognitive Task Analysis (CTA) offer valuable tools for analysing human-system interactions in dynamic navigation environments (Fan, Yang, 2024).

Against this backdrop, this thesis aims to explore the key variables that influence officer performance on the bridge, with a particular focus on how these factors shape navigation safety outcomes.

2. Review of existing research on factors affecting watch officer safety

The issue of performance of maritime watch officers and civil aviation pilots has consistently been of interest to the scientific community, and particular attention has been paid in recent years to the role of fatigue, stress and routine as factors affecting decision-making performance and operational safety. Although the maritime and aviation sectors differ in terms of the specifics of their work, both human functioning environments are united by intense

responsibility, prolonged concentration and often irregular working patterns. Contemporary scientific literature is increasingly clear that fatigue and occupational stress are among the main threats to operational safety in maritime transport. Officers of the watch are particularly vulnerable, carrying out their duties under conditions of sleep deprivation, multi-hour shifts and increasingly high administrative and technological demands (Rajapakse, Emad, 2024, Zhao et al., 2021).

Rajapakse and Emad (2023) indicate that the problem of fatigue is not just a result of poor working time organisation, but also a result of structural problems in the industry, such as lack of functional support and overload of duties (Rajapakse, Emad, 2024; Zhao et al., 2021). Similar observations appear in a study by Zhao et al. (2023), who analyse the effects of the COVID-19 pandemic on vessel crews, indicating an increase in symptoms of burnout, depression and sleep disorders (Zhao et al., 2023).

Bury et al. (2025) highlight how watch officers experience cognitive overload resulting from routine, pressure and conflict between technology and situational perception (Bury et al., 2025). This theme is deepened by Li et al. (2022), showing that fatigue recognition using AI methods can be an effective tool in error prevention (Li et al., 2022).

From a physiological and organisational perspective, studies by Yancheshmeh et al. (2020) and Mansyur et al. (2020) confirm that poor sleep quality and excessive working hours are the main factors that increase fatigue levels (Yancheshmeh et al., 2020; Mansyur et al., 2020). In contrast, Uğurlu et al. (2021) show that rotating navigation schedules in coastal shipping should be individually tailored to the officer's function (Uğurlu et al., 2021).

The impact of modern technology and automation on operator vigilance is analysed by Hannaford and Hassel (2021), suggesting that crew reduction does not lead to a reduction in workload and may even increase the risk of errors (Hannaford, Hassel, 2021). Stoliarov (2024) argues that modern systems on the bridge, such as integrated bridge management systems (IBS) or electronic navigational charts (ECDIS), in the absence of adequate training and integration with human perception, reduce performance (Stoliarov, 2024).

Fan et al. (2023) and Apostol-Mates and Barbu (2019) show that human errors are often rooted in cognitive and physical overload, and result in real accidents involving watch crew. The authors of (Fan et al., 2023) focus on the psychological aspects of safety and the use of behavioural assessment in risk analysis, while research (Apostol-Mates, Barbu, 2019) focuses mainly on empirical analyses of marine accidents resulting from fatigue and lack of concentration.

Equally relevant are Shan and Neis' (2020) observations of labour mobility and poor regulatory oversight in Canadian coastal shipping, leading to exacerbating problems of fatigue and burnout (Shan, Neis, 2020). Huang (2020), on the other hand, presents the results of an analysis of officer work intensity and how shifts are organised, highlighting the need for rationalisation. The study was qualitative and based on an analysis of observations and interviews with crew members, providing an in-depth understanding of practical organisational problems (Huang, 2020).

In civil aviation, the topic of fatigue has been developed for decades. Studies by Lee and Kim (2018) and Dawson et al. (2005) confirm that the primary preventative factor is adequate sleep time, not just technical procedures (Lee, Kim, 2018; Dawson, 2005). Drury et al. (2012) show a direct link between sleep deprivation and impaired mood and cognitive function (Drury, 2012). In contrast, Goode (2003) shows a correlation between pilot fatigue and aviation incidents (Goode, 2003).

Liao (2015) and Banks (2012) analyse cultural aspects and legal considerations related to fatigue management, showing differences between countries in the implementation of prevention strategies. Liao points out the contrast between Chinese and Western pilots' attitudes towards procedural adherence and risk perception, while Banks focuses on differences in fatigue legislation and the role of trade unions in shaping operational practices (Liao, 2015; Banks, 2012).

In summary, the literature review indicates that fatigue, stress and routine are key factors affecting the performance of both watch officers and pilots. It is not only the length of the shift or the number of hours of sleep that matters, but also the quality of recovery, psychological support and the structure of the tasks performed on the job. In light of the above research, it seems reasonable to implement personalised human risk management strategies that take into account the specifics of shift work and the pressure of responsibility in operational professions.

Structure of the watch officer's work

The work of an officer of the watch on a seagoing vessel is multifaceted and requires consideration of both technical and psychosocial factors. A ship is simultaneously a place of work, residence and rest, which places seafarers in a situation of constant exposure to changing operational conditions and occupational stress. Therefore, the design of the ship's space should take into account the requirements of the natural, material-technical and psychosocial environment, in accordance with the applicable standards and regulations.

International regulations such as the STCW Convention (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers) and the MLC (Maritime Labour Convention) set standards for training, certification and working conditions for seafarers. Their main objective is to ensure safe navigation and decent working conditions for the crew. In addition, the International Safety Management Code (ISM Code) and the International Ship and Port Facility Security Code (ISPS Code) define procedures to minimise operational hazards and protect against incidents at sea.

The International Convention for the Safety of Life at Sea (SOLAS) and the SAR Convention (International Convention on Maritime Search and Rescue), which set out minimum safety standards and search and rescue procedures, are also crucial in the context of a watch officer's work. In addition, each country may also introduce its own national regulations governing working conditions at sea, which further complements existing international standards. Understanding and adhering to these regulations and adapting the

working environment on board to the needs of the crew are key to ensuring the efficiency and safety of the watch officer.

Responsibilities of the officer of the watch

Serving as a watch officer requires not only a high degree of professional competence, but also the ability to make quick and accurate decisions in dynamically changing conditions. The officer of the watch must be prepared for emergencies and effectively manage the lower-level crew. His or her role is not just about following procedures - it is also about being able to anticipate risks and take preventive measures. The structure of his or her job is closely linked to ensuring the safety of the entire ship and crew (Figure 3).

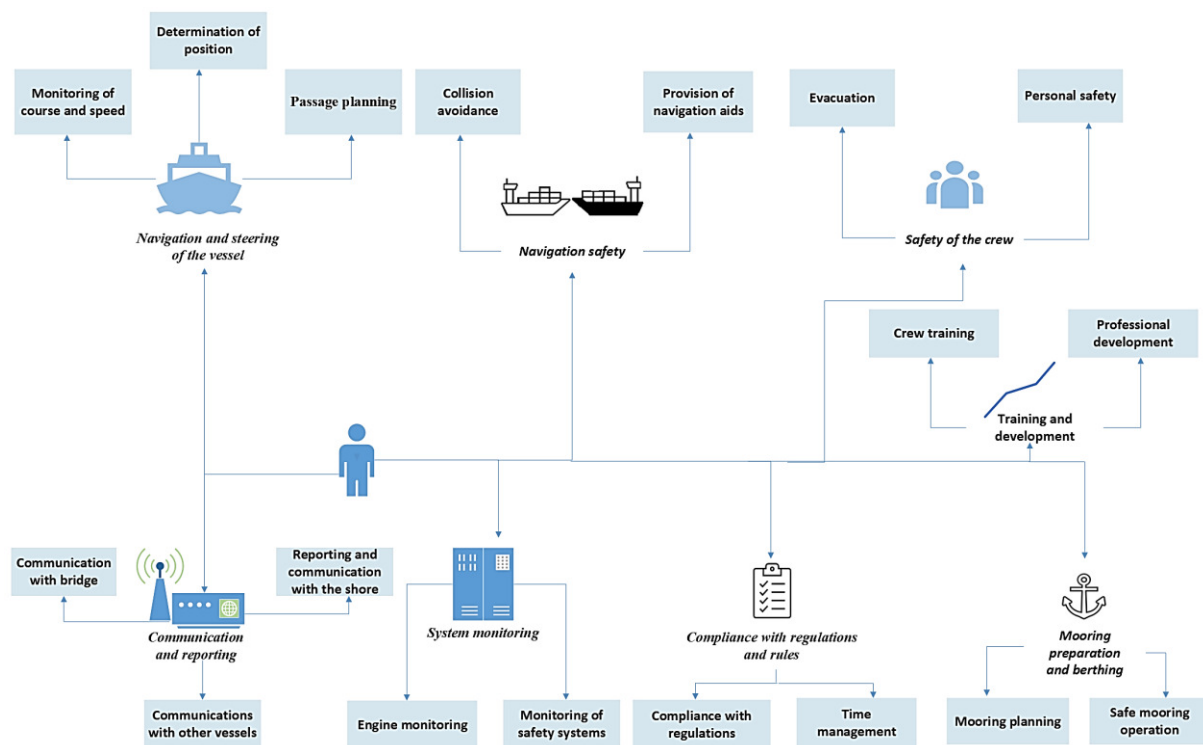


Figure 3. Structure of the watch officer's work - own development.

Understanding and adhering to these regulations and adapting the working environment on board to the needs of the crew are key to ensuring the efficiency and safety of the watch officer.

Reliability of the officer of the watch and safety of maritime operations

The reliability of the officer of the watch is a key aspect of ensuring safe navigation. In the context of human-ship interaction, the term can be defined as the ability of a system to effectively perform its assigned tasks under specified operational conditions and within a set time (Bęczkowska, Grabarek, 2021). The human being, as a key element of this system, plays an important role in its functioning, and the influence of individual and environmental factors on its reliability has been the subject of numerous studies. In the literature, the concept of human reliability refers to a person's ability to maintain the required performance while performing

specific tasks (Hansen, Nazir, 2024). This means that a watch officer not only needs to have the right skills and qualifications, but also to be able to use them effectively, especially in dynamically changing navigational conditions.

Human factors, understood as the interaction between humans and the operational system, include perception, information processing and decision-making processes. In the context of maritime operations, it is human error that is identified as one of the main causes of incidents and accidents. Their analysis shows that both an individual's characteristics, such as resilience to stress or the ability to quickly assess risk, and environmental factors can significantly affect his or her performance and ability to make accurate decisions.

Navigational safety is shaped by the interplay of subjective (e.g. personality traits, level of experience) and situational (e.g. weather conditions, work organisation) factors. The situational awareness of the watch officer is a key element in the decision-making process and influences the effectiveness of the response to unexpected events. High levels of stress and increased operational risk can result in a reduced ability to perceive threats correctly, which in turn increases the likelihood of error. Understanding the impact of the human factor on watch officer reliability is essential to minimise the risk of errors and improve the safety of marine operations. Developing effective risk reduction strategies requires consideration of both individual predispositions and environmental factors that may affect human performance in navigation systems.

The human factor and reliability of the officer of the watch

Human error is an inherent part of the watch officer's job and its impact on navigational safety is crucial (Adumene et al., 2022). Perception, interpretation of the situation and the amount of information influence decisions that can lead to incidents. Decisions are made under time pressure and based on experience. Officers who are more experienced act faster and more effectively, but conditions such as fatigue and stress can reduce the reliability of decisions (Kum et al., 2007). Risk perception decreases when the officer feels in control of the situation, but overconfidence or inexperience increases the likelihood of error. Not every mistake leads to an incident, but the consequences depend on environmental conditions and the ability to correct (Kum et al., 2007). Psycho-physical conditions such as fatigue, shift patterns, lack of rest and stress have a significant impact on work performance. Although rest regulations exist, the reality of work often deviates from the norm, increasing the risk of errors. Communication is crucial to navigational safety - problems in communication can lead to lack of cooperation and increased tension among the crew. All these elements affect the reliability of the watch officer and the safety of marine operations.

3. Methodological Framework for Questionnaire Design

The survey used the expert method, which is based on the selection of experts to take part in the study. Each participating respondent was consciously selected by the authors for their expertise and type of work

For the purpose of the article, a survey was conducted among watch officers from the deck department. Each person surveyed was an expert in his or her field - they had a university degree and were qualified to at least operational level. We expected them to be people with an interesting personality, a lot of knowledge, broad horizons, as well as thinking independently and, above all, able to justify their answers. We did not select random people for the survey, they were people who actually sail on the ship. This allowed us to eliminate the answers of those people who have no idea whatsoever about the answer by which would be inconsistent with the topic, while at the same time supporting those who have an unusual view of the safety situation. Experts gave their answers without contacting each other. The survey was conducted using the MS Forms platform.

Through the questions asked, it was possible to define a common position on the management of safety on board and, most importantly, to identify the factors affecting officer reliability.

Conducted survey on mood among employees and their views on safety in the workplace.

Purpose of the survey: The research undertaken was to identify human behaviour in assessing the reliability and safety of a watch officer in the performance of their duties.

The survey aims to collect information related to the hazards on board.

Survey sample: this survey was conducted on a group of 100 officers from the deck department. The subjects have a university degree and were sailing on a ship at the time of the survey. The survey takes into account the age, job position and length of service of the officers and the types of ships they sail on. The officers have a minimum of 5 years' work experience (Figure 5) and the age of the respondents is less than 65 years (Figure 6).

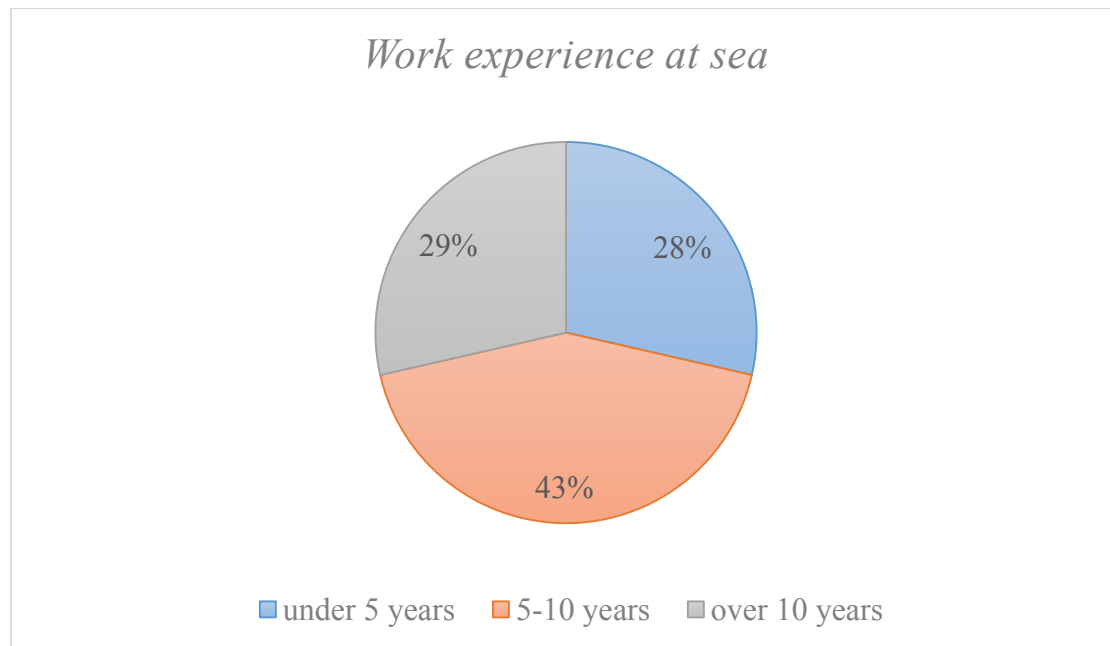


Figure 5. Distribution of work experience of respondents.

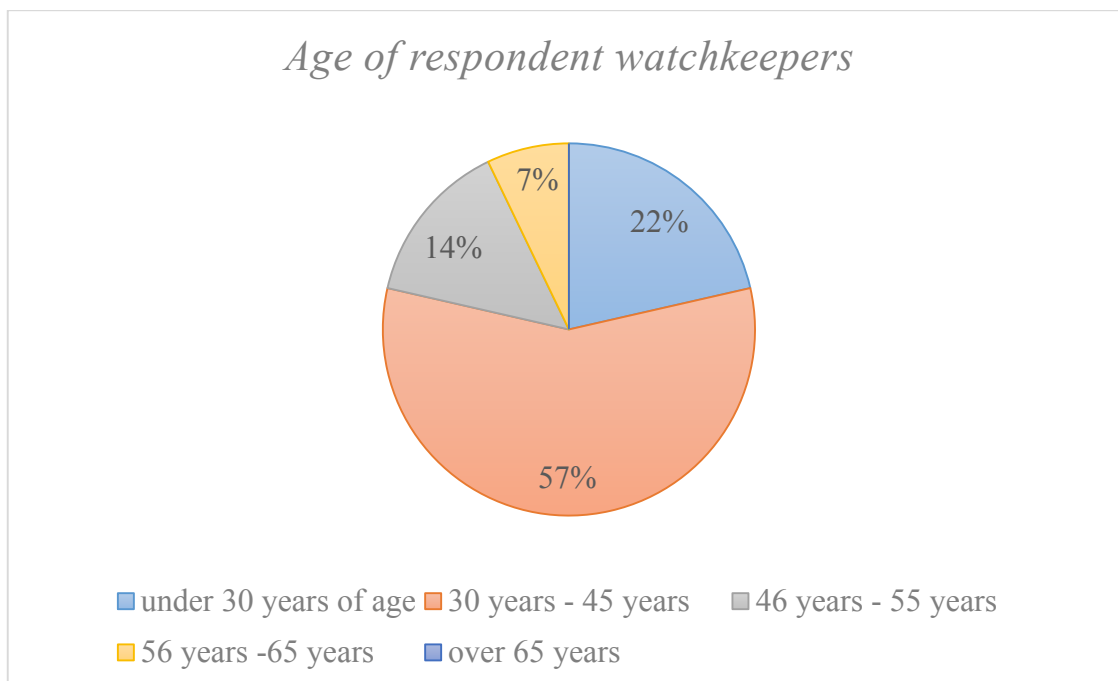


Figure 6. Age distribution of respondents.

The selection of respondents was a quota sample, which means that the selection of respondents usually takes into account characteristics such as age, gender, social and occupational status. This type of purposive sampling involves selecting people who, according to the researchers or expert assessment, are typical representatives of the target population. This means that the respondents meet predefined criteria of belonging, e.g. occupation, place of residence. An improvement on this method is quota selection, in which the distributions of the population characteristics of interest to the researchers are determined at the outset (Swiderska et al., 2023). The aim of the selection becomes to reproduce the same proportions

of these variables in the sample. In recent survey research, five-point scales are commonly used in different types of surveys and survey tools. They are used in both opinion surveys and employee satisfaction analysis.

Structure of the survey: it consists of three stages (Figure 7)

Stage I - aims to determine the degree of satisfaction with the job and the atmosphere in the working environment.

Stage II - to obtain information on safety in the workplace.

Stage III - gathering information to identify factors affecting efficiency on board.

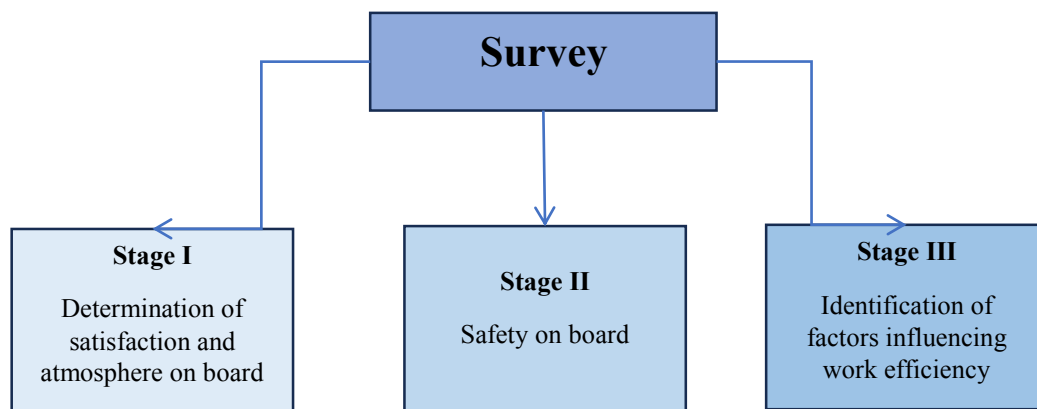


Figure 7. Structure of the survey.

Survey implementation form/methodology: The survey was conducted using the Microsoft service application, contained 71 questions and was completely anonymous.

Research technique used: the survey was given to the respondent to complete via a link that allowed access to the questions. The survey is a one-off, but will be evaluated for further research in the future.

The survey used the Rensis Likert scale, which is designed to measure attitudes towards specific problems or opinions on a particular topic. The Rensis Liert scale is one of the most popular methods in surveys of this type (5-point response scale). It can be used to obtain a response regarding the degree of acceptance of a phenomenon or opinion on a particular topic. It is also used in a large number of surveys to assess satisfaction (Interankiety, 2023).

Structure and options:

A five-stage scale:

- 1 - Strongly disagree.
- 2 - I rather disagree.
- 3 - I have no opinion.
- 4 - I rather agree.
- 5 - Strongly agree.

The authors wanted to use this method to determine the extent to which the respondent agreed with a statement.

Type of questions: closed questions (5-point scale) and open questions. Respondents were asked 71 questions. Questions 4 to 31 for a mood survey among employees - job satisfaction and atmosphere. Questions 32 to 52 on surveying perceptions of safety in the workplace. Questions 53 to 71 on the survey of identification of factors influencing work performance.

Time and place of implementation. There was unlimited time for responses. Each survey participant was able to answer the survey questions at their convenience. The estimated completion time was 16 minutes. The collection of completed surveys lasted from March 2023 to September 2023.

Exactly 100 surveys were collected during this period, each of which was completed correctly, although not every participant answered all the questions. There were 4 surveys where the respondent left a question unanswered.

4. Quantitative Results of the Study

Part I of the survey determined the degree of satisfaction with the job and the atmosphere of the working environment on board. The survey at this stage provided information on loyalty to the employer and employee commitment, which helped to identify problems in the working environment. Responses to the satisfaction questions were measured on a 5-point Likert scale. Examples of questions and responses are shown in Figure 8 and Figure 10.

Figure 8 shows the percentage distribution of satisfaction with the maritime work, measured on a five-point scale.

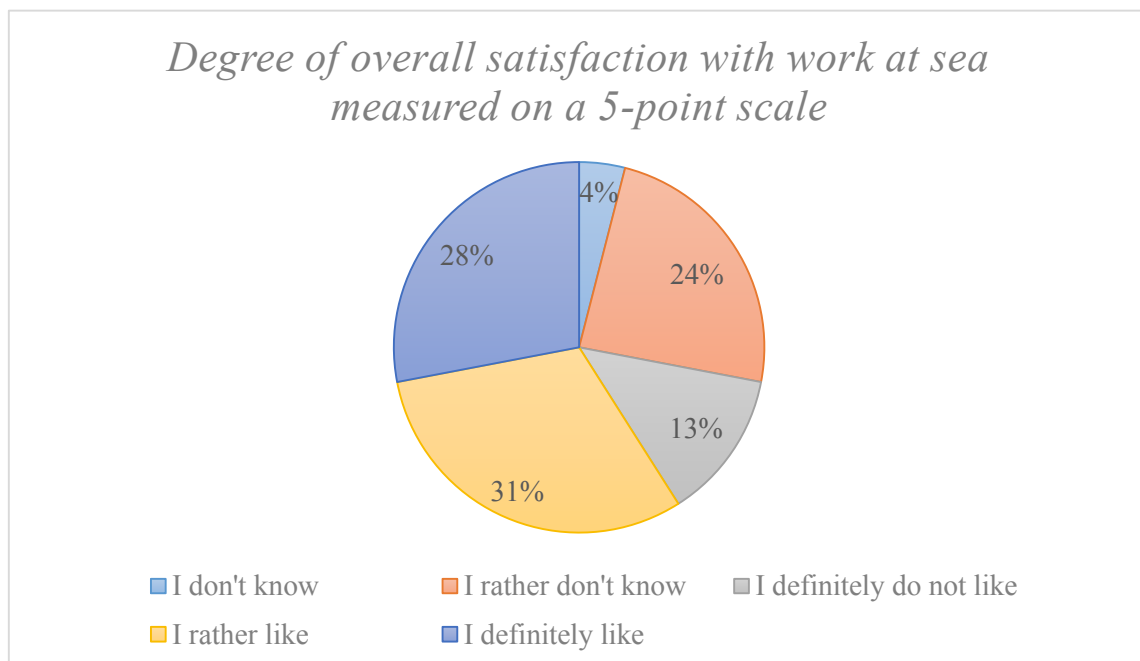


Figure 8. Degree of overall satisfaction with work at sea measured on a 5-point scale.

The sum of respondents who rather like (31%) and definitely like (28%) their job is 59%. This means that the majority of watch officers have a positive attitude towards their work at sea. In contrast, the sum of respondents who rather dislike (24%) and definitely dislike (13%) their work at sea is 37%. This indicates that there is a significant group of people with negative feelings. A small number of respondents (4%) are undecided about their satisfaction with their job, showing that the majority have an educated opinion.

Overall, Figure 8 shows that although the majority of watch officers are satisfied with their work at sea, there is a significant minority who have negative feelings. This may indicate a need for further analysis and possible action to improve working conditions and increase overall satisfaction.

Figure 9 shows the degree of overall job satisfaction among watch officers by different age groups.

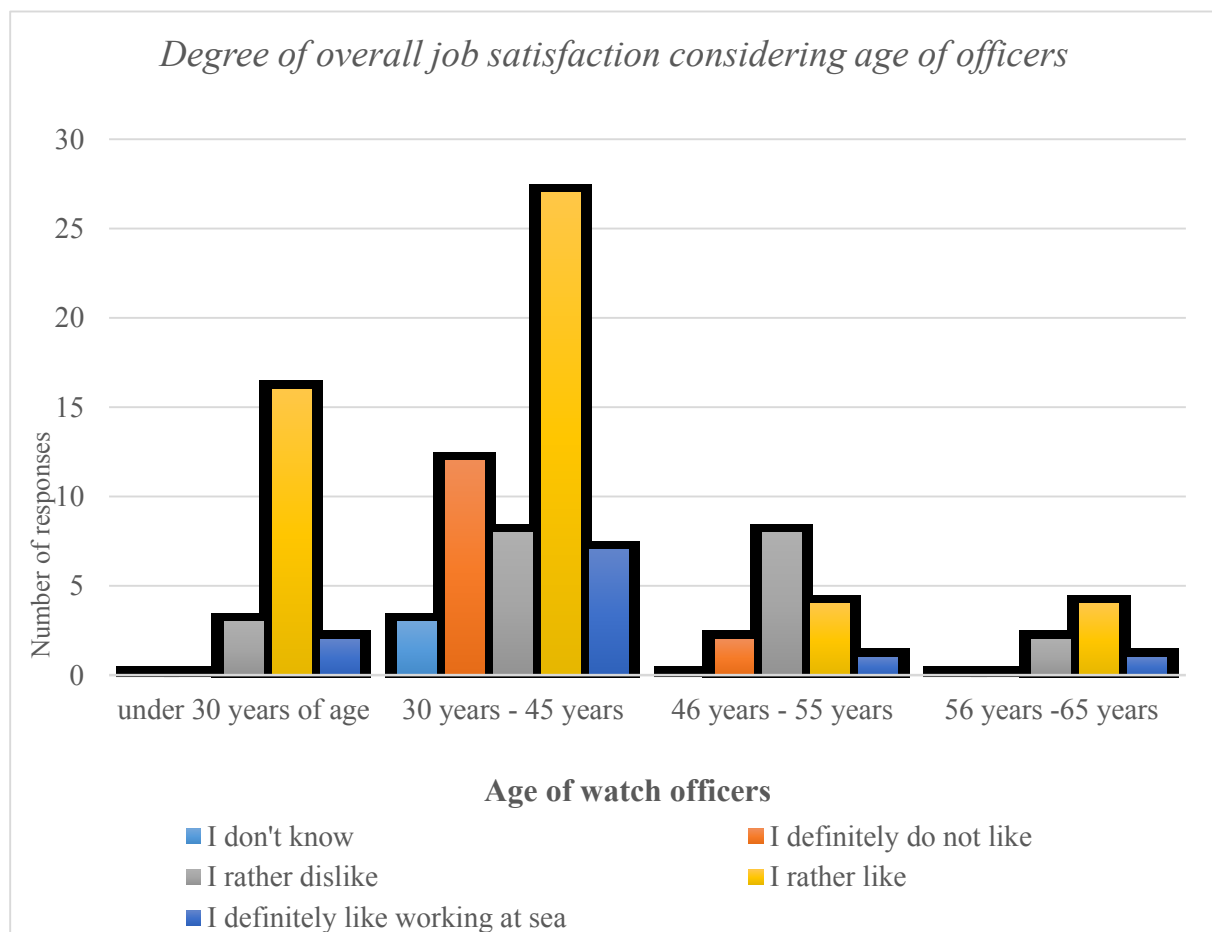


Figure 9. Degree of overall job satisfaction considering age of officers.

Overall, the majority of watch officers show a positive attitude towards their job, with the highest number of 'I rather like' responses in each age group. The highest degree of satisfaction can be seen in the 30-45 age group, where the predominant response is 'I rather like'. The under-30 and 56-65 age groups have a higher number of people unsure about their satisfaction ('Don't know'). Negative opinions are relatively rare in all age groups, but the highest percentage of dissatisfaction can be observed in the 30-45 age group. This graph

indicates a generally positive attitude of watch officers towards their work, with some differences depending on the age group.

Figure 10 shows how seafarers rate the impact of social conditions on board the ship on their level of work.

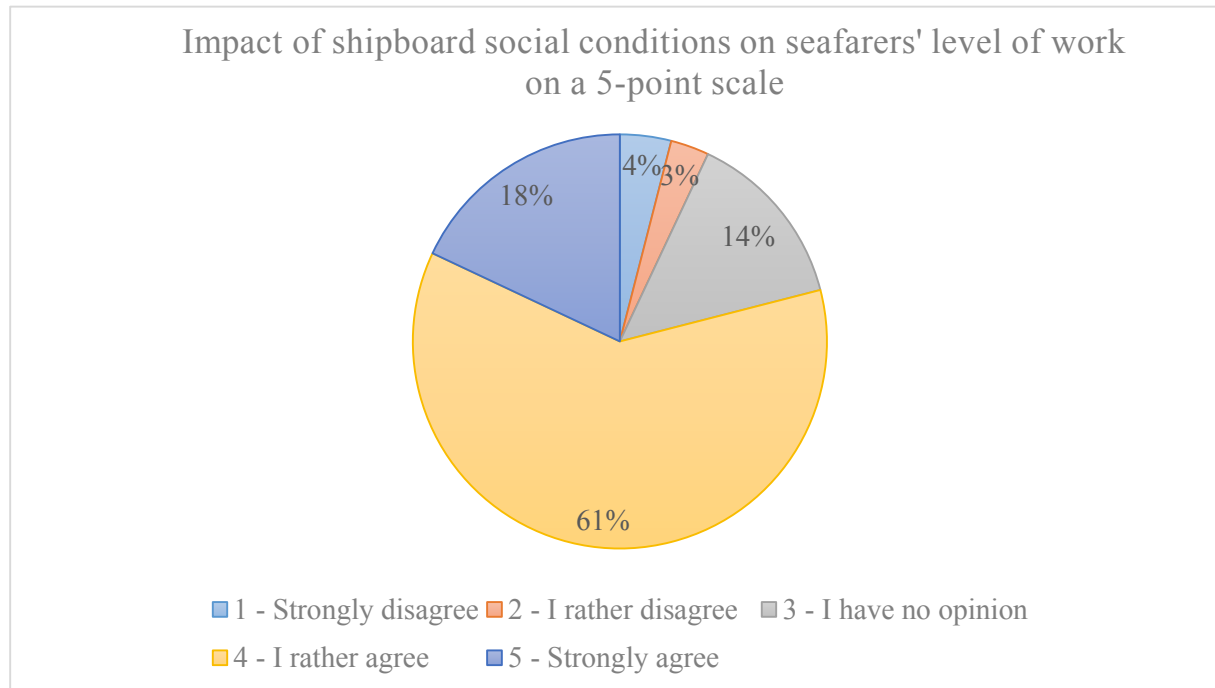


Figure 10. Impact of shipboard social conditions on seafarers' level of work on a 5-point scale.

Officers from the deck department by a large majority of 61% believe that the social conditions on board rather affect work efficiency.

The sum of respondents who tend to agree (61%) and strongly agree (18%) that the social conditions on board affect the level of work is 79%. This means that the vast majority of seafarers perceive a positive impact of social conditions on their work performance. A much smaller group (14% no opinion, 4% rather disagree, 4% strongly disagree) does not perceive or assess the impact of social conditions as unambiguously positive. The overall result shows that social conditions are a key factor affecting seafarers' job satisfaction and performance. It is therefore worth paying particular attention to improving these conditions in order to increase the overall level of crew satisfaction and efficiency on board ships. In conclusion, shipboard social conditions are an important element affecting seafarers' work levels, suggesting that improving them can bring tangible benefits in terms of crew satisfaction and productivity.

Officers were also asked on a scale of 1 to 5 whether their responsibilities were demanding. Figure 11 shows the results.

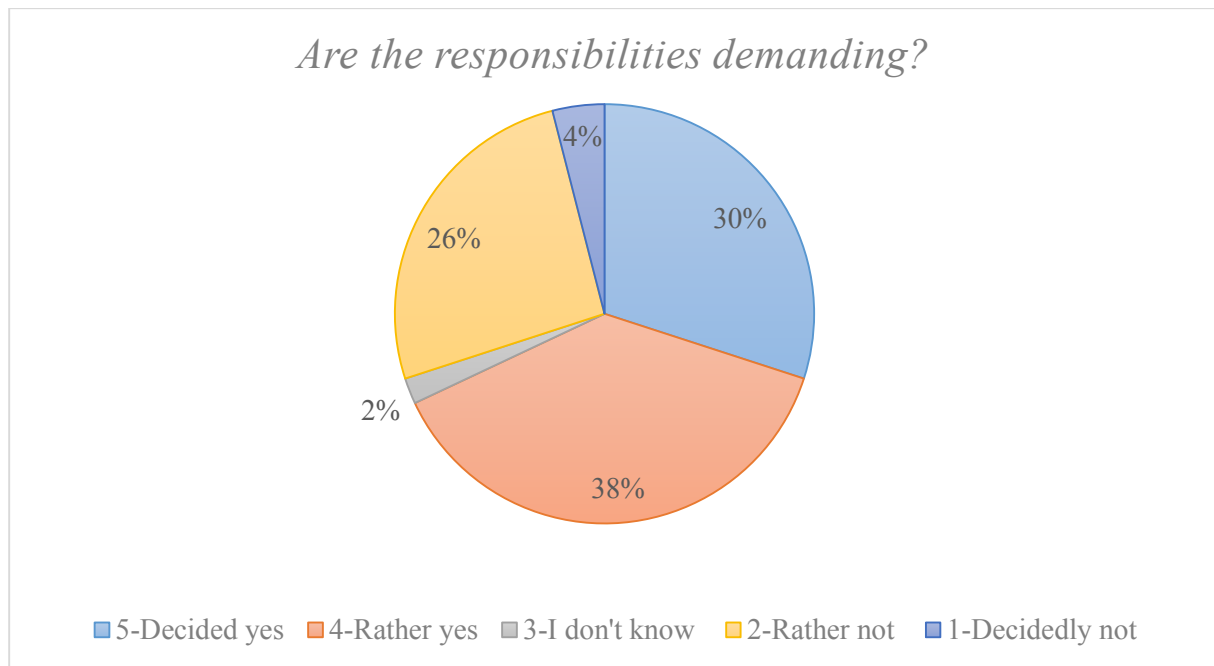


Figure 11. Responsibilities versus requirement on a 5-point scale.

According to the question asked, rather yes (38%) and definitely yes (30%) the responsibilities of their job are demanding.

Part II of the survey was aimed at obtaining information on safety in the workplace. At this stage, respondents were given the opportunity to comment on safety on the ship. One such question was; is the ship as a workplace safe. The results are shown in Figure 12.

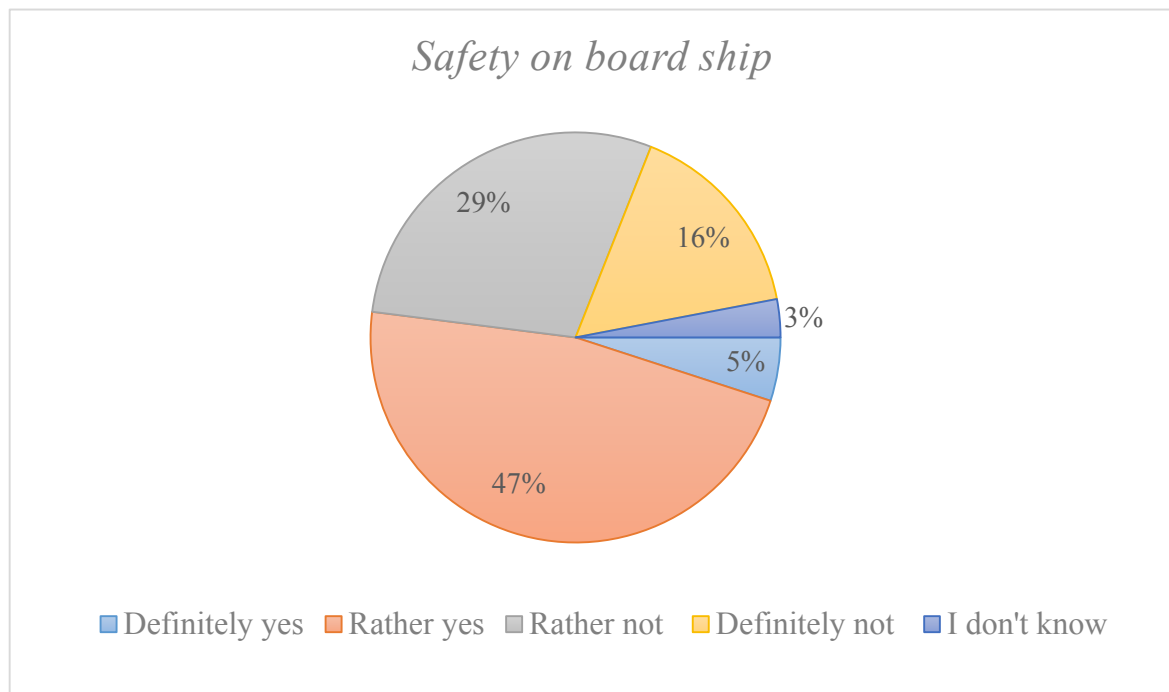


Figure 12. Safety on board.

The majority of respondents answered, 47%, that the ship was a rather safe place to work.

The next questions in Phase II of the questionnaire survey concerned the identification of risks arising from officer misconduct.

Figure 13 shows respondents awareness of the risks that can result from an officer making a wrong decision.

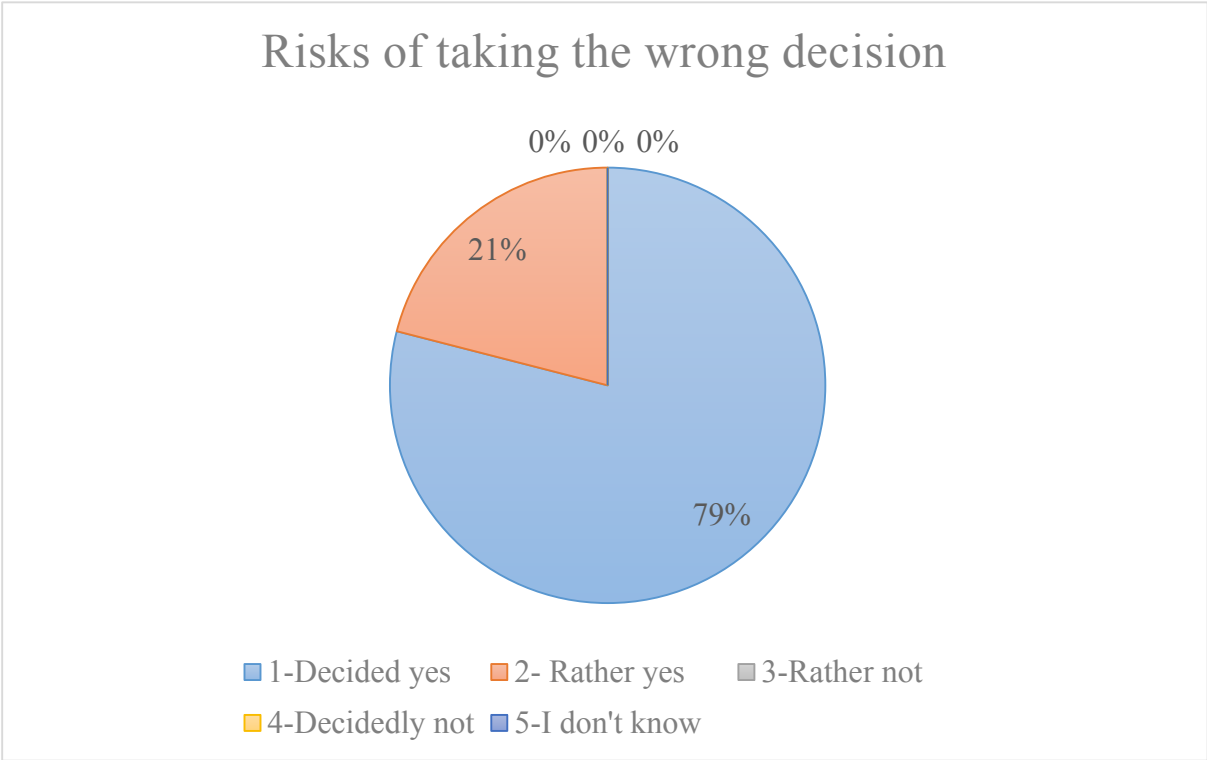


Figure 13. Awareness of risk when an officer makes a wrong decision.

For this question, as many as 79% answered '**Definitely yes**', and also the majority answered '**Yes**' to questions about making the wrong decision. This shows that the majority of officers (100% of respondents) are aware of the risks of making the wrong decision. (Figure 14).

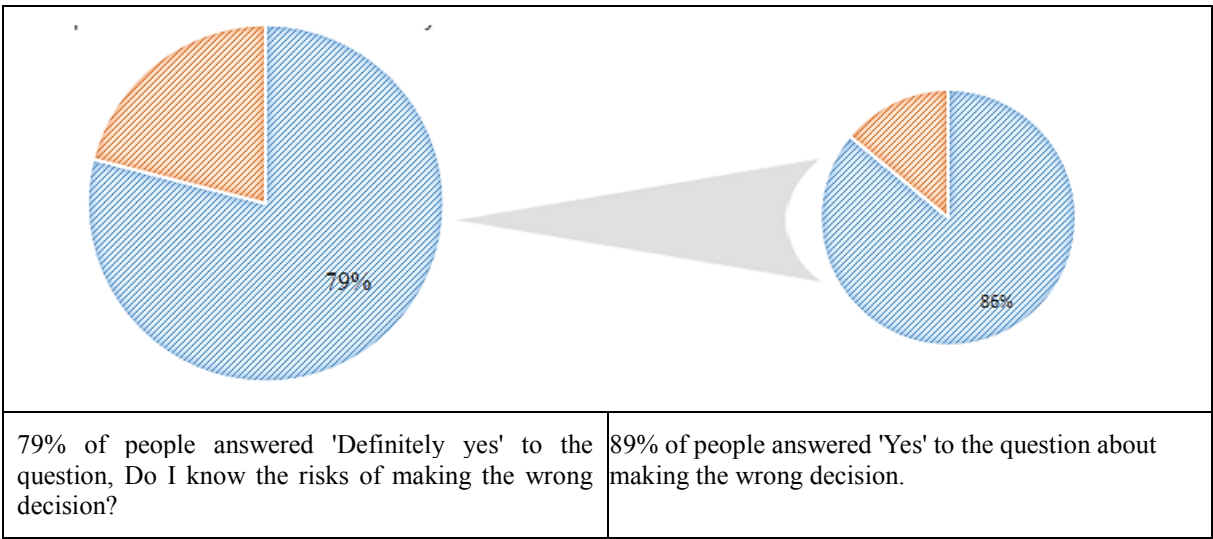


Figure 14. Awareness of risks of wrong decisions in the context of safety at work.

86% of those who witnessed a bad decision also mostly answered 'Yes' to the question 'Did you witness a dangerous situation?' (Figure 15).

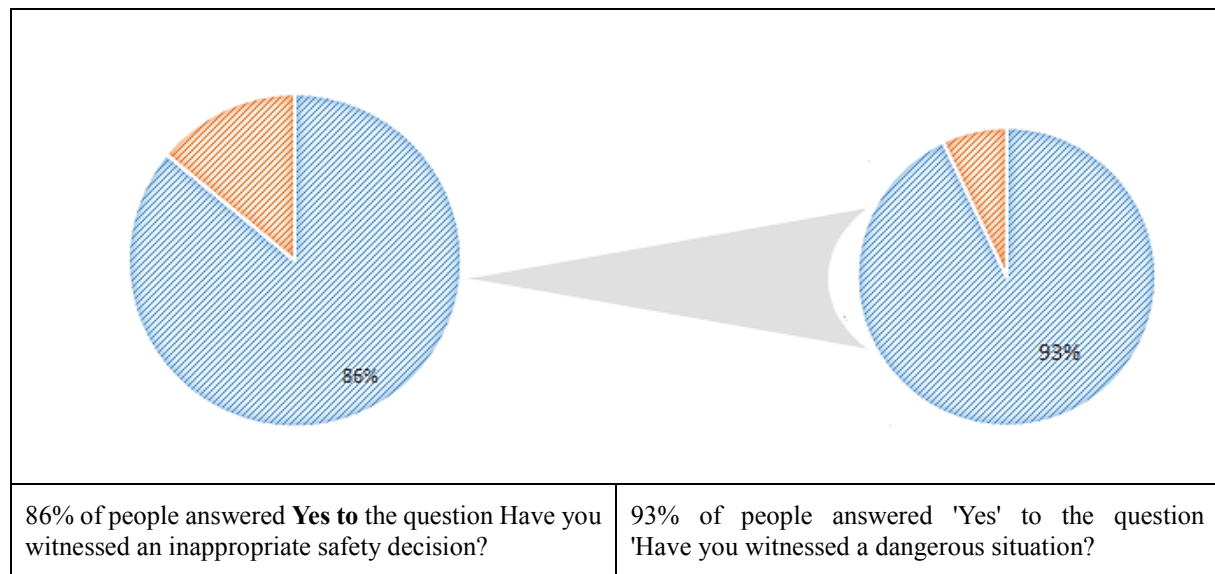


Figure 15. Awareness of poor safety decisions and the occurrence of dangerous situations at work.

Part III aims to gather information to identify the factors affecting the efficiency of the ship's work.

Many factors affect productivity and job satisfaction. One of them is stress. In most of our work duties, we are unable to avoid stressful situations that cause us problems, i.e. carrying out new tasks, interacting with colleagues, etc.

The following are the most interesting responses of officers in the boarding department to questions on stress.

One of the relevant questions is; do officers feel stressed about their job. To this question, the majority answered in the affirmative (considering the answer YES and RATHER YES). Figure 16 details the responses of the respondents.

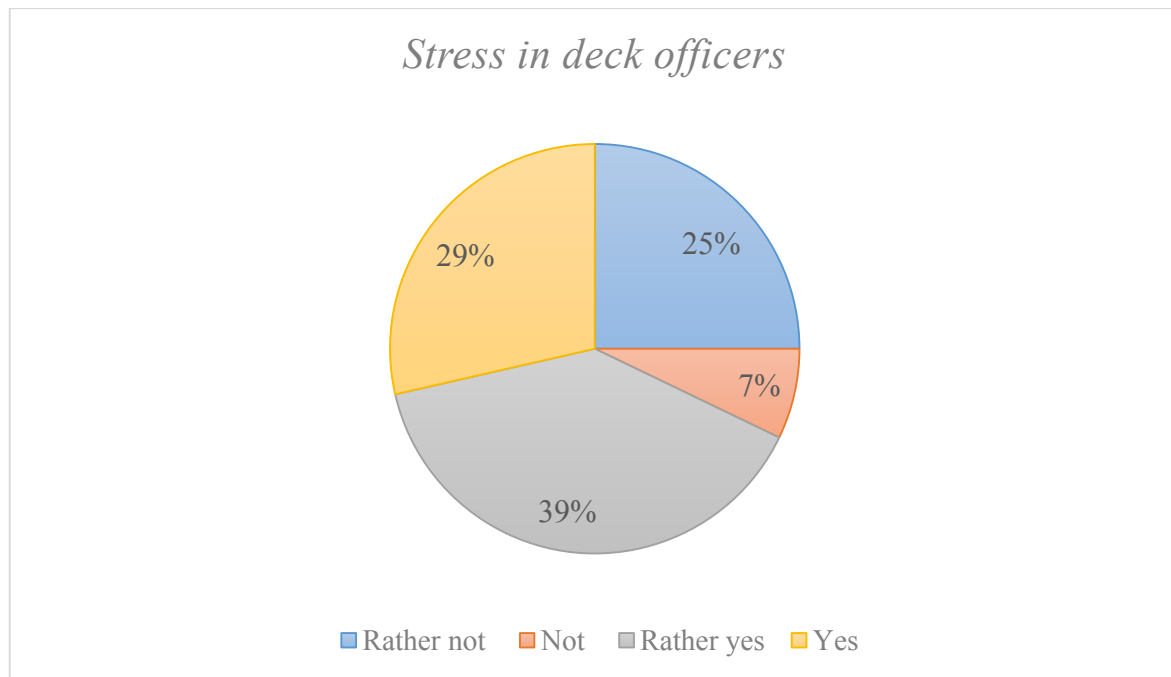


Figure 16. Perception of stress among officers of the deck department.

Figure 17 shows the effect of age on the perception of stress.

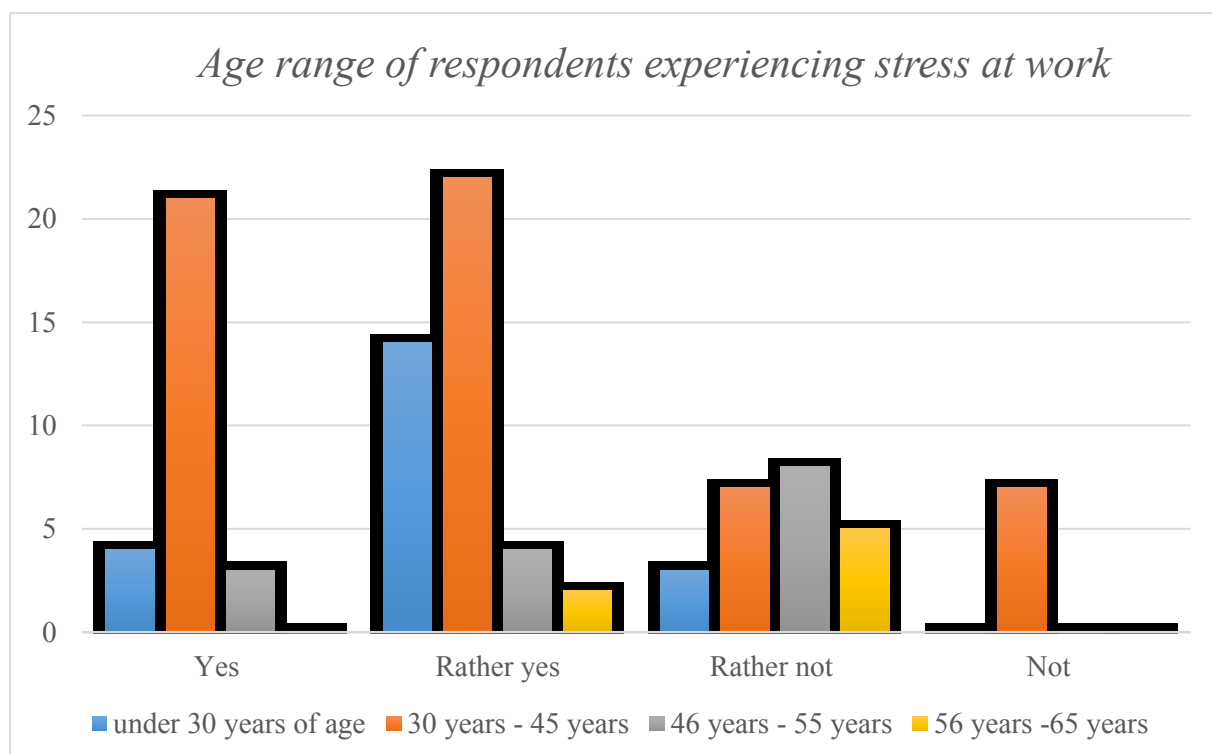


Figure 17. Age range of respondents experiencing stress at work.

It is noteworthy that 68% of the officers surveyed experiencing stress at work are aged 45 or under. Officers aged 46-65 are less likely to feel stress at work (Figure 18). This is likely to be due to a lack of experience in higher, more responsible positions.

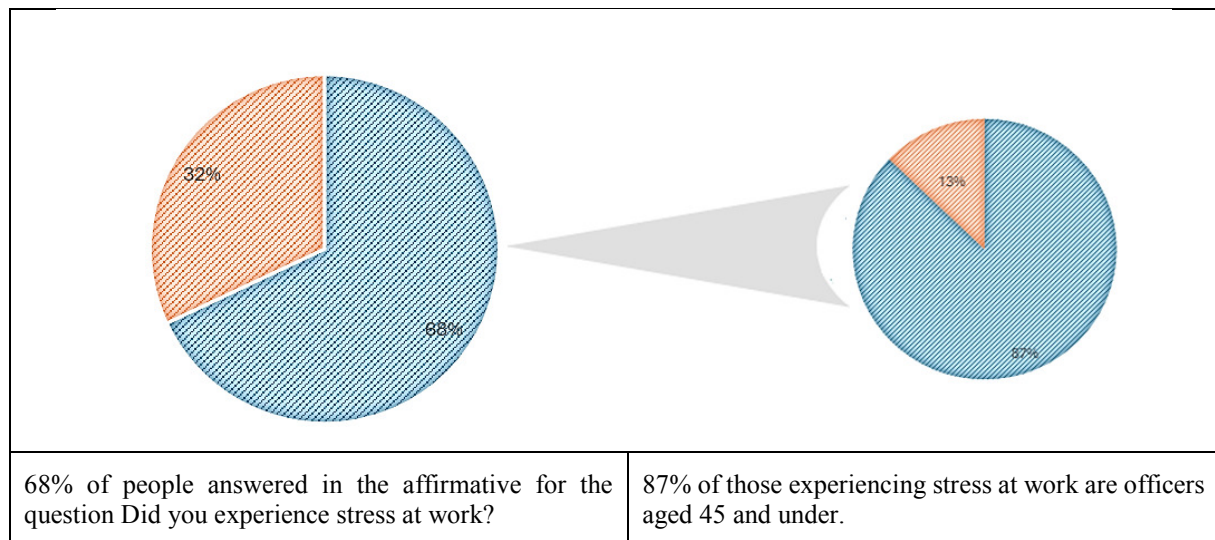


Figure 18. Percentage of people experiencing stress at work by age group and position.

Those who responded affirmatively to feeling stress also indicated how often it occurs during work. From Figure 12, it can be seen that as many as 32% of respondents feel stress several times a week and 21% daily. It is also worth noting the officers (29%) who marked a response in which they make the feeling of stress dependent on many other factors, i.e. undesirable situations during work. These types of factors will be explored later in the survey.

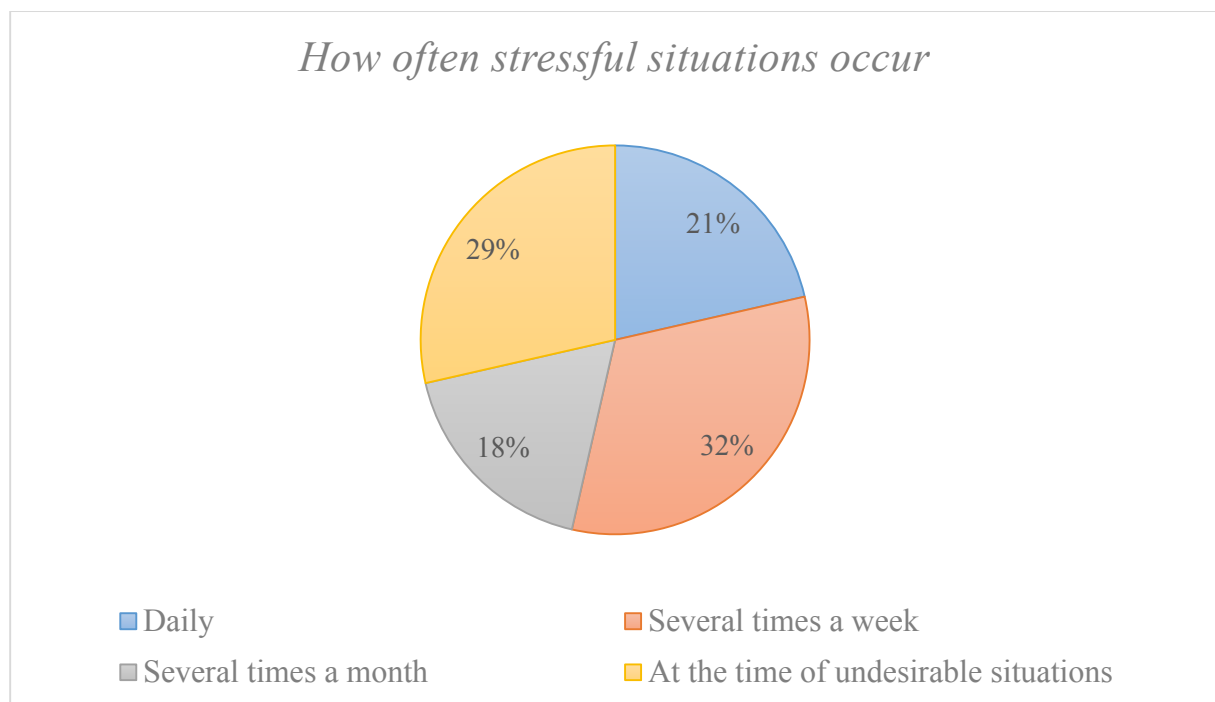


Figure 19. Prevalence of stress in the work of a deck officer.

Figure 20 shows how the frequency of perceived stress at work varies with the age of watch officers. The trend analysis shows that stress may be more or less common in certain age ranges.

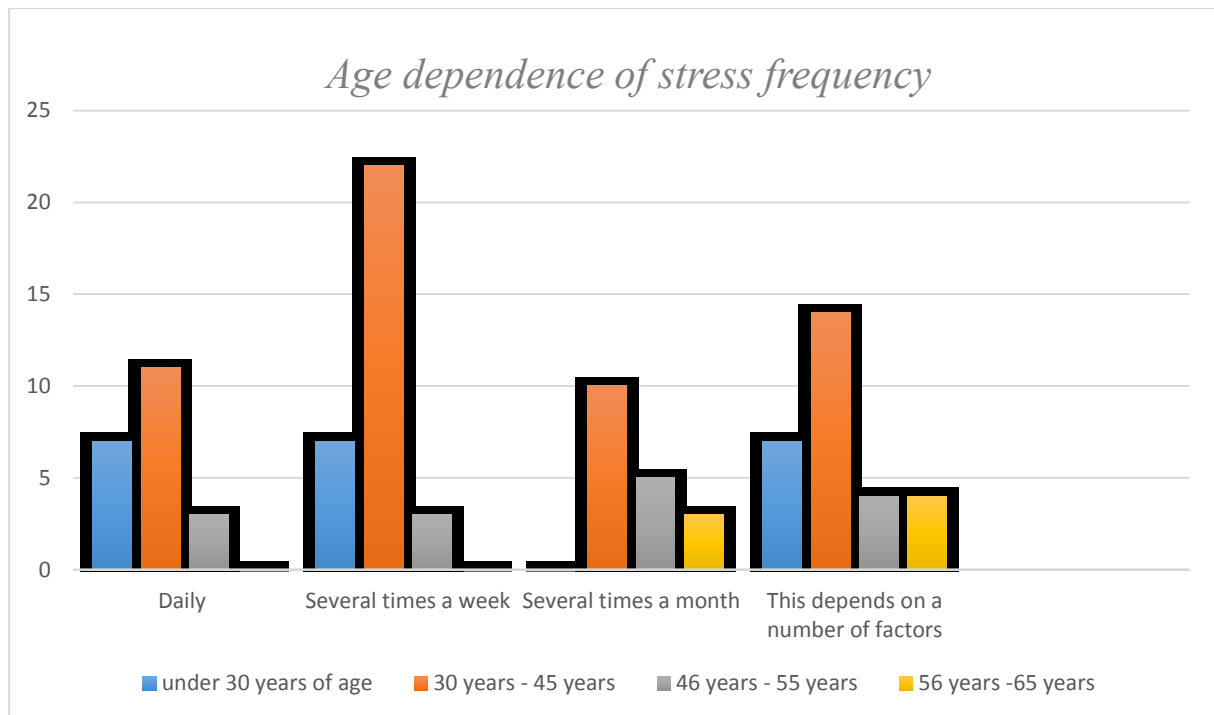


Figure 20. Relationship between age and frequency of stress.

Figure 20 above shows that middle-aged officers (30-46 years) are more likely to experience stress than younger-aged employees (under 30 years). The age group above 46 years has the lowest frequency of stress. This is related to the fact that promotions are most common in this age range (30-46).

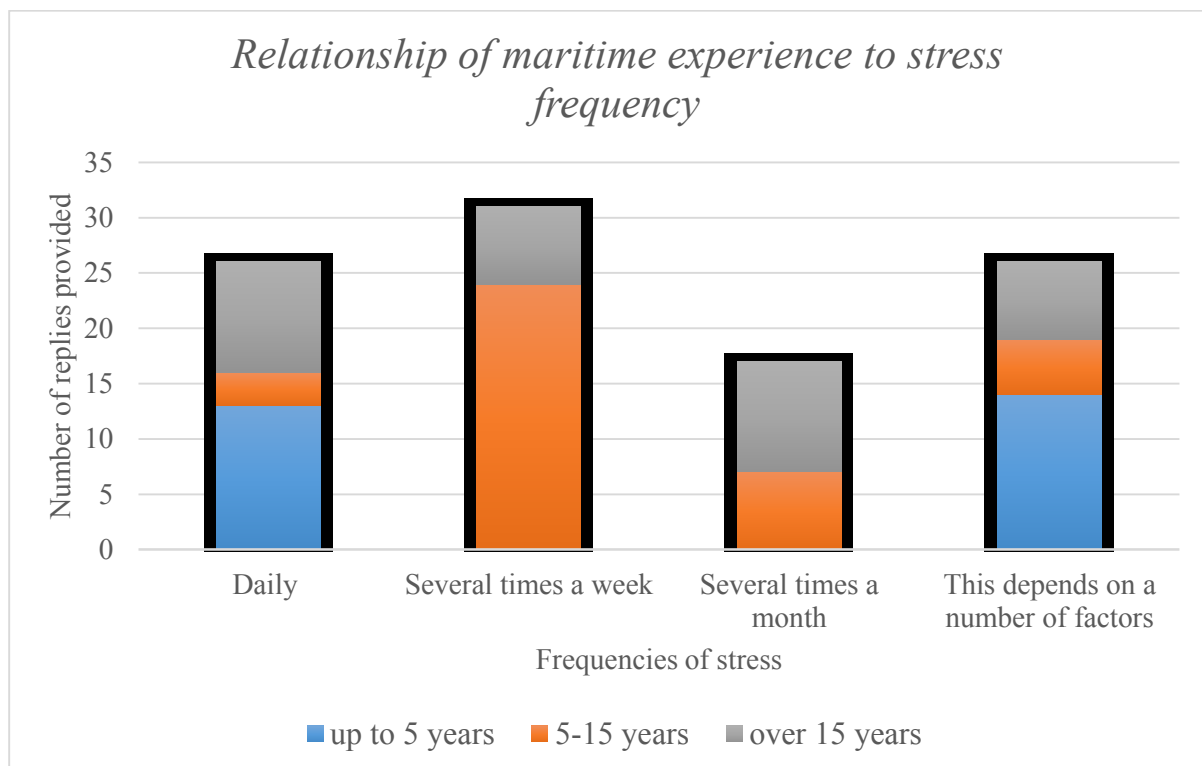


Figure 21. Shows how the frequency of stress at sea varies according to seafarers' years of work experience.

The trend analysis shows how stress levels change with increasing experience at sea. The graph shows that those with less experience (0-5 years) report a higher frequency of stress than the most experienced officers (group of more than 15 years). It is worth noting that the last group with the longest experience, may be more established professionally, which translates into less stress. Officers with experience of 5-15 years may be more likely to experience stress due to career advancement, which comes with greater responsibility for the safety of the vessel and crew. **Figure 21** suggests that experience at sea is a key factor in stress levels. Employers can learn from this about the need for more intensive support and training for newly promoted officers.

Figure 22 shows the various symptoms that most often accompany stress. Respondents indicated the most common symptoms that accompany them when stressed. Officers indicated that the most common symptoms that accompany them when they are stressed are a headache (22%) and an aversion to work (20%).

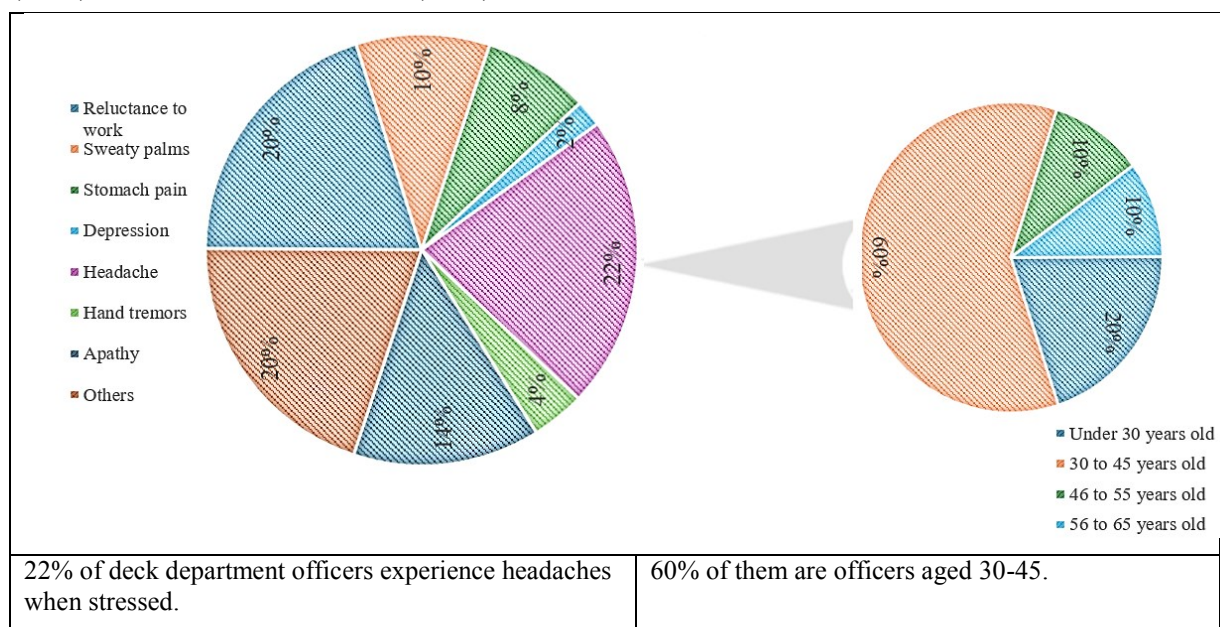


Figure 22. Physical symptoms of stress in officers of the department.

It is noteworthy (Figure 23) that officers in the 46-55 age bracket feel aversion to work as a result of stress (40%), while officers aged 56-65 complain of other stress-related symptoms.

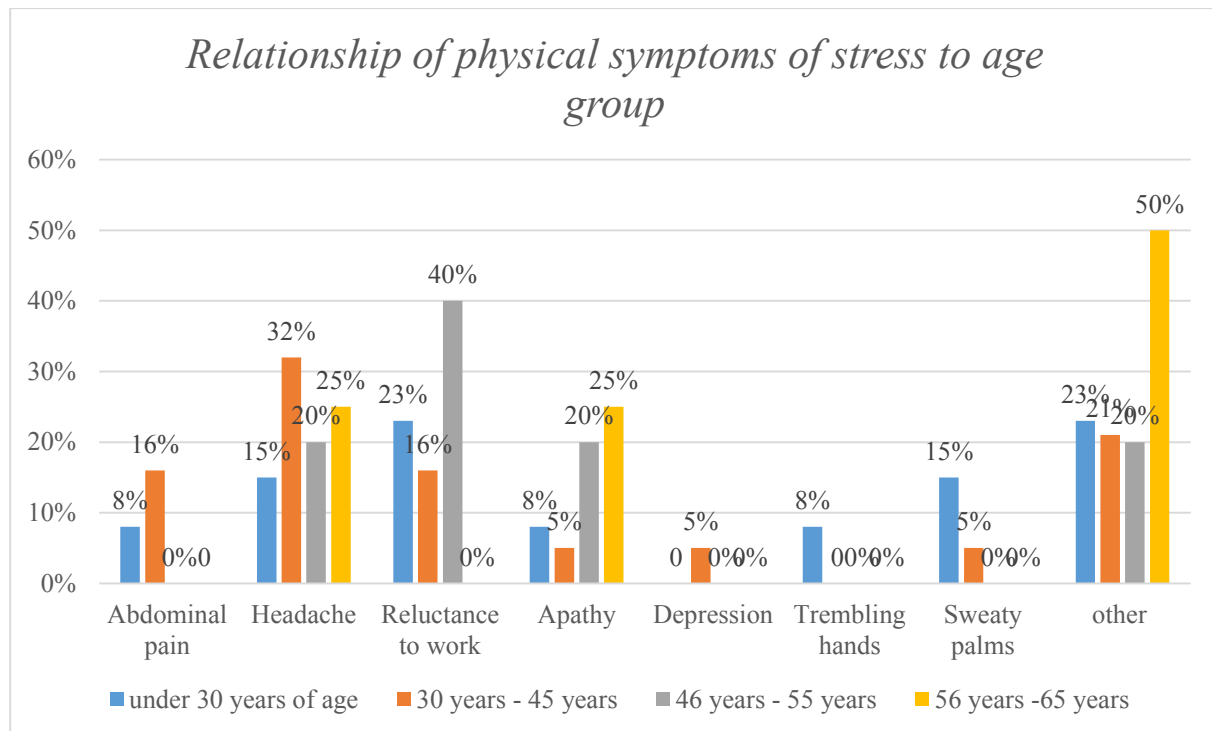


Figure 23. Relationship of physical symptoms of stress to age group.

It is interesting to note that as many as 48% of respondents confirm that stress motivates them to work effectively and 30% have problems focusing their thoughts (Figure 24).

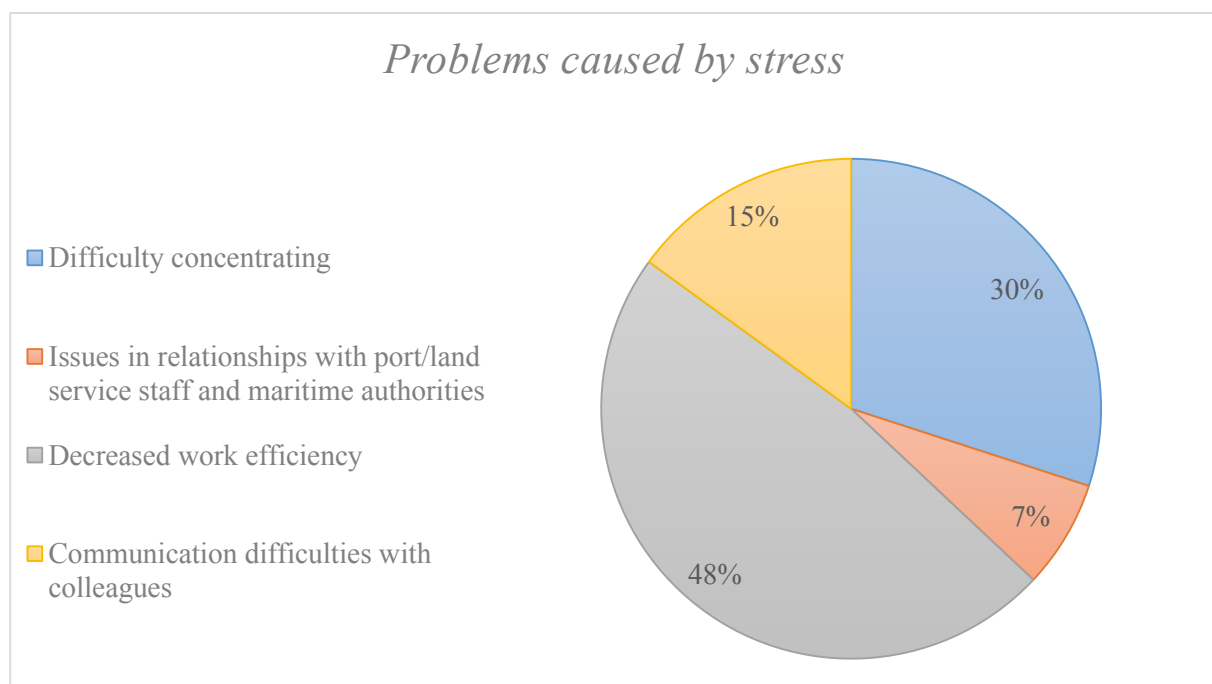


Figure 24. Problems caused by stress.

The group of respondents where stress is most likely to affect job performance are officers aged up to 45 years. This may be due to a lack of experience acquired with age, so that the onset of stress combined with inexperience results in lower efficiency at work (Figure 25).

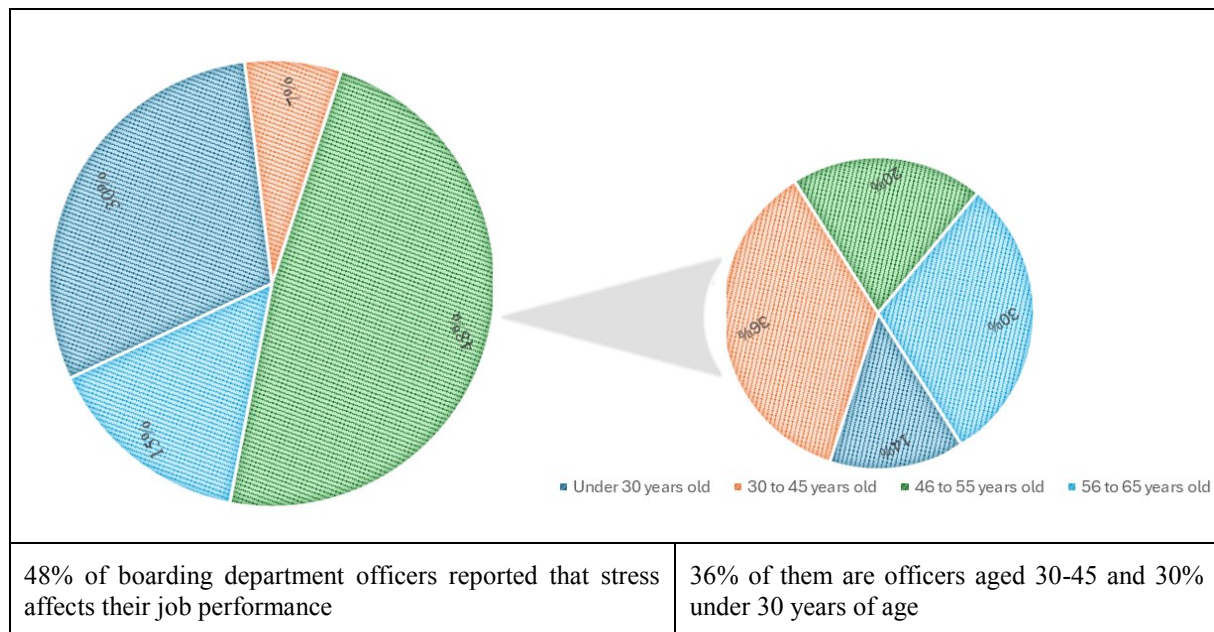


Figure 25. Impact of stressors on different age groups.

The main symptom appearing in all groups is a reduction in work efficiency. In the group with experience of up to 5 years and over 15 years, this is the most frequently mentioned item. In the group of 5-15 years, a slight advantage was given to the answer 'with concentration of thought', but the advantage is small enough that we can safely assume that stress, according to the officers surveyed, is most likely to translate into work efficiency.

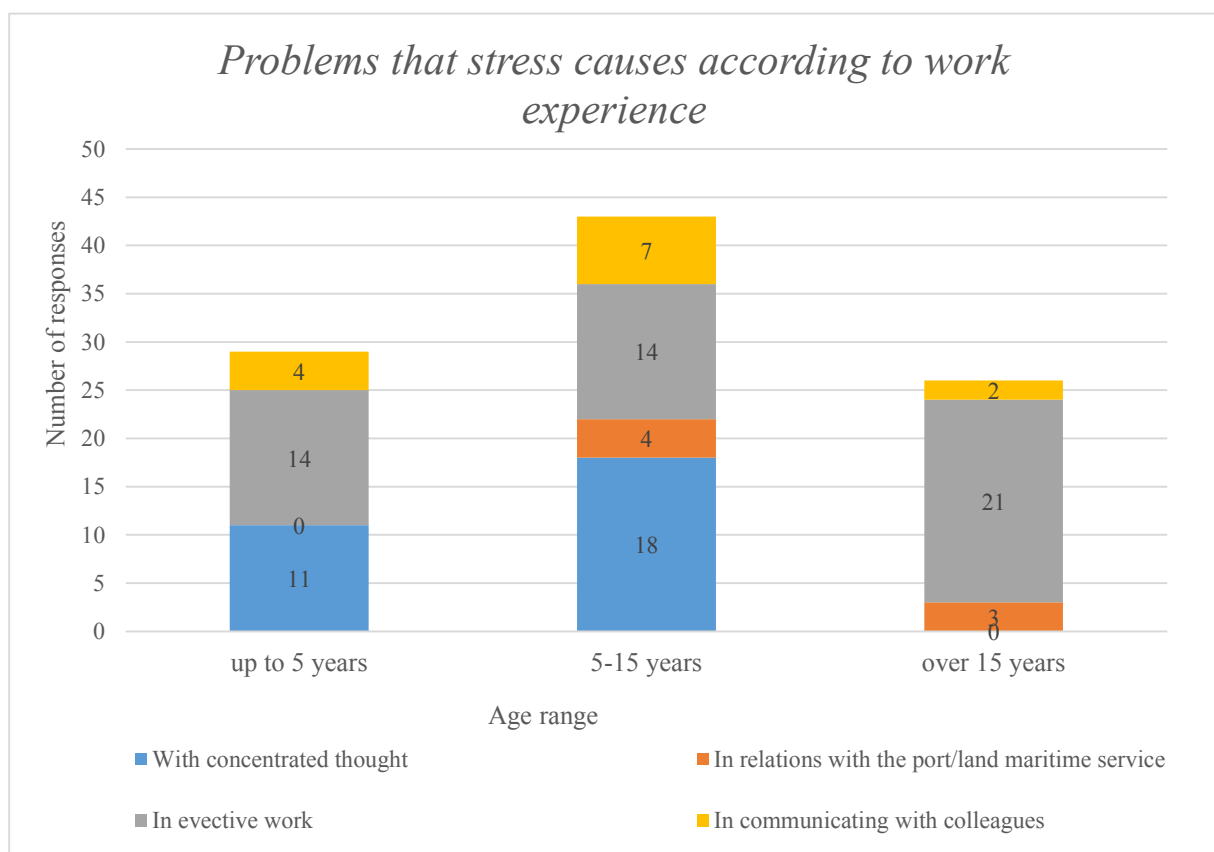


Figure 26. Problems that stress causes according to work experience.

The nature of the job was most frequently cited by the officers surveyed as a source of stress, with 29% and colleagues 28% (Figure 27).

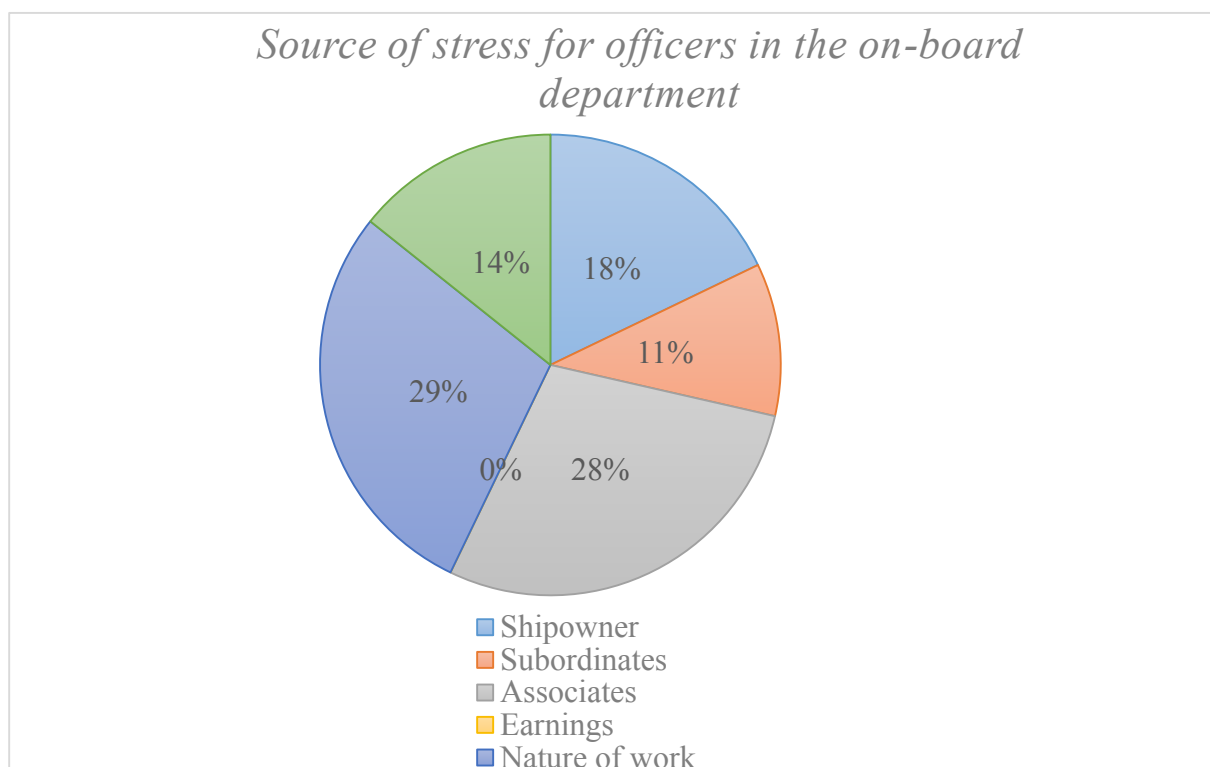


Figure 27. Source of stress for officers in the deck department.

Figure 28 below shows the sources of stress according to the ages of the officers.

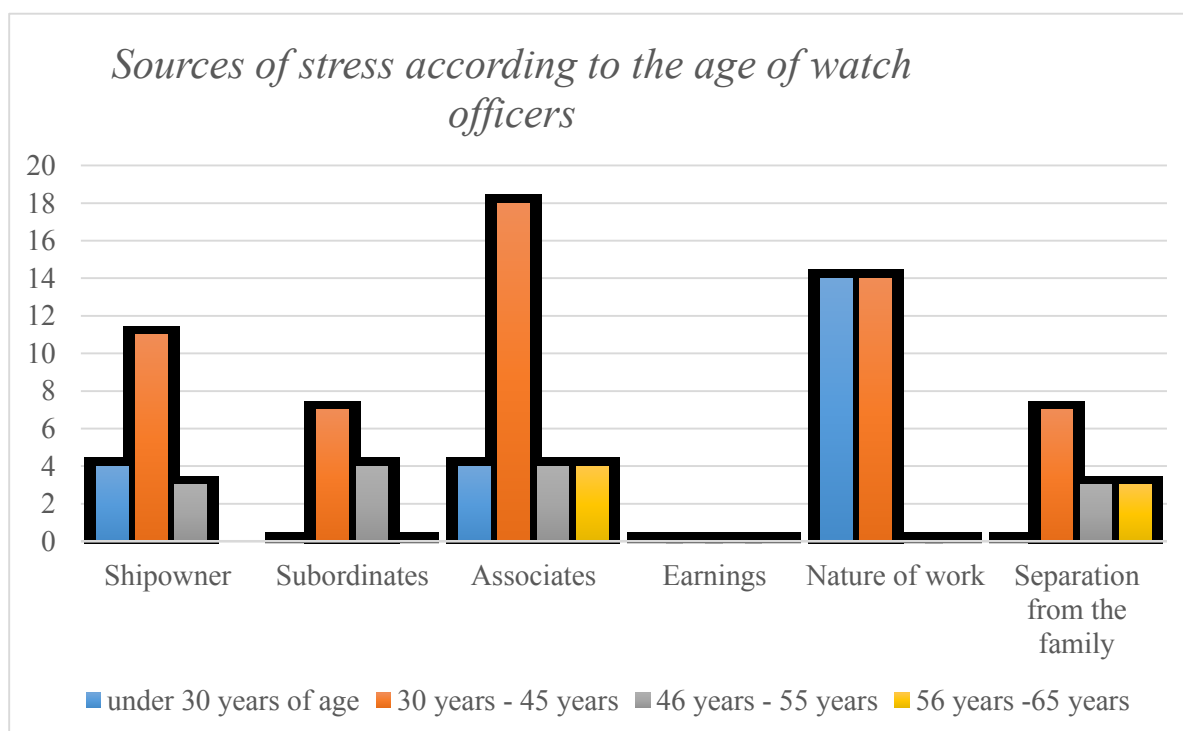


Figure 28. Sources of stress according to the age of watch officers.

In the under-30 age group, the main reason for stress is the nature of the job (63.6%). Officers aged 30-45 decisively indicate that the main reasons for stress are co-workers (31.6%) and the nature of the job (24.6%). In the 46-55 age bracket, stress is evenly distributed between the shipowner, subordinates, colleagues and separation from family. For the over 56s, the main reasons for stress are subordinates (57.1%) and separation from family (42.9%).

Analysis of the results shows that the nature of the job is a significant stressor for younger officers (under 30 and 30-45 years old). Co-workers are the main source of stress for officers aged 30-45. Shipowners cause stress mainly in the 30-45 age group. Subordinates and separation from family are the main causes of stress for older officers (56-65 years).

Additional factors contributing to stress are illustrated in Figure 29.

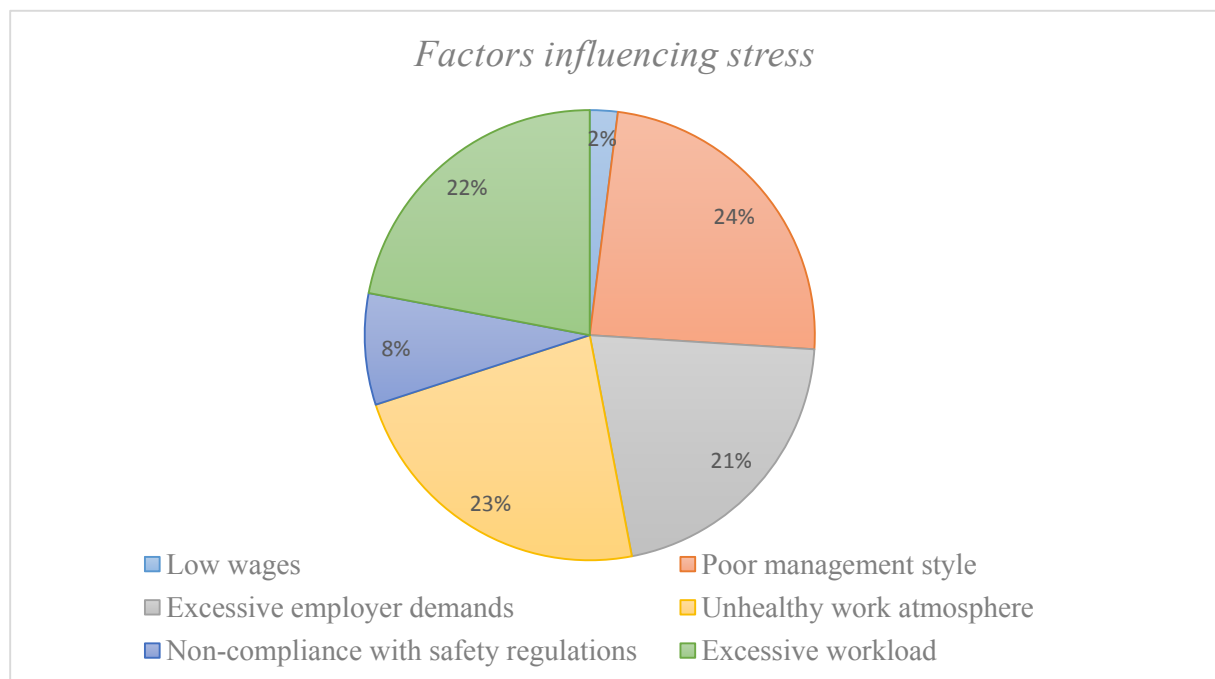


Figure 29. Factors contributing to stress.

The most commonly cited factors were poor management style 24%, an unhealthy working atmosphere 23% and overwork 22%.

Figure 30 below shows the results of the responses to the question on the causes of mental strain on the watch officer. The respondent was asked to choose three visits that cause him/her mental strain.

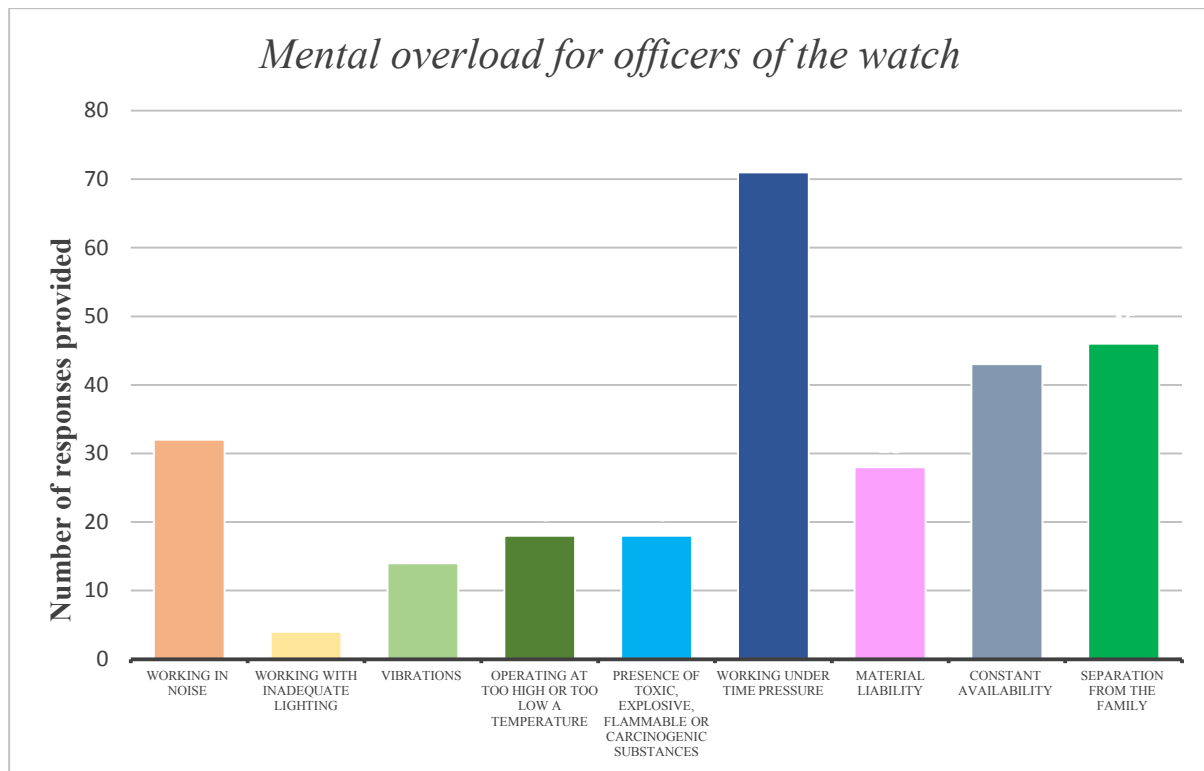


Figure 30. Mental overload of watch officers.

Out of 100 respondents, as many as 71 said that their mental health was most affected by working under pressure, followed by 46 indicating separation from loved ones and for 43 it was the constant availability. These three responses were most frequently answered by respondents in the 30 to 45 age group with a minimum of five years' experience.

At this stage of the study, respondents also answered questions on human error. When asked about the most common cause of human error, the majority of officers, 46%, indicated that it was fatigue, followed by routine at 32% and inexperience at 14% (Figure 31).

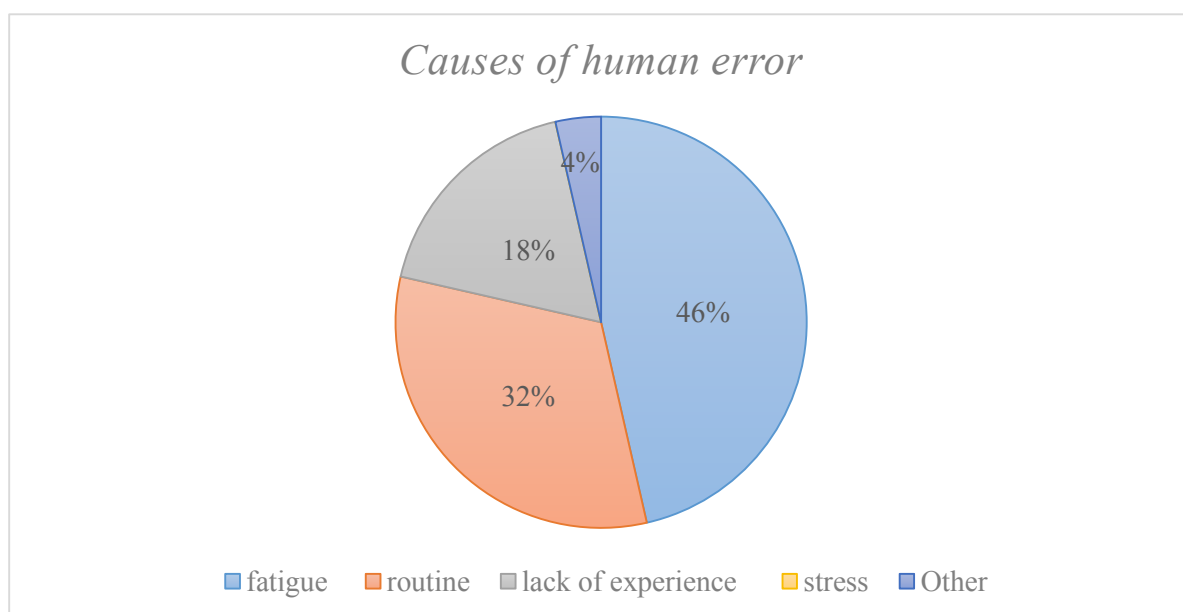


Figure 31. Most frequently cited causes of human error according.

Figure 32 shows the responses of respondents regarding the perception of fatigue during a watch at sea.

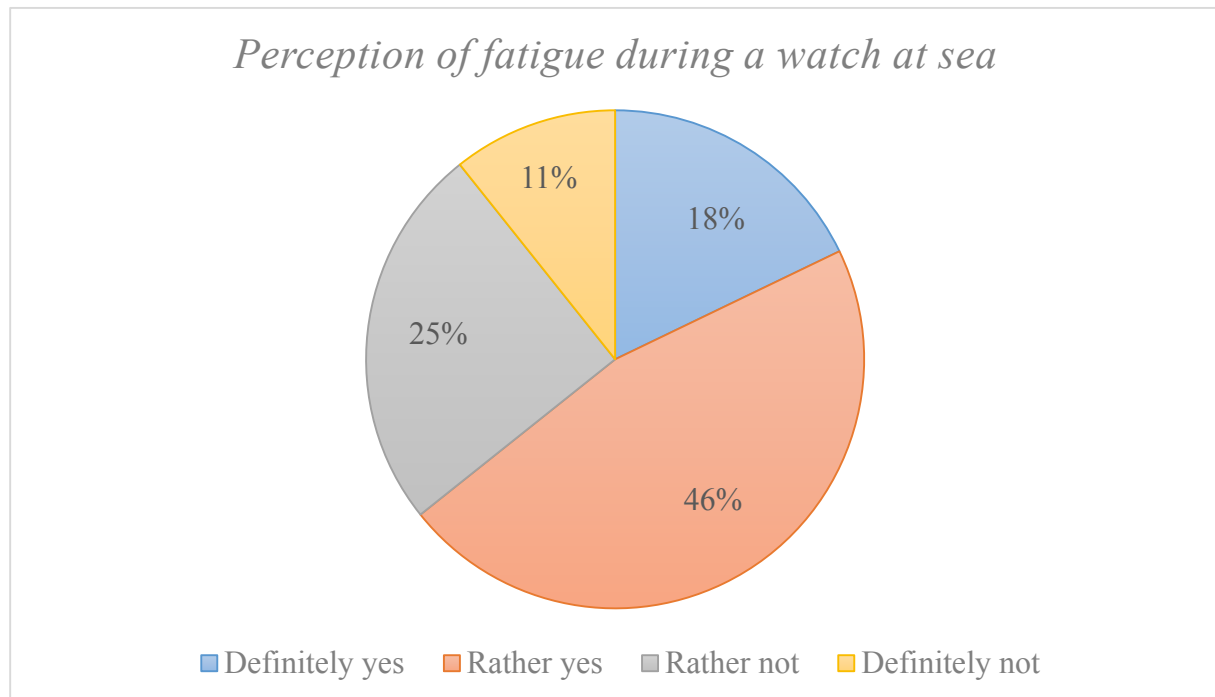


Figure 32. Perception of fatigue by respondents during a watch at sea.

The largest proportion of respondents definitely feel fatigue when on watch at sea (46%). This is almost half of all respondents. Another group of respondents, accounting for a quarter (18%), also feel fatigue, although not as intensely as the first group. A significant proportion of respondents (less than a fifth) are unlikely to feel fatigue during the watch. The smallest group of respondents definitely does not feel fatigue.

It is worrying that the majority (71%) of respondents feel fatigue when on watch at sea (sum of 'definitely yes' and 'rather yes' responses). A minority (29%) of respondents do not feel fatigue (sum of 'definitely not' and 'rather not' responses). These results suggest that fatigue is a significant problem for the majority of watch officers, which can affect their performance and safety while working at sea.

Figure 33 shows the respondents' answers to the question on making safety decisions routinely.

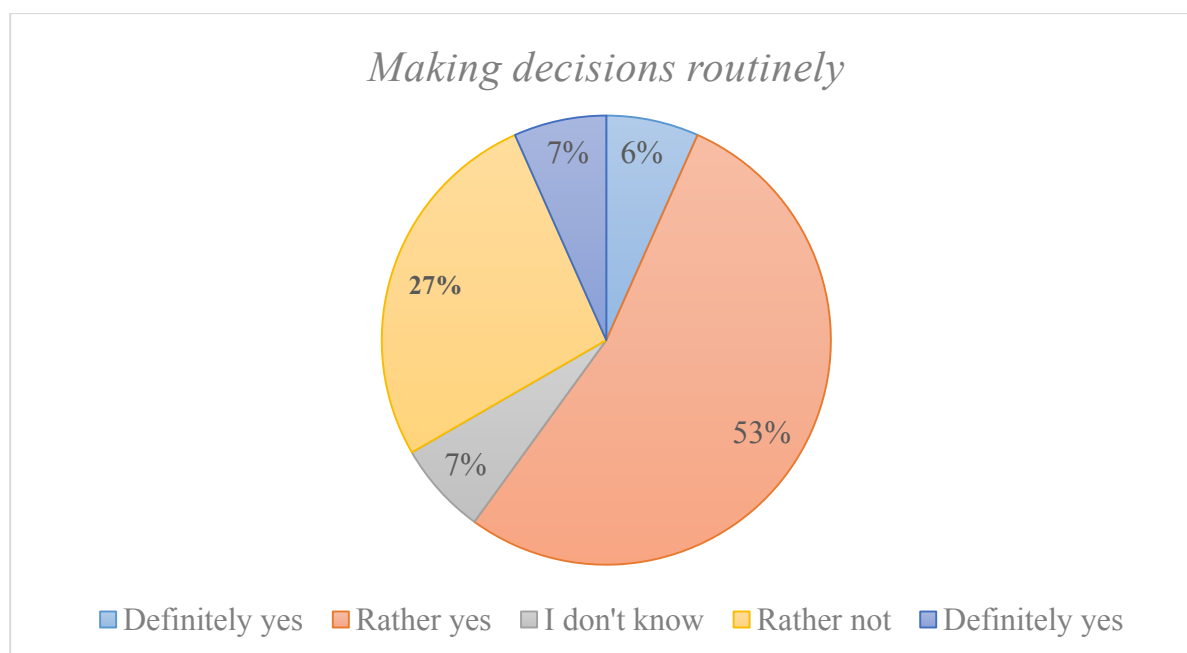


Figure 33. Taking safety decisions on board as a matter of routine.

Experts 53% admitted that **Rather Yes** happened to make a decision routinely.

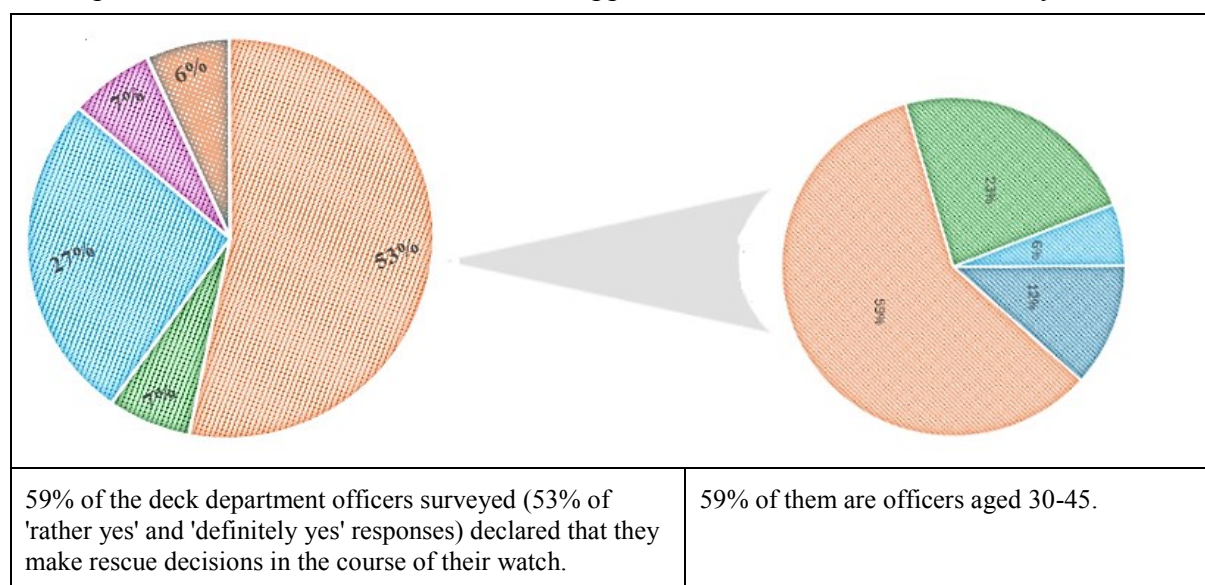


Figure 34. Percentage of deck department officers making rescue decisions during a watch, by age group 30-45 years.

Figure 35 shows the results of the questionnaire on routine decision-making according to the age of the respondents. The question asked about the situation in which the respondent has led to an undesirable situation leading to danger. The responses are divided into five categories: "definitely yes", "rather yes" "no" and "don't know", "rather not" and "definitely not", and the results are presented in four age groups: under 30, 30-45, 46-55 and 56-65.

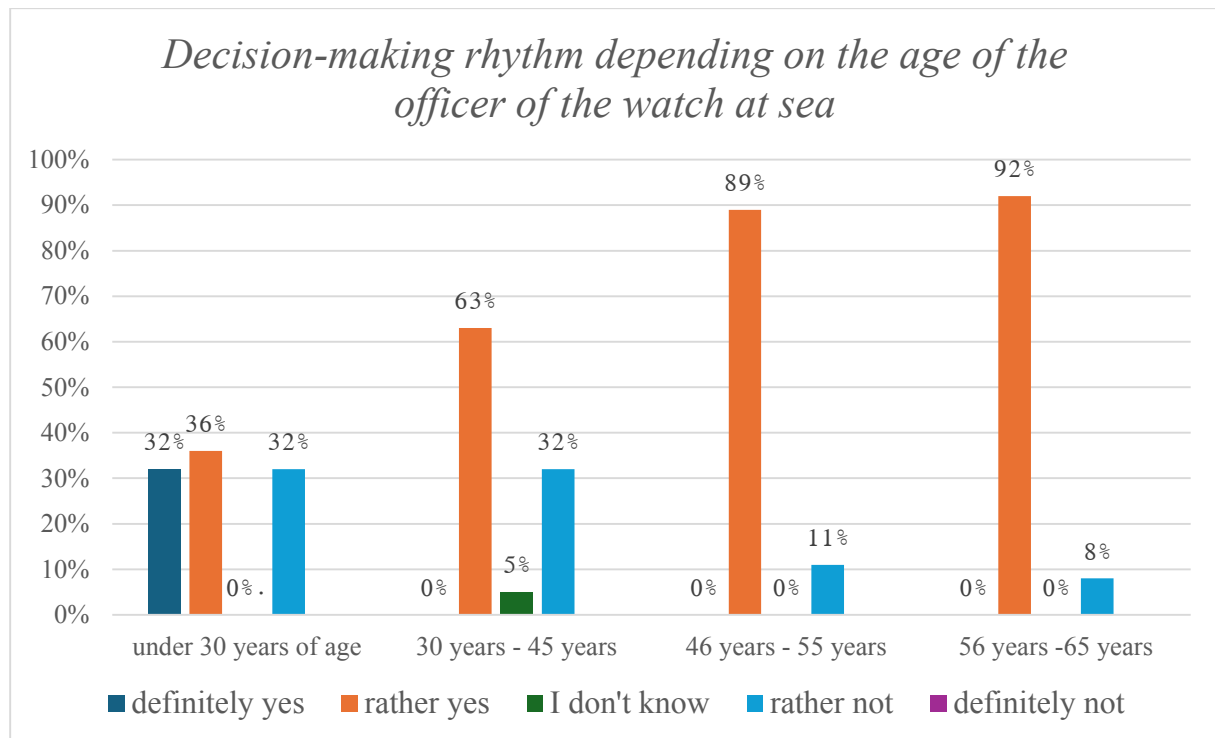


Figure 35. Rescue decision-making in relation to the age of the officer of the watch at sea.

In the under-30 age group, responses are mixed. The majority of respondents tend to make decisions routinely (68% summing 'definitely yes' and 'rather yes'), however 32% tend not to make such decisions. The 30-45 age range is dominated by 'rather yes' responses (63%), suggesting that the majority of middle-aged respondents tend to make decisions routinely. A small proportion (5%) are unsure and 32% tend not to make decisions routinely. For respondents aged 46 and over, a large majority say they tend to make decisions routinely (above 89%), suggesting a strong belief in routine decision-making.

It can be concluded that younger officers (under 30 years old) have a mixed attitude towards making decisions routinely, with the majority tending to make decisions routinely. Officers aged 30-45 are mostly more likely to make decisions routinely, with a small percentage of those unsure and a similar percentage of those unlikely to make decisions routinely. The older age groups (46-55 and 56-65) clearly indicate rather routine decision-making, with no uncertainties or refusals.

Such results may suggest that as officers get older, they become more confident in their decision-making, which may be due to their experience and stability in their professional role.

The next Figure 36 shows how many percentages of officers surveyed made the wrong safety decision.

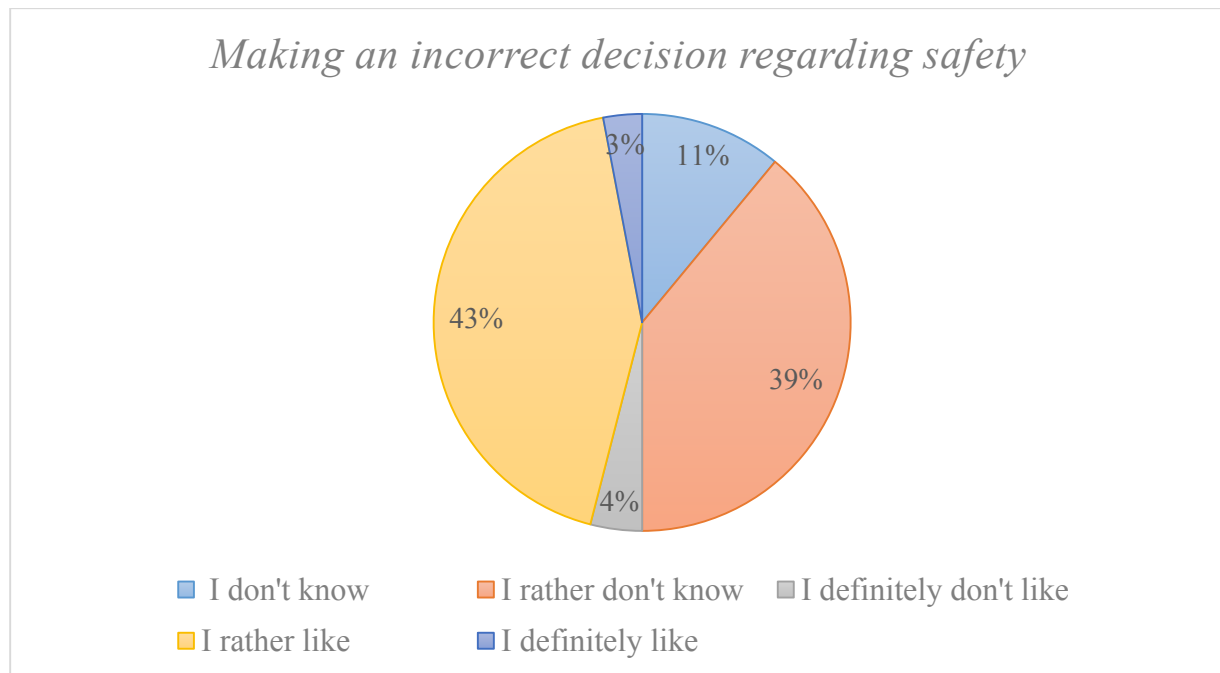


Figure 36. Taking the wrong decision regarding navigational safety.

There are marginally more affirmative answers than negative ones, a difference of only 3%, and it is interesting to note that as many as 11% do not know whether they made the wrong security decision.

The bar chart below (Figure 37) shows the results of the survey on the decision that led to the undesirable situation according to the age of the respondents. The results are presented in percentages for four age groups: under 30, 30-45, 46-55, and 56-65. Responses are divided into three categories: 'yes', 'no' and 'don't know'.

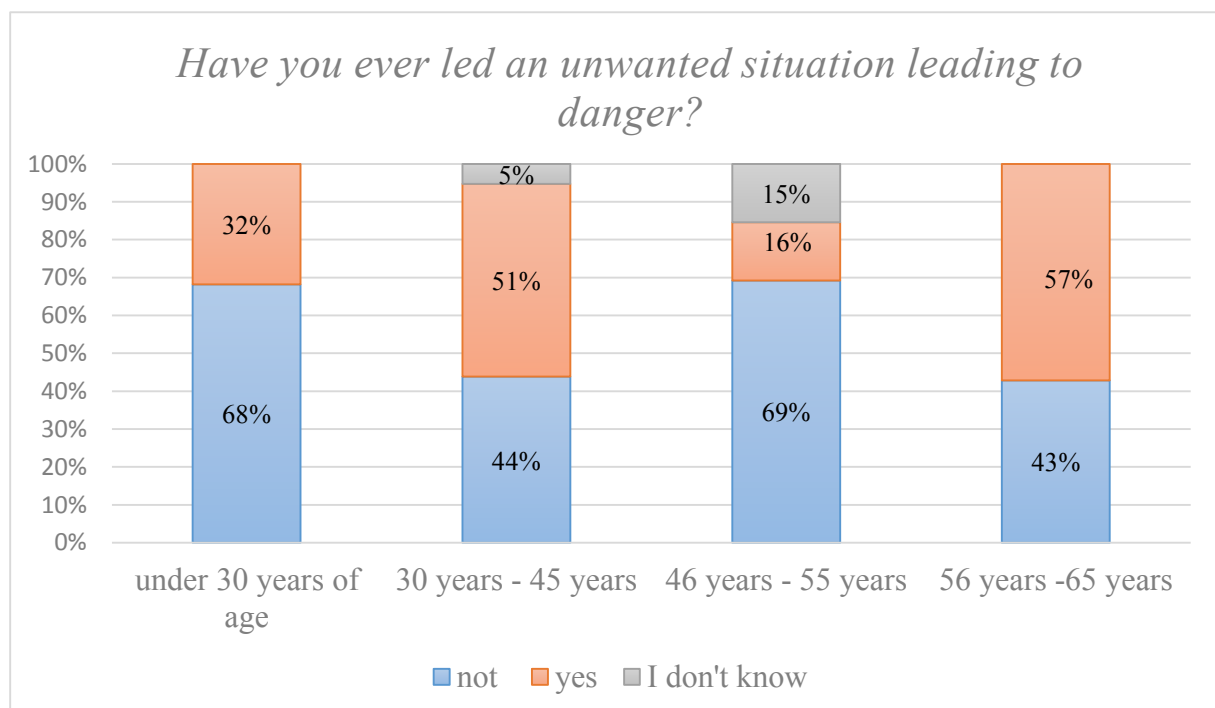


Figure 37. Incidence of Situations Leading to Danger.

The majority of respondents (around 70%) under the age of 30 have not led to an unwanted situation, but around 30% have such experience. In the 30-45 age group, we see a higher number of "yes" answers (51%), which means that almost half of the respondents in this age group have had experience of unwanted situations leading to danger, while 44% answered "no" and 5% that they "do not know". Respondents the 46-55 age group 69% had not led to an unwanted situation, but 16% answered 'yes' and a further 15% 'don't know'. The results in the 56-65 year old group are similar to the 30-45 year old group, with 56% answering 'yes' and 43% answering 'no'.

Analysing the graph above, it can be seen that younger people are less likely to bring about undesirable situations (around 70% of 'no' answers). Middle-aged people have a higher percentage of "yes" answers (about 51%), which may suggest more professional experience and therefore a higher risk of making mistakes. The 46-55 age group shows more uncertainty (15% of 'don't know' responses), which may suggest difficulties in evaluating their experience or changes in professional responsibility. Older people are more likely to bring about undesirable situations, as is the group in the 30-45 age range, which may be due to greater confidence and routine decision-making.

It is worth noting that the highest uncertainty in responses is found in the 46-55 age group. The highest proportion of those who have had experience of adverse situations is in the 30-45 age group. The younger and older age groups (under 30 and 46-55) have similar distributions of responses, with a predominance of 'no' responses.

With the results obtained, it is possible to analyse the relationship between routine decision-making and the occurrence of adverse situations leading to danger. To do this, we use data on the responses of respondents in different age groups (**Table 1 and Table 2**).

Table 1.

Data on decision-making routinely

Age	Definitely yes	Rather yes	I don't know	Rather not	Definitely not
Under 30 years	32%	36%	0%	32%	0%
30-45 years	0%	63%	5%	32%	0%
46-55 years	0%	100%	0%	0%	0%
56-65 years	0%	100%	0%	0%	0%

Table 2.

Data on adverse situations leading to danger

Age	Yes	Not	I don't know
Under 30 years	32%	68%	0%
30-45 years	51%	44%	5%
46-55 years	16%	69%	15%
56-65 years	57%	43%	0%

The majority of junior officers (68%) make decisions routinely (summing up 'definitely yes' and 'rather yes'). At the same time, about 70% of them have not had adverse situations. It seems that younger officers who make decisions routinely are more cautious, leading to fewer undesirable situations. They seem to have a more nuanced approach to making decisions

routinely and their percentage of undesirable situations is relatively low. Younger people (under 30 years) are often recently trained and have fresh theoretical and practical knowledge that is in line with the latest standards and procedures. This can lead to a more cautious and procedurally compliant approach. Younger officers may also be less likely to take a routine approach (32% are unlikely to make decisions routinely), which may mean that they analyse each decision in more detail and carefully, rather than relying on established patterns. Those under 30 may be more motivated and committed to their work, seeking to avoid mistakes in order to build their reputation and advance their careers.

In the 30-45 age group, although most people make decisions routinely (63%), a high proportion (51%) admit to adverse situations. This may suggest that in this age group, routine decisions alone are not sufficient to avoid risky situations, which may be related to work experience or task specificity. People aged 30-45 often have enough experience to make decisions routinely (63%), but may encounter more complex and challenging situations that cannot always be solved routinely. This age group may tend to be routine (rather yes: 63%), but at the same time they have to adapt to new challenges and situations, which can lead to more undesirable situations (51%). This is often linked to career advancement; during this time, a large number of officers gain new qualifications (e.g. change of job at management level).

Officers in the 46-55 age range, make decisions routinely, with only 16% admitting to adverse situations. It appears that routine decision-making can be effective in reducing risk in this age group. Professional experience and a stable position in one's job will have a big impact.

In the 56-65 year-old group, the high incidence of adverse situations (57% of respondents) may be related to a greater awareness of risk or professional fatigue.

5. Concept for a method to assess watchkeeping officer reliability

With the help of the analysis carried out, it is possible to develop the concept of a method to assess the reliability of the officer of the watch. The authors, after careful analysis of the questionnaire, developed a model that makes it possible to identify factors influencing officer reliability as well as shipboard safety management. A diagram of the model is shown in Figure 38.

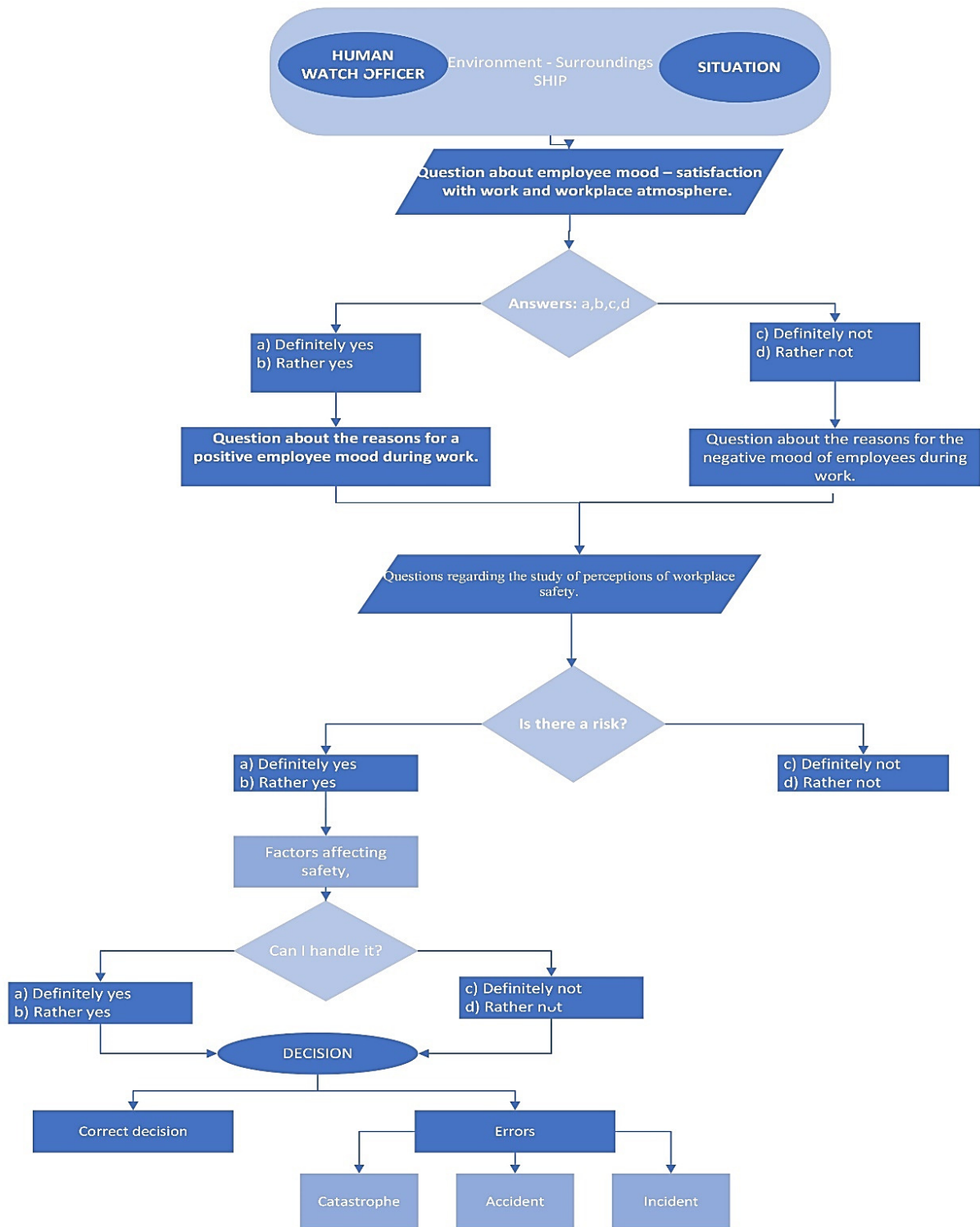


Figure 38. Reliability assessment model for a watch officer from the deck department.

The Officer of the Watch reliability assessment model provides a comprehensive tool to identify and assess the factors affecting officer quality and safety levels on the vessel. The model consists of individual factors, environmental factors, safety management system and systemic risk factors.

Individual factors relate to an officer's personal characteristics, such as experience, knowledge and psycho-physical abilities, which influence decision-making. Environmental factors include working conditions, such as weather, noise or equipment, which can increase the risk of errors. Safety management focuses on work organisation and crew cooperation, minimising human error. Systemic risk factors and the human-system relationship emphasise the importance of the effectiveness of supporting technologies, such as radar and ECDIS, and their intuitive use. The purpose of the model is to identify risk factors affecting watch officer reliability and to develop corrective actions in the areas of training, vessel equipment and operational procedures. The model also serves to improve safety management on the vessel by reducing human errors and minimising the risk of accidents, leading to an increased overall level of maritime safety.

The diagram shows the interrelationships between the factors mentioned, allowing a better understanding of the impact of the different elements on the end result, i.e. the reliability of the watch officer and the level of safety on the vessel.

6. Discussion

A survey of officers of the watch at sea provided valuable data on factors affecting their reliability in the course of their duties. With the information obtained, it was possible to create a reliability assessment model that takes into account key aspects of working in a dynamic and demanding maritime environment.

However, it is worth critically assessing the limitations of the study. The survey method used, based on the officers' self-assessment, although useful for learning about their experiences and opinions, carries the risk of subjectivity and bias in the responses. Participants may have unconsciously underestimated or overestimated the frequency of stress, fatigue or routine decisions.

The sample of 100 deck officers is a limited and homogeneous group, which makes it difficult to generalise the results to other ship departments, ship types or cultural contexts. The results should therefore be treated as indicative.

The lack of direct observation and simulation studies limits the ability to capture the real context of decision-making on the bridge. In future studies, it would be worthwhile to combine survey methods with observation, simulation experiments or physiological measurements to obtain a more complete picture of human reliability in the maritime environment.

Organisational and economic factors, such as safety culture or management style, which may influence stress and fatigue levels, were also not taken into account. Despite these limitations, the study provides valuable empirical data on the relationships between

psychological factors and the work environment and serves as a starting point for further modelling research on human reliability in the maritime environment.

Despite these limitations, the study provides valuable empirical data on the relationships between psychological factors and the work environment and provides a starting point for further modelling research on human reliability in shipping.

The study allowed the identification of key areas of risk, such as the impact of fatigue, the complexity of operations or team communication, which can lead to undesirable situations. The use of an empirical data-driven approach has enabled a better understanding of the relationship between human factors and the reliability of watch officers' operations. The results of the survey provide a basis for further analysis and potential interventions to improve navigational safety. The reliability assessment model can be applied to both training and operational practices, helping to minimise the risk of errors and improve performance at key moments.

7. Results

The main objective of the study was to assess officer reliability and identify factors contributing to human error. In order to carry out a comprehensive analysis, it was necessary to use an expert method. The study identified the sources of hazards arising from human activity as part of the man-ship system and the analysis of human error in the reliability and safety of this system. It also enabled the development of a model method for assessing the reliability of the officer of the watch.

The results of the study provide new insights into the relationship between age, professional experience and decision-making by watch officers. The analysis showed that younger officers are more likely to be cautious and risk-aware, while those with more professional experience are more likely to make routine decisions, which can lead to reduced vigilance and an increased likelihood of error. A clear impact of stress and fatigue on the quality of decisions was also identified, especially in groups with less experience and a higher level of responsibility.

The results confirm previous findings on the impact of psychophysical factors on human reliability, but at the same time expand our knowledge of the structure of the relationship between age, experience and risk perception in the maritime environment. They also show that psychological factors (such as stress and time pressure) are just as important as technical or organisational factors.

Productivity and job satisfaction are affected by many factors. One of them is certainly stress. In most professions, we are unable to avoid stressful situations, such as carrying out new tasks and interacting with colleagues etc.

The classification of the causes of stress can vary, mainly depending on the individual, the situation and the context. Nevertheless, there are some factors that were frequently mentioned by the interviewees as the main causes of stress. Table 2 shows the hierarchy of the most frequently mentioned causes of stress by the surveyed watch officers.

Table 3.

Classification of the most frequently cited causes of stress in the position of officer from the deck department

Work environment	• Unregulated working hours. • Time pressure and pressure from the client/charterer-at the expense of safety and comfort. • Lack of sleep, non-compliance with occupational hygiene rules related to working time. • Lots of things to do in a short space of time. • Rush. • Fear associated with loss of health and, as a result, of work. • Unloading, loading operations. • Manoeuvres.
Weather conditions	• Weather conditions. • Sudden change in weather conditions. • Bad weather for manoeuvring.
Relationship with the supervisor	• Superior (Chief, Captain). • Difficult relationship with the supervisor. • Pressure from the shipowner. • Pressure from the office. • Ship inspections and unannounced inspections. • Bullying.
Technology	• Equipment unreliability on board. • Emergency situations e.g.: blackout or General Alarm. • Unforeseen hazardous situations related to equipment failure. • Ship collision situation.
Associates	• Other crew members- training and crew morale. • Lack of crew competence. • Crew conflicts.
Communication	• Communication between crew, shipowner or port staff.
Human relations	• Conflicts and relationship difficulties with other crew members. • Interpersonal difficulties. • Meeting the exorbitant expectations of others. • Responsibility for the safety of the vessel and crew.
Family and relationships	• Limited contact with family. • Separation from family. • Problems in family or partner relationships. • Life changes - e.g. loss of a loved one. • Conflicts with children or other family members.
Other	• Unjustified controls in third world countries based on extortion and bribes, etc.

It is worth noting that these factors are not completely independent of each other, and many of them can interact, reinforce each other or lead to complex interactions. As a consequence, strategies for coping with stress often require a holistic approach that takes into account different aspects of an individual's life.

Workplace stress is a mental and emotional state that results from the tension and pressure associated with the demands and expectations set in the workplace. Analysing the responses of the officers interviewed, it can be said that the source of stress is:

- Heavy workload due to excessive responsibilities.
- Performing duties under time pressure, constant rush.
- Irregular working hours and lack of rest.
- Poor communication between colleagues and supervisor.
- Conflicts within the crew and lack of support or assistance from superiors.
- Changes for which workers are not prepared- changing weather conditions and breakdowns of technical equipment.
- Tasks beyond capacity.
- Too much responsibility.
- Hazardous physical conditions in the working environment.
- Unannounced inspections, etc.

The impact of stress at work can be negative for both employees and the employer. When stress is experienced regularly, it leads to fatigue, regular headaches and other physical complaints. Stress can also lead to reluctance to perform one's duties, indifference or mood swings. When analysing the responses of all age groups of officers, the most frequently cited causes of stress and mental strain are pressure and unregulated working hours. Mental strain is also worth mentioning for officers, who point out the non-compliance with occupational hygiene rules regarding lack of sleep and unregulated working hours. The most severe symptoms accompanying stress, according to the respondents, are headache and unwillingness to work (Figure 15).

The routine associated with working at sea can be considered a mistake for several reasons. Many unforeseen situations occur in maritime conditions, such as changing weather conditions, technical failures of equipment or emergencies. If a person performs his or her tasks automatically and is unable to adapt to changing conditions, this can lead to human error. Working at sea is physically and mentally demanding. If a seafarer gets stuck in a routine without rest, it can lead to fatigue, reduced productivity and potentially mistakes. Above all, routine has an impact on safety. Such routines can cause the crew to miss certain hazards or fail to take appropriate precautions. Habitual performance of tasks can result in a lack of attention to important details, which can in turn increase the risk of accidents. Performing work in monotonous conditions can result in a loss of interest and commitment to the task. This can have a negative impact on motivation and increase the risk of errors and inaccuracies.

To avoid the above problems, it is important that the crew is flexible, adequately trained in safety, undergoes regular reviews of operating procedures and is aware of the need to adapt to changing conditions. It is also good practice, to make changes to work schedules and procedures from time to time, which can help to keep the crew alert and engaged.

Fatigue

Crew fatigue on board a vessel, can be the result of various factors related to the characteristics of work at sea. Some of the main factors that contribute to fatigue are outlined below:

- **Shift work and lack of contact with family**

Crew on ships work in shifts that involve long working hours, sometimes without breaks. Long flights between ports, frequent lack of coverage and therefore no constant access to family and social life can lead to mental and physical fatigue.

- **Adverse conditions**

Working at sea sometimes involves extreme weather conditions (storms, high waves or strong winds). Such conditions can lead to increased physical and mental stress.

- **Monotony and routine**

Performing routine tasks for long periods of time without much change can lead to boredom and fatigue. Monotony in daily duties can affect crew morale and conflict.

- **Limited opportunities for rest**

Due to the need to maintain the safety of the vessel, the crew may have limited opportunities for rest, including during rapid loading/unloading, frequent port entries and exits, sailing in bad weather conditions. This encourages a lack of regular breaks and short sleep, which can affect the overall fatigue of crew members.

- **Security stress**

Each member of the ship's crew is responsible for maintaining safety at sea. The stress of being responsible for the safety of themselves and others, especially in the event of an emergency, can lead to increased fatigue.

To counteract fatigue, it is important to put in place appropriate fatigue management procedures, provide adequate rest conditions, and regularly train staff on how to manage stress and maintain a healthy lifestyle during the voyage. Providing adequate breaks and opportunities for crew to relax can help maintain their physical and mental fitness.

Communication

Miscommunication is a common cause of incidents and accidents at sea, and plays a key role in ensuring safety on ships. Any misunderstanding, miscommunication or error can lead to significant consequences. The major causes of communication errors at sea include:

- **Inadequate communication**

Lack of clear and correct communication between crew members, as well as between vessels, can lead to numerous misunderstandings. Improper communication of, for example, one's intentions, course, speed, or other important variables can lead to collisions or other incidents.

- **Language barriers**

Many seafarers come from different countries, which can lead to language misunderstandings (variety of dialect). Understanding messages in this case can be difficult, especially in stressful situations. This can lead to errors of interpretation and potential problems.

- **Lack of uniform procedures**

Each ship and each maritime campaign may follow slightly different communication procedures. A lack of uniform understanding and adherence to these procedures can lead to mistakes being made.

- **Too many messages**

Excessive information (e.g. in situations where multiple vessels are communicating simultaneously), can lead to confusion and cause important messages to be overlooked.

In order to mitigate communication errors on board, it is important to ensure that the crew is adequately trained in communication, that procedures are standardised, and that the focus is on clear and understandable messages. Situational awareness of potential difficulties due to language barriers is also important. Systematic situational exercises and training can be helpful here to help improve the effectiveness of communication at sea.

It is also worth noting that the survey also took into account the age and experience of the officers. From this it was possible to show that young workers with little seniority responded that they sometimes make mistakes regarding safety on board. They also often feel stressed if unforeseen situations occur. Some of them also feel that they still lack experience. In contrast, the longest-serving employees admit that they sometimes make decisions routinely. They feel confident in their jobs.

Based on an analysis of the factors influencing shipboard safety in a watch officer's job, it is possible to develop a fault tree that can help to understand how different factors, i.e. routine, stress, communication, fatigue and system failure, can lead to errors at sea (Figure 39).

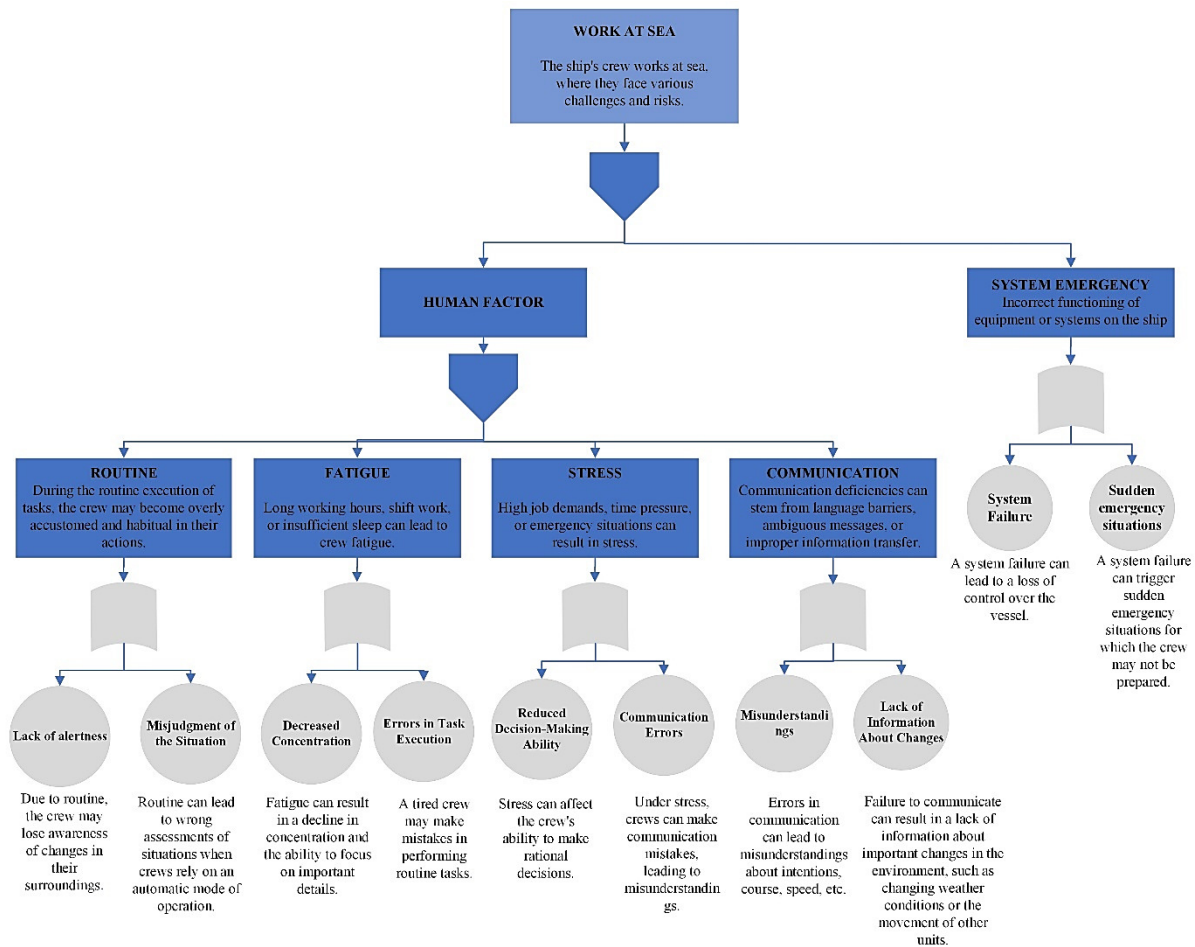


Figure 39. Damage tree.

The tree above illustrates how different types of factors can interconnect and lead to mistakes being made at sea. This type of tool allows for risk analysis in further studies, helping to identify areas that may require additional attention, training or improvements to procedures.

To summarise the study carried out; errors are caused by several factors resulting from taking the wrong action. This article looks at factors related to human nature: stress, fatigue, routine and inexperience. The survey and its analysis will enable further research into maritime safety. In future, the results will be used to carry out further research on this topic using a simulation method. This research will be based on a model for assessing the reliability of a watchkeeping officer from the deck department.

8. Conclusions

The study expands existing knowledge about human reliability in maritime operations by empirically demonstrating how fatigue, stress and routine affect decision-making on the navigation bridge.

The results show that younger officers are more cautious and risk-aware, while those with more experience are more likely to make routine decisions, which may increase the likelihood of error. From a theoretical point of view, the study contributes to the development of risk-based reliability assessment models in maritime navigation.

In practical terms, the results obtained can form the basis for improving Bridge Resource Management (BRM) training programmes, developing fatigue prevention strategies and improving communication procedures on the bridge.

In the future, it is recommended to conduct research verifying the model in simulated conditions and cross-sector comparisons – for example, with aviation or the offshore industry – in order to deepen the understanding of factors affecting human reliability in the maritime environment.

References

1. Adumene, S., Afenyo, M., Salehi, V., William, P. (2022). An Adaptive Model for Human Factors Assessment in Maritime Operations. *Int. J. Ind. Ergon.*, 89, 103293. <https://doi.org/10.1016/j.ergon.2022.103293>
2. Apostol-Mates, R., Barbu, A. (2019). Fatigue Leading to Human Error: A Study Based on Marine Accidents. *Scientific Bulletin Mircea cel Bătrân"Naval Academy*, 22(1), 76-81. <https://doi.org/10.21279/1454-864X-19-I2-013>
3. Banks, J.O., Avers, K.E., Nesthus, T.E., Hauck, E.L. (2012). A Comparative Study of International Flight Attendant Fatigue Regulations and Collective Bargaining Agreements. *Journal of Air Transport Management*, 19, 21-24. <https://doi.org/10.1016/j.jairtraman.2011.12.003>
4. Bęczkowska, S.A., Grabarek, I. (2021). The Importance of the Human Factor in Safety for the Transport of Dangerous Goods. *Int. J. Environ. Res. Public Health*, 18(14), 7525. <https://doi.org/10.3390/ijerph18147525>
5. Bhattacharya, S. (2012). The Effectiveness of the ISM Code: A Qualitative Enquiry. *Mar. Policy*, 36(2), 528-535. <https://doi.org/10.1016/j.marpol.2011.09.004>
6. Bury, A., Fan, S., Khalique, A. (2025). Behind the Eyes of a Watchkeeping Officer. *Seaways: the International Journal of The Nautical Institute*, March, 21-23. Available online: <https://researchonline.ljmu.ac.uk/id/eprint/25226/>
7. Dawson, D., McCulloch, K. (2005). Managing Fatigue: It's About Sleep. *Sleep Medicine Reviews*, 9(5), 365-380. <https://doi.org/10.1016/j.smr.2005.03.002>
8. Drury, D.A., Ferguson, S.A., Thomas, M.J.W. (2012). Restricted Sleep and Negative Affective States in Commercial Pilots during Short Haul Operations. *Accident Analysis & Prevention*, 45 (Suppl.), 80-84. <https://doi.org/10.1016/j.aap.2011.09.031>

9. Fan, S., Blanco-Davis, E., Fairclough, S., Zhang, J. (2023). Incorporation of seafarer psychological factors into maritime safety assessment. *Ocean & Coastal Management*. <https://doi.org/10.1016/j.ocecoaman.2023.106515>
10. Fan, S., Yang, Z. (2024). Accident Data-Driven Human Fatigue Analysis in Maritime Transport Using Machine Learning. *Reliability Engineering & System Safety*, 241, 109675. <https://doi.org/10.1016/j.ress.2023.109675>
11. Fan, S., Yang, Z. (2023). Analysing Seafarer Competencies in a Dynamic Human-Machine System. *Ocean Coast. Manag.*, 240, 106662. <https://doi.org/10.1016/j.ocecoaman.2023.106662>
12. Goode, J.H. (2003). Are Pilots at Risk of Accidents Due to Fatigue? *Journal of Safety Research*, 34(3), 309-313. [https://doi.org/10.1016/S0022-4375\(03\)00033-1](https://doi.org/10.1016/S0022-4375(03)00033-1)
13. Hannaford, E., Hassel, E.V. (2021). Risks and benefits of crew reduction and/or removal with increased automation on the ship operator: A licensed deck officer's perspective. *Applied Sciences*, 11(8). <https://doi.org/10.3390/app11083569>
14. Hansen, M., Nazir, S. (2024). Situational Awareness and Decision-Making in Maritime Operations: A Cognitive Perspective. In: M.M. Soares, E. Rosenzweig, C. Falcão (Eds.), *Engineering Psychology and Cognitive Ergonomics. EPCE 2024* (pp. 165-189). Lecture Notes in Computer Science, 14692. Cham: Springer. https://doi.org/10.1007/978-3-031-60729-5_14
15. Huang, J. (2020). *Study on Ship Officer's Labor Intensity and Duty Arrangement. World Maritime University Dissertations 2020*. Available online: https://commons.wmu.se/all_dissertations/1345, 23 March 2025.
16. *Interankiety* (2023). Available online: <https://www.interankiety.pl/>.
17. Jaram, H., Vidan, P., Vukša, S., Pavić, I. (2021). Situational Awareness – Key Safety Factor for the Officer of the Watch. *Pedagogika [Pedagogy]*, 93(7s). Education and Aspects of Maritime Security. <https://doi.org/10.53656/ped21-7s.20situ>
18. Kizilay, F.E., Arslan, O., Akyuz, E., Kececi, T. (2023). Prediction of Human Error Probability for Officers During Watchkeeping Process under SLIM Approach. *Aust. J. Marit. Ocean Aff.*, 16(3), 1-18. <https://doi.org/10.1080/18366503.2023.2168357>
19. Kum, S., Furusho, M., Duru, O., Satir, T. (2007). Mental Workload of the VTS Operators by Utilising Heart Rate. *TransNav Int. J. Mar. Navig. Saf. Sea Transp.*, 1(2), 145-151.
20. Lee, S., Kim, J.K. (2018). Factors Contributing to the Risk of Airline Pilot Fatigue. *Journal of Air Transport Management*, 67, 197-207. <https://doi.org/10.1016/j.jairtraman.2017.12.009>
21. Li, C., Fu, Y., Ouyang, R., Liu, Y., Hou, X. (2022). ADTIDO: Detecting the Tired Deck Officer with Fusion Feature Methods. *Sensors*, 22(17), 6506. <https://doi.org/10.3390/s22176506>

22. Liao, M.-Y. (2015). Safety Culture in Commercial Aviation: Differences in Perspective between Chinese and Western Pilots. *Safety Science*, 79, 193-205. <https://doi.org/10.1016/j.ssci.2015.05.011>
23. Mansyur, M., Sagitasari, R., Wangge, G., Sulistomo, A. (2020). *Long Working Hours, Poor Sleep Quality, and Non-Officer Task: Determinant Factors of Fatigue Among Indonesian Tugboat Crews*. <https://doi.org/10.21203/rs.3.rs-39492/v1>
24. Mu, B., Guo, F., Chu, X. (2024). Assisting Human-Centred Ship Bridge Design through Virtual Reality. In: G. Praetorius, C. Sellberg, R. Patriarca (Eds.), *Advances in Human Factors of Transportation. AHFE 2024 International Conference. AHFE Open Access: USA, Vol. 148* (pp. 729-739). <https://doi.org/10.54941/ahfe1005265>
25. Rajapakse, A., Emad, G.R. (2023). Fatigue, an unsolved puzzle that continues contributing to accidents at sea. *Marine Policy*, 155. <https://doi.org/10.1016/j.marpol.2023.105745>
26. Shan, D., Neis, B. (2020). Employment-related mobility, regulatory weakness and potential fatigue-related safety concerns in short-sea seafaring on Canada's Great Lakes. *Safety Science*, 121, 165-176. <https://doi.org/10.1016/j.ssci.2019.08.017>
27. Stoliarov, M. (2024). *Effect of Modern Bridge Equipment on Officer Attention. Theseus.fi*. Available online: <https://www.theseus.fi/handle/10024/744567>, 23 March 2025.
28. Swiderska, J., Puchalska, M., Grzegorzczak, M., Szalek, Z. (2023). Samples in Psychological Research – Conclusions and Recommendations from the Literature Review. *Przegląd Psychologiczny*, 66(3), 111-132. <https://doi.org/10.31648/przegldpsychologiczny.9831>
29. Uğurlu, Ö., Köse, E., Başar, E., Özkök, M. (2021). Simulation modelling of chief officers' working hours on short sea shipping. *Ships and Offshore Structures*, 17(6). <https://doi.org/10.1080/17445302.2021.1912457>
30. UNCTAD (2023). *A Study on Navigating the Digital Seas: The Impact of Modern Communication on Ship Broking*. FONASBA.
31. Yancheshmeh, F.A., Mousavizadegan, S.H., Amini, A., Smith, A.P., Kazemi, R. (2020). Poor Sleep Quality, Long Working Hours and Fatigue in Coastal Areas: A Dangerous Combination of Silent Risk Factors for Deck Officers on Oil Tankers. *International Maritime Health*, 71(4), 243-250. <https://doi.org/10.5603/IMH.2020.0042>
32. Zhao, W., Li, J., Ma, D., Zhang, Z. (2021). Research on Man-Machine Safety of Officer of the Watch Fatigue Based on Fuzzy Mathematics and Safety Ergonomics. *IEEE Conf. Proc.*, <https://doi.org/10.1109/ICMSSE53595.2021.00031>
33. Zhao, Z., Tang, L., Ma, Y., Wu, Y., Lin, S., Wu, Z., Zhou, Z. (2023). Fatigue at sea during and after the COVID-19 pandemic: A comparative study of two matched samples of seafarers. *Marine Policy*, 155. <https://doi.org/10.1016/j.marpol.2023.105730>

GREEN KNOWLEDGE AS ONE OF THE DIMENSIONS OF GREEN COMPETENCES: RESEARCH AMONG GENERATION Z

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Purpose: The article pursued two equally important research aims. The first aim of the study was to diagnose the extent to which Generation Z representatives assess their level of green knowledge. The second aim was to identify differences in the level of green knowledge among Generation Z, considering the demographic variable of gender.

Design/methodology/approach: To achieve the research aims, a representative survey was designed and conducted among representatives of Generation Z. Two techniques were used in the data collection process: CATI and CAWI. A total of 370 respondents (184 women and 186 men) were surveyed. Questions were asked on a five-point Likert scale, which allowed for the calculation of the weighted average of the responses and the construction of a Green Knowledge Index.

Findings: Based on the Green Knowledge Index obtained, a high level of knowledge was found among the respondents surveyed. Nevertheless, the index value was closer to average than to a very high level of green knowledge.

Research limitations/implications: A key limitation of the study was that respondents self-assessed themselves in the context of a given statement, which may involve the risk of overestimation (especially since the assessment concerned the respondents' knowledge). Furthermore, the questionnaire referred only to two aspects of green knowledge. Future research should expand the study of green knowledge to include new dimensions (e.g., the practical application of green knowledge in various sectors of the economy).

Practical implications: Attention was drawn to measures that should be implemented to more effectively promote the importance of green knowledge among Generation Z, especially in the context of their professional career development. One such measure is the need to develop cooperation between universities and businesses in the field of shaping green competences.

Originality/value: Attention was drawn to the need for further research in the context of green knowledge as a foundation for the development of other green dimensions of green competences. Key research gaps were identified, including the need to examine the extent to which green knowledge acquired through education (formal, informal and non-formal) is used by Generation Z representatives in their professional practice, especially in the context of green jobs. The article is addressed to all those interested in the issues of green knowledge and Generation Z.

Keywords: Generation Z, green competences, green jobs, green knowledge, sustainable development.

Category of the paper: Research paper.

1. Introduction

Climate change (e.g. Pekez et al., 2025; Xian et al., 2025), air pollution (e.g. Edgeman, 2020; Tarsitano, 2006), ecosystem degradation (e.g. Rokochynskiy et al., 2021; Zhang et al., 2023), biodiversity loss (e.g. Hou et al., 2025; Opoku, 2019; Su et al., 2019), and depletion of natural resources (e.g. Ahmed et al., 2025) are just a few of the issues that are the subject of an increasing number of scientific analyses conducted by researchers representing various scientific disciplines who are looking for ways to reduce (and ultimately even eliminate) the negative impact of human activity on the environment. Within the scope of these scientific considerations, it is important to note the efforts to develop various types of solutions that would support not only businesses or other market players, but also entire communities in embarking on the path to sustainable development. Achieving a balance between social, economic and environmental aspects is identified in scientific discussions as an essential element for further equitable development, for example in the context of meeting the needs of future generations (e.g. Izah et al., 2025; Job, Khanna, 2024; Sakshi et al., 2025). At the same time, it is pointed out that the effective and, consequently, sustainable implementation of the idea of sustainable development into socio-economic life requires the implementation of numerous supporting solutions.

Among such solutions, attention is often drawn to the need to develop and implement appropriate technological solutions that would be environmentally friendly. As a result, scientific research raises the issue of innovative green technologies (e.g. Kharb et al., 2024; Shahzad et al., 2022). The implementation of various economic and market solutions is also important in supporting the transition towards sustainable development. Particular attention is paid to the need to create environmental tax systems (e.g. Alola et al., 2023; Saqib et al., 2025; Zainol Ariffin et al., 2023) that would effectively discourage inappropriate behaviour in an environmental context. It is also pointed out that business models based on environmental responsibility should be promoted (e.g. Faccin et al., 2025). Attention is also drawn to the need to promote the greening of existing workplaces (e.g. Fleacă et al., 2024) or the creation of new green jobs (e.g. de Andrade et al., 2025; Kozar, Sulich, 2023b; Mathieu, 2024). Of course, such activities should be supported by the creation of an appropriate legal framework to prevent undesirable phenomena such as greenwashing (e.g. Sciortino et al., 2025; Wodnicka, 2023; Wu, Zuo, 2025). It should also be remembered that the above-mentioned solutions cannot be implemented in a sustainable manner without simultaneously shaping green awareness (e.g. Rustam et al., 2020), green attitudes (e.g. Ezech, Dube, 2025) and green behaviours (e.g. Le et al., 2025; Wu et al., 2025) in both social and economic life. Thus, on the one hand, it is important to promote responsible consumption patterns in social campaigns. On the other hand, there is a clear need to support and develop a high-quality education system for

sustainable development, which would shape green competences, especially one of their key dimensions, namely green knowledge (Sulich, Kozar, 2024b).

An important feature of contemporary socio-economic life is functioning in conditions of intense flow of various types of information. Numerous scientific studies point to the growing phenomenon of dissemination of content of dubious reliability, including distorted information (e.g. Bettis-Outland, 2015; Yuan et al., 2021) or deliberately manipulated information (e.g. Guarda et al., 2018; Stefanova et al., 2025). In this context, green knowledge takes on particular importance as a key element enabling a critical understanding of environmental phenomena. Moreover, it is essential for distinguishing facts from opinions or misinformation in the context of various environmental issues. Thus, as the author of this article points out, it can be assumed that the development of green knowledge can form a kind of foundation for shaping conscious green attitudes (also known as pro-ecological attitudes) and making responsible decisions in the field of sustainable development.

The important role of green knowledge in contemporary socio-economic development is recognised not only by the author of this article, but also by numerous researchers in this field. However, it is worth considering how Generation Z, a generation that is just entering professional life and shaping their career paths, perceives their green knowledge. Previous studies have often shown that Generation Z is a group raised in a digital environment and characterised by a high level of proficiency in information and communication technologies (e.g. Zahra et al., 2025), which has consequences in terms of their daily access to various types of information, including those of dubious reliability. At the same time, some studies devoted to this generation emphasise its clear interest in the issues of climate change and sustainable development (e.g. Tan et al., 2023). This aspect is evident, for example, in the consumer attitudes of some members of Generation Z (e.g. Borah et al., 2024; Deshmukh, Pasumarti, 2025; Ghorbanzadeh et al., 2025).

The article addresses two equally important research aims related to green knowledge among Generation Z. The first aim of the study was to diagnose the extent to which representatives of Generation Z assess their level of green knowledge. The second aim of the study was to identify differences in the level of green knowledge among Generation Z, considering the demographic variable of gender. To achieve the research aims, a study was conducted on a representative sample of 370 Generation Z respondents using Computer-Assisted Telephone Interviewing (CATI) techniques and, additionally, Computer Assisted Web Interview (CAWI). The quantitative analyses were supported by the PS IMAGO PRO 10.0 software.

The article is divided into five sections, which refer both to the role and significance of green knowledge in scientific research related to sustainable development and to the empirical research undertaken. The first part, i.e. this introduction, is theoretical in nature. It draws attention to the topicality of the research issue, outlines the research aims and indicates the research techniques used. The second part points out that green knowledge is one of the

dimensions of green competences. The third part presents a description of the research methodology. It outlines the individual research procedures and places the research in time. An important element of this part of the article is also the special attention paid to the measures taken to ensure the highest possible quality of the results of our own research. The penultimate part presents the research results obtained from the responses provided by respondents representing Generation Z. This part also includes a discussion outlining measures that could be implemented in economic practice and/or better supported to promote the importance of green knowledge in the professional development of Generation Z. The summary, which also concludes the article, indicates future research directions, including the need to undertake research on the level of use of green knowledge acquired in the education process in the labour market (particularly in green jobs). Attention was also drawn to the need to continue research on the issue of green knowledge itself, including the need to develop a research tool in the future that will address this research issue in a much broader way.

2. Green knowledge as one of the dimensions of green competences

Green competences are increasingly discussed in academic discourse due to their important role and significance in the process of socio-economic changes aimed at sustainable development (e.g. Doghan et al., 2024; Gadomska-Lila et al., 2024; Tahir et al., 2024). Some researchers clearly recognise that without the appropriate development of green competences among both employees (e.g. Galabova et al., 2025; Kozar, Sulich, 2023a) and society as a whole (e.g. Surono, 2025), the transition of the economy to a sustainable model will not be possible. It will be even more impossible for the greening of the economy. Therefore, the author of this article believes that green competences constitute a kind of foundation for sustainable development in both the social and economic dimensions.

Scientific research emphasises the complexity of green competences, drawing attention to their key dimensions, which include green knowledge (e.g. Iliescu, 2024; Maksimov et al., 2022), green skills (e.g. Fuchs, 2024; Sulich, Kozar, 2024a), green behaviour (e.g. Jasim et al., 2025; Wu et al., 2025), green attitudes (e.g. Sharma et al., 2025; Zhong et al., 2025), green abilities (e.g. Cabral, Dhar, 2021) and green awareness (e.g. Cabral, Dhar, 2019; Nurcholis et al., 2024). It should be noted that green knowledge, understood as the scope of information, concepts and theories concerning the principles of sustainable development, environmental protection, efficient use of natural resources and ways of reducing the negative impact of human socio-economic activities on the environment, constitutes a kind of cognitive basis for the development of other dimensions of green competences. Possessing green knowledge promotes, for example, more environmentally conscious consumer decisions, and in the workplace, it can lead to reduced or more rational consumption of resources. Labour market

research increasingly shows a demand for employees with relevant green competencies (e.g. Moczydłowska et al., 2024), including green knowledge. At the same time, researchers point out that because of the ongoing shift towards more sustainable management, new jobs are being created, which are referred to as green jobs (e.g. Sulich, Kozar, 2024b). In such jobs, due to the professional activities associated with them, employees are expected to have green competencies (e.g. Olekanma et al., 2024).

Due to the increasing importance of green knowledge in socio-economic life and the dynamic environmental changes taking place, the need to continuously deepen this type of knowledge is emphasised. Green knowledge can be shaped through formal education (an organised education system that takes place in schools), non-formal education (organised educational activities that take place outside the traditional school system) and informal education (acquiring knowledge through everyday experiences and the influence of the environment). The inclusion of pro-environmental content in formal education curricula can promote the development of various dimensions of green competences, including the consolidation of green knowledge from an early age (e.g. Kupper et al., 2012). Nevertheless, as the author of this article notes, it is necessary to recognise the need to develop, in the process of formal education, the ability to critically evaluate individual sources of information on environmental issues and to distinguish between reliable and manipulated content. These aspects will play an important role in the further development of green knowledge by individuals through both non-formal and informal education.

3. Research methodology

The analyses presented in this article are the results of research conducted between September 2024 and October 2025. The research process covered such a long period of time because it included the development of a research tool, the conduct of research, and the interpretation of the results obtained. As shown in Figure 1, the individual research activities can be grouped into four main stages of research, including: identification of the research problem, methodological approach and development of the survey instrument, conducting empirical research, and analysis and interpretation of the research results.

In the first stage of the research, as shown in Figure 1, the research problem was identified. To this end, an analysis of selected scientific publications on green competences indexed in the Scopus and/or Web of Science databases was carried out. Based on a free review of literature on the subject, it was noted that researchers are increasingly drawing attention to the need to conduct research on the issue of green competences among different generations in the labour market, especially among Generation Z. It has been noted that, in the field of green competences, scientific research is currently being conducted to examine their individual green

dimensions, i.e. green skills, green behaviour, green attitudes, green abilities and green awareness, as already mentioned in the second part of this article.

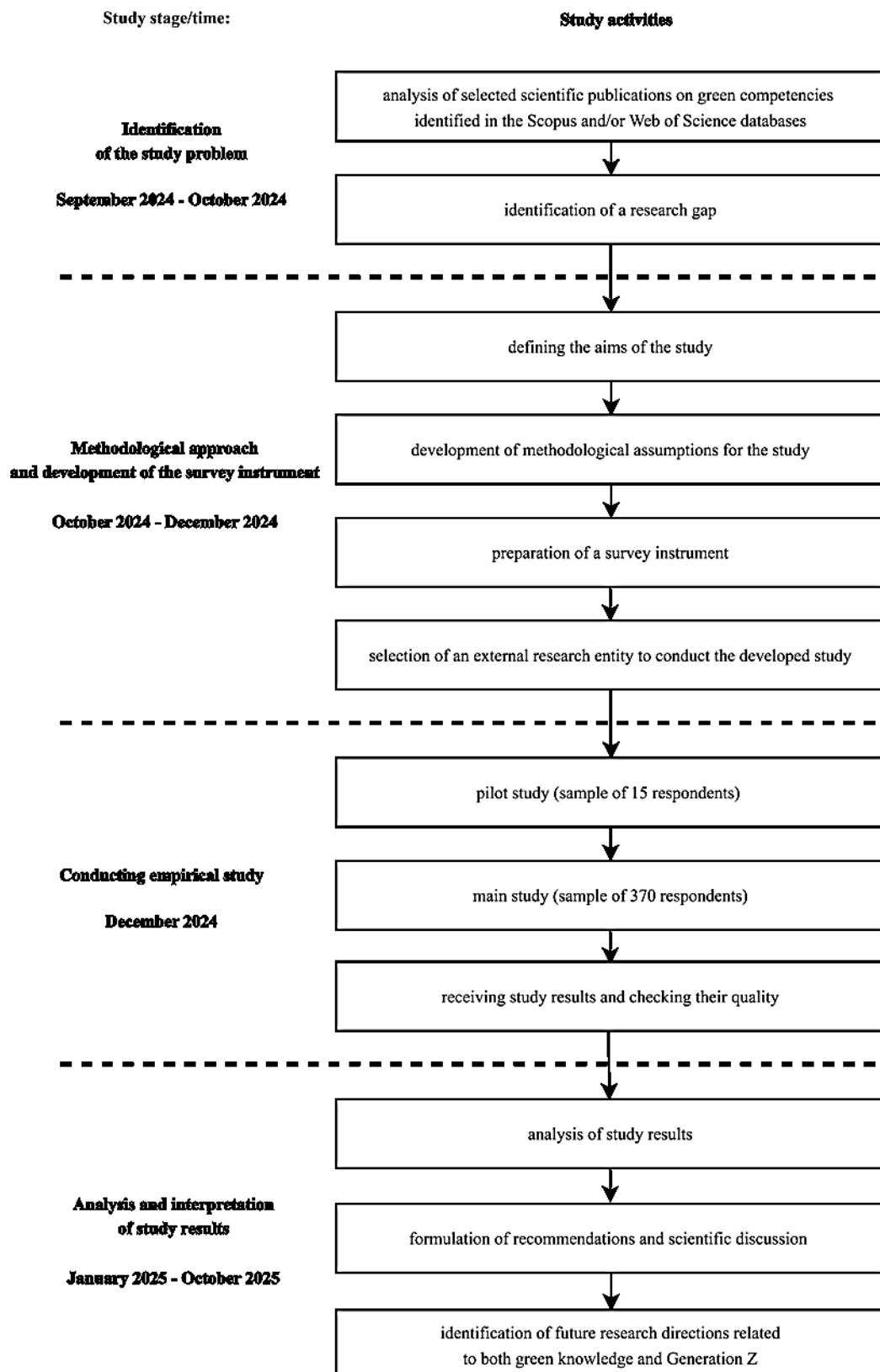


Figure 1. Research procedure stages and timeline.

Source: Author's elaboration.

At the same time, it has been noted that the scientific considerations in this area to date have been mainly theoretical scientific analyses. For example, there are numerous bibliometric analyses focusing on this issue (e.g. Gołaszewska-Kaczan, Augustyńczyk, 2025; Sulich, Kozar, 2024b). These analyses show a growing interest among researchers in the issue of green competences. Despite this, there is still little empirical research on the individual dimensions of green competences. Recognising a research gap in this area, it was decided to focus the empirical study on representatives of Generation Z, with particular emphasis on green knowledge as one of the key dimensions of green competences.

Based on the observed research gap, the aims of the planned research were formulated in the second stage of the study. The first aim of the research was to diagnose the extent to which representatives of Generation Z assess their level of green knowledge. The second aim of the research was to identify differences in the level of green knowledge among Generation Z, considering the demographic variable of gender. To achieve these research aims, a research questionnaire was developed in which representatives of Generation Z responded to two statements concerning green knowledge on a five-point Likert scale:

- ‘I believe that I have sufficient knowledge about actions that can reduce the negative impact of humans on the environment’ (hereinafter referred to as question ‘A’);
- ‘I have a good knowledge of the principles of sustainable development and environmental protection’ (hereinafter referred to as question ‘B’).

The choice of the above-mentioned measurement scale was a deliberate research decision and was aimed at analysing data in the context of the research aims. First, it was assumed that a weighted mean (1) would be calculated for each question, reflecting the average level of agreement with the statement on the part of the respondents. Due to the second aim of the research, it was assumed that this type of analysis would be carried out not only in relation to the total number of respondents, but also broken down by gender (women, men).

$$\bar{x} = \frac{\sum_{i=1}^n w_i \times x_i}{\sum_{i=1}^n w_i} \quad (1)$$

where:

$\bar{x}$ - weighted mean,

x_i - category value - level on the Likert scale (1-5),

w_i - weight - the number of respondents who chose a given answer,

n - number of categories - in a 5-point Likert scale, $n = 5$.

Because two statements in the survey referred to green knowledge at the planning stage, it was assumed that a common index (2) would need to be created from them during the analysis by using weighted averages (1) for this purpose. This index is further referred to in this article as the Green Knowledge Index (GKI). As before, it was decided to calculate the values for all respondents (total) and broken down by gender (women, men).

$$GKI_g = \frac{\bar{x}_{Ag} + \bar{x}_{Bg}}{2} \quad (2)$$

where:

g - group of respondents – total, women, men,

$\bar{x}_{Ag}$ - weighted mean from question ‘A’ for a given group of respondents,

$\bar{x}_{Bg}$ - weighted mean from question ‘B’ for a given group of respondents.

At the same time, prior to conducting the research, a uniform interpretation was adopted for the weighted averages obtained for green knowledge in the context of the given statement being assessed and the GKI. This issue is presented in Table 1.

Table 1.

Interpretation of green knowledge level – guidelines

Average range	Interpretation	
	level of green knowledge	interpretative description
1.00-1.80	very low	respondents rate their green knowledge as very low
1.81-2.60	low	green knowledge is rated by respondents as low (insufficient)
2.61-3.40	average	respondents rate their green knowledge as average
3.41-4.20	high	respondents rate their green knowledge as high
4.21-5.00	very high	respondents rate their green knowledge as very high (very high confidence in green knowledge)

Source: Author's elaboration.

For the purposes of selecting an appropriate research sample, data from the Statistics Poland for 2024 on the state and structure of the population was used. As a result, it was assumed that a representative research sample would consist of 370 respondents (184 women and 186 men). It was assumed that all respondents should be of legal age at the time of the survey and belong to Generation Z. Therefore, people born between 1996 and 2006 were surveyed. The sample selection was based on stratified representativeness, considering three key variables: gender, labour market status and participation in formal education. It was assumed that two techniques, CATI and CAWI, would be used in the data collection process.

After selecting the research entity, the third stage of the research began. The first action taken here was to conduct pilot studies on 15 deliberately selected respondents representing Generation Z. The aim of this study was to identify and, in further actions, eliminate potential errors or inaccuracies in the design of the original research questionnaire. After verifying the quality of the research tool and introducing changes, the actual study was launched on a sample of 370 respondents. The interviewers conducted the study in accordance with the guidelines of the Interviewer Quality Control Programme, which guaranteed high methodological standards. As a result, the data collection process was reliable and compliant with the principles of social research ethics. After the survey was completed and the data was received, a data quality identification procedure was carried out (including in terms of its completeness).

The final stage of the research focused on the analysis and interpretation of the data obtained in the study. For the purposes of quantitative analysis, the PS IMAGO PRO 10.0 software was used, which enables the processing and interpretation of statistical data. At the same time, it should be noted that this software is used for scientific analysis by researchers in the context of quantitative research on various issues related to the green economy (e.g. Dziawgo, 2024), including the issue of green competences (e.g. Kozar, Sulich, 2023a).

4. Results and discussion

During the study, all Generation Z representatives participating in the study rated statements concerning the aspect of ‘green knowledge’ on a five-point Likert scale. Therefore, the results presented below refer to the subjective assessment of the level of green knowledge provided by the respondents. The results are presented in Table 2. In the case of the first statement, considering the entire study population, most people assessing this statement indicated ‘I neither agree nor disagree’. The same opinion on this statement was also most common among the responses given by men. In turn, most women assessing statement ‘A’ gave the rating ‘I rather agree’.

In the case of the second statement evaluated, as indicated by the data in Table 2, the largest number of respondents indicated ‘I rather agree’. It should be noted that in this statement, the same assessment as for the overall group of respondents was given by both women and men. The data obtained also indicate that in the case of statement ‘B’, women were significantly more likely to choose the assessment ‘I strongly agree’ than men.

Table 2.

Distribution of respondents’ answers to statements assessing the level of green knowledge by gender

Assessed statement		Scale*	Respondents:		
			total	women	men
A	I believe that I have sufficient knowledge about actions that can reduce the negative impact of humans on the environment.	1	8	3	5
		2	27	14	13
		3	138	65	73
		4	131	72	59
		5	66	30	36
B	I have a good knowledge of the principles of sustainable development and environmental protection.	1	7	1	6
		2	33	18	15
		3	131	60	71
		4	146	74	72
		5	53	31	22

* The following Likert scale was adopted in the survey: I strongly disagree (1); I rather disagree (2); I neither agree nor disagree (3); I rather agree (4); I strongly agree (5).

Source: Author's elaboration based on survey data.

To achieve the research aims in accordance with the methodology presented in the third part of the article, the weighted average for both questions was calculated for the total, women and men (Table 3). The Green Knowledge Index value was also calculated. The method of data collection was deliberate and resulted from the need not only to determine the overall level of green knowledge among all respondents, but also to capture any differences between women and men.

Table 3.

Weighted mean values of responses to statements assessing the level of green knowledge by gender

Assessed statement		Weighted mean ($\bar{x}$)		
		total	women	men
A	I believe that I have sufficient knowledge about actions that can reduce the negative impact of humans on the environment.	3.59	3.61	3.58
B	I have a good knowledge of the principles of sustainable development and environmental protection.	3.55	3.63	3.48
Green Knowledge Index value		3.57	3.62	3.53

Source: Author's elaboration based on survey data.

In the case of the first statement ('A'), the weighted average obtained for the entire study group (without division by gender) was 3.59, which indicates that this group demonstrated a relatively high level of green knowledge about actions that can reduce the negative impact of humans on the environment. As Table 2 shows, more respondents agreed with the statement than disagreed or gave a neutral response. Nevertheless, this group of respondents was dominated by people who rather agreed with the statement, i.e. they did not declare full certainty, which could be expressed by the answer 'I definitely agree'. This response may indicate that these respondents consider their green knowledge on the issue in question to be sufficient, but at the same time there remains a certain gap or desire to further develop their green knowledge in this area in order to learn about a wider range of activities than before that can contribute to reducing the negative impact of humans on the environment. It is also worth noting that women (3.61) obtained a slightly higher weighted average score in their assessment of this statement than men (3.58). This result is in line with the trend observed in the literature, according to which women are more likely to show greater environmental sensitivity and interest in sustainable development issues (e.g. Gökmen, 2021; Li et al., 2022; Zhao et al., 2021). The results suggest that, regardless of gender, there is a need to deepen practical knowledge about ways to reduce the negative effects of human activity (in the context of the possibility of implementing specific measures).

The results for the second statement ('B') indicate that respondents declare a high level of knowledge of the principles of sustainable development and environmental protection. The weighted average for the entire sample assessing the respondents' green knowledge in this statement was 3.55, which meant that most respondents rather agreed with this statement, although not decisively. There were significant differences in the ratings given to this statement between women and men. Women scored 3.63, while men scored 3.48, suggesting that female

respondents were slightly more likely to identify themselves as having good knowledge of the principles of sustainable development and environmental protection. This difference may result from the observation already mentioned above that researchers in the literature on the subject note that women are more likely to show greater environmental sensitivity and interest in the topic of sustainable development. Nevertheless, as in the previous statement analysed, the need to further deepen green knowledge about the principles of sustainable development and environmental protection was also recognised. Such targeted knowledge provides the basis for developing other dimensions of green competences, in particular green attitudes and green skills. It can even be said that without adequate green knowledge about the principles of sustainable development and environmental protection, it is impossible to understand the complex relationships between natural, social and economic factors.

In the context of the analysed study, the Green Knowledge Index can be interpreted as a kind of measure of Generation Z's cognitive readiness to participate in processes supporting sustainable development. The result obtained, reflecting the GKI value, indicates a high level of green knowledge (3.57) in the group of respondents surveyed (Table 3). It is also worth noting that women achieved a slightly higher index level than men. On the one hand, this result may indicate the existence of general green knowledge among Generation Z, which may serve as a starting point for developing other dimensions of green competences. On the other hand, this result suggests that for most of the people participating in the study, the level of green knowledge was not fully established (this aspect is further emphasised by the number of 'strongly agree' responses to both statements analysed, which is not very high). In the opinion of the author of this article, the level of green knowledge may influence further career development in an economy entering the path of sustainable development. Thus, the obtained index level reflecting green knowledge, which is closer to the average than to the very high level, may indicate that some members of Generation Z may find it difficult to develop their professional careers. There is therefore a clear need to implement measures to more effectively promote the importance of green knowledge among Generation Z, especially in the context of their professional development. Such measures should include:

- developing cooperation between universities and businesses in the field of green competences (organising work placements and/or internships in businesses operating within the green economy sectors),
- incorporating 'green' content into formal and professional education programs at all stages of education,
- creating mentoring programmes that could enable members of Generation Z to connect with leaders promoting issues related to sustainable development and the green economy,
- supporting various types of information campaigns to raise awareness of the importance of green knowledge in professional and private life,

- promoting green entrepreneurship as an interesting career path,
- supporting and promoting young leaders who implement green solutions in economic practice.

The implementation of the above measures in practice may contribute to raising awareness among Generation Z of the role of green knowledge as an important element in the development of their professional careers in the context of an economy entering the path of sustainable development. However, it should be remembered that in this process it is important to use appropriate communication channels that will enable us to reach the widest possible group of representatives of this generation. In the context of shaping knowledge among Generation Z, as previous studies show, modern and interactive forms of communication are of particular importance (e.g. Düzenli, 2021). Therefore, promoting green knowledge in the context of professional career development for this generation should be done using social media, e-learning platforms and mobile applications created for this purpose. It is also worth using various types of visual and audiovisual channels (including short videos, podcasts and infographics). Such forms of communication, as recognised by various studies, meet the needs of young audiences who prefer fast communication (e.g. Manalu et al., 2025). Another effective solution may be to engage influencers, opinion leaders and youth organisations that are trusted by this group and can support the promotion of green knowledge in an authentic way. The use of interactive online campaigns, educational games and themed competitions that combine elements of learning and entertainment is also important. In the academic environment, it is worth developing platforms for cooperation between students, universities and businesses, enabling the exchange of experiences and examples of good practices in the field of sustainable development. In the opinion of the author of this article, such a broad communication approach is necessary to shape green knowledge among Generation Z.

5. Summary

The analyses carried out contributed to the achievement of the research aims. Based on the Green Knowledge Index obtained, a high level of green knowledge was found. Nevertheless, the index value was closer to the average than to a very high level of green knowledge. Thus, during the analyses, actions were identified that could lead to an increase in the level of green knowledge among Generation Z. Women in the study rated their own green knowledge slightly higher than men. The results obtained show that the Generation Z respondents surveyed were interested in pro-environmental issues, but their green knowledge needs to be further developed and deepened.

The survey had two key limitations. First, respondents self-assessed themselves in the context of a given statement, which may always involve the risk of overestimation (especially since the assessment concerned the respondents' knowledge). Furthermore, the questionnaire referred only to two aspects of green knowledge. Therefore, in the future, it would be worth considering expanding it to include, for example, the practical application of green knowledge in various sectors of the economy. The above limitations of the study do not affect its quality because the study was conducted on a representative sample of people representing Generation Z. Furthermore, as indicated in the methodology chapter, measures were implemented to maintain high methodological standards (including a pilot study preceding the main study).

The results obtained are of significant cognitive and practical importance, as they allow us to understand how the Generation Z respondents perceived their readiness to act in accordance with the principles of sustainable development. The study indicates that green knowledge should not be limited to knowledge of environmental issues but should also be assessed in the context of the ability to apply it in everyday decisions aimed at reducing the negative impact of humans on the environment. Therefore, as the author of the article points out, green knowledge is a factor that provides the cognitive basis for shaping pro-environmental skills, attitudes and behaviours. During the discussion, it was also noted that Generation Z, raised in the digital age, is open to acquiring environmental knowledge, especially if the message is conveyed in an attractive and interactive way. This reveals the potential for the development of modern methods of green education and environmental communication aimed at young audiences.

Green knowledge is a kind of foundation for shaping other dimensions of green competences. This highlights the need to conceptualize green knowledge as a strategic resource that enhances the capacity of societies and individuals to adapt to environmental and climate challenges. Therefore, the author of this article sees the need for further research in this area in the future. At this point, it is worth noting the need to examine the extent to which green knowledge acquired through education (formal, informal and non-formal) is used by Generation Z in their professional practice, especially in the context of green jobs. In the future, it would be worthwhile to develop a more comprehensive, yet universal research tool that would allow for a much broader research approach to green knowledge. Such a research tool should also consider, for example, the impact of intercultural differences on the development of green knowledge, which would allow for conducting research in different countries and comparing them with each other. In the opinion of the author of this article, continuing research around Generation Z's green knowledge is a very important area of research, considering the prospect of socio-economic life entering the path of sustainable development. The results obtained in such targeted research can form the basis for recommendations for educational institutions, decision-makers and businesses that want to actively support the development of green competences and consequently contribute to sustainable socio-economic development (including the 'greening' of its individual elements).

References

1. Ahmed, E.M., Elfaki, K.E., Bashir, M.S. (2025). How investment and technological innovation interact with resource rents to affect environmental sustainability in MENA countries? *Journal of Environmental Management*, 391, 126566. <https://doi.org/10.1016/j.jenvman.2025.126566>
2. Alola, A.A., Muoneke, O.B., Okere, K.I., Obekpa, H.O. (2023). Analysing the co-benefit of environmental tax amidst clean energy development in Europe's largest agrarian economies. *Journal of Environmental Management*, 326, 116748. <https://doi.org/10.1016/j.jenvman.2022.116748>
3. Bettis-Outland, H. (2015). Information Distortion, Receiver Reaction, & Organizational Responsiveness: The Impact of Information Distortion Within the Context of Implementing and Sustaining a Market Orientation. In: *Developments in Marketing Science: Proceedings of the Academy of Marketing Science* (p. 189). Springer Nature. https://doi.org/10.1007/978-3-319-13078-1_60
4. Borah, P.S., Dogbe, C.S.K., Marwa, N. (2024). Generation Z's green purchase behavior: Do green consumer knowledge, consumer social responsibility, green advertising, and green consumer trust matter for sustainable development? *Business Strategy and the Environment*, 33(5), 4530-4546. <https://doi.org/10.1002/bse.3714>
5. Cabral, C., Dhar, R.L. (2019). Green competencies: Construct development and measurement validation. *Journal of Cleaner Production*, 235, 887-900. <https://doi.org/10.1016/j.jclepro.2019.07.014>
6. Cabral, C., Dhar, R.L. (2021). Green competencies: insights and recommendations from a systematic literature review. *Benchmarking*, Vol. 28, Iss. 1. Emerald Group Holdings Ltd., pp. 66-105, <https://doi.org/10.1108/BIJ-11-2019-0489>
7. de Andrade, R.D., Benfica, V.C., de Oliveira, H.V.E., Suchek, N. (2025). Investigating green jobs and sustainability in SMEs: Beyond business operations. *Journal of Cleaner Production*, 486, 144477. <https://doi.org/10.1016/j.jclepro.2024.144477>
8. Deshmukh, R., Pasumarti, S.S. (2025). Expectations and Propensity of Gen Z to Spend Additional for Eco-friendly Green Products: Lessons for Marketers. In: *Green Marketing Perspectives* (pp. 175-188). Emerald Publishing Limited. <https://doi.org/10.1108/978-1-83608-772-420251015>
9. Doghan, M.A., Al, Soomro, F.A., Bano, S., Abdelmegeed Abdelwahed, N.A. (2024). Green competence and environmental performance: Do green empowerment and green passion matter? *Sustainable Environment*, 10(1). <https://doi.org/10.1080/27658511.2024.2425187>
10. Düzenli, H. (2021). A systematic review of educational suggestions on generation Z in the context of distance education. *Journal of Educational Technology & Online Learning*, 4(4), 896-912. <https://doi.org/10.31681/jetol>

11. Dziawgo, L. (2024). Support for the European Green Deal by Individual Investors: Research Results. *European Research Studies Journal*, XXVII(Iss. 4), 486-496. <https://doi.org/10.35808/ersj/3529>
12. Edgeman, R. (2020). Urgent evolution: excellence and wicked Anthropocene Age challenges. *Total Quality Management & Business Excellence*, 31(5-6), 469-482. <https://doi.org/10.1080/14783363.2018.1430510>
13. Ezeh, P.C., Dube, K. (2025). Trends and development in green and sustainability marketing: a bibliometrics analysis using VOSviewer. *Discover Sustainability*, 6(1), 324. <https://doi.org/10.1007/s43621-025-01159-z>
14. Faccin, K., Beuter, N., Martins, B., Vasconcellos, S.L. (2025). Promoting sustainable business model innovation: a dynamic capabilities approach. *Management Decision*, 1-28. <https://doi.org/10.1108/MD-07-2024-1548>
15. Fleacă, B., Militaru, G., Fleacă, E. (2024). Reinforcement of Workforce Training Programs—Insights from Pilot Testing Process to Enhance Greening Practices in Enterprises. *Sustainability*, 16(23), 10377. <https://doi.org/10.3390/su162310377>
16. Fuchs, M. (2024). Green Skills for Sustainability Transitions. *Geography Compass*, 18(10). <https://doi.org/10.1111/gec3.70003>
17. Gadomska-Lila, K., Sudolska, A., Łapińska, J. (2024). The importance of green competencies in advancing organizational sustainability: The empirical perspective. *Sustainable Development*, 32(1), 1152-1169. <https://doi.org/10.1002/sd.2729>
18. Galabova, B., Trifonova, B., Petrova, V. (2025). Integration of Green Competencies in Entrepreneurial Practices for Sustainable Development of the Industry. *The Eurasia Proceedings of Educational and Social Sciences*, 43, 102-114. <https://doi.org/10.55549/epess.929>
19. Ghorbanzadeh, D., Khan, M.A., Vaca Cárdenas, M.L., Prasad, K., Abduvalieva, D., Procel Silva, M.A. (2025). From attitude to action: examining the factors affecting sustainable purchasing behavior in Generation Z with an emphasis on environmental responsibility. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-025-06141-3>
20. Gökmen, A. (2021). The effect of gender on environmental attitude: A meta-analysis study. *Journal of Pedagogical Research*, 5(1), 243-257. <https://doi.org/10.33902/JPR.2021167799>
21. Gołaszewska-Kaczan, U., Augustyńczyk, J. (2025). Green competence and higher education - a bibliographic analysis. *Economics and Environment*, 93(2), 950. <https://doi.org/10.34659/eis.2025.93.2.950>
22. Guarda, R.F., Ohlson, M.P., Romanini, A.V. (2018). Disinformation, dystopia and post-reality in social media: A semiotic-cognitive perspective. *Education for Information*, 34(3), 185–197. <https://doi.org/10.3233/EFI-180209>
23. Hou, Y., Yang, Y., Chang, J., Peng, J. (2025). Ecological environment protection evaluation

- method based on mineral resource planning and its impact on land use. *Humanities and Social Sciences Communications*, 12(1). <https://doi.org/10.1057/s41599-025-05003-7>
24. Iliescu, A.N. (2024). Green Knowledge Management - Bibliometric Analysis. *Encyclopedia*, 4(2), 923-935. <https://doi.org/10.3390/encyclopedia4020060>
 25. Izah, S.C., Ogwu, M.C., Salimon, S.S. (2025). Principles of Sustainable Development and Environmental Management. In: *Environmental Science and Engineering: Vol. Part F513* (pp. 29-63). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/978-3-031-85327-2_2
 26. Jasim, N.I., Gunasekaran, S.S., Al-Sharafi, M.A., Ibrahim, M., Hassan, A., Mahmoud, M.A., Bakather, A. (2025). Exploring a nexus among green behavior and environmental sustainability: A systematic literature review and avenues for future research. *Resources, Conservation & Recycling Advances*, 25, 200249. <https://doi.org/10.1016/j.rcradv.2025.200249>
 27. Job, J.S., Khanna, S. (2024). Building a resilient future: collaborative sustainability regulation. *Clean Energy*, 8(3), 223-237. <https://doi.org/10.1093/ce/zkae026>
 28. Kharb, R., Saini, N., Kumar, D. (2024). Driving environmental sustainability in emerging economies: The nexus of green finance, foreign direct investment, financial development, and green technology innovation. *Business Strategy & Development*, 7(4). <https://doi.org/10.1002/bsd2.70008>
 29. Kozar, Ł.J., Sulich, A. (2023a). The Development of Employees' Green Competencies Through Sustainable Business Practices. *Forum Scientiae Oeconomia*, 11(3), 127-143. https://doi.org/10.23762/FSO_VOL11_NO3_7
 30. Kozar, Ł.J., Sulich, A. (2023b). Green Jobs: Bibliometric Review. *International Journal of Environmental Research and Public Health*, 20(4), 2886. <https://doi.org/10.3390/ijerph20042886>
 31. Kupper, H., Laurentzen, R., Mulder, M. (2012). Recent Policy Developments in Green Education in the Netherlands. *The Journal of Agricultural Education and Extension*, 18(2), 121-139. <https://doi.org/10.1080/1389224X.2012.655966>
 32. Le, H.T.P.M., Van Nguyen, P., Stokes, P. (2025). Green influencers and consumers' decoupling behaviors for parasocial relationships and sustainability. A comparative study between Korea and Vietnam. *Journal of Retailing and Consumer Services*, 84, 104256. <https://doi.org/10.1016/j.jretconser.2025.104256>
 33. Li, Y., Wang, B., Saechang, O. (2022). Is Female a More Pro-Environmental Gender? Evidence from China. *International Journal of Environmental Research and Public Health*, 19(13), 8002. <https://doi.org/10.3390/ijerph19138002>
 34. Maksimov, V., Wang, S.L., Yan, S. (2022). Global connectedness and dynamic green capabilities in MNEs. *Journal of International Business Studies*, 53(4), 723-740. <https://doi.org/10.1057/s41267-019-00275-z>
 35. Manalu, S.R., Yusriana, A., Putri, F.K., Budiarsa, Y.T. (2025). *How Gen Z Uses Media:*

- An Exploratory Sequential Mixed-Methods Study BT - Proceedings of the 9th International Conference on Indonesian Social and Political Enquiries (ICISPE 2024)*, 424-437. https://doi.org/10.2991/978-2-38476-436-5_37
36. Mathieu, A. (2024). Bibliometric dataset (1995-2022) on green jobs: A comprehensive analysis of scientific publications. *Data in Brief*, 52, 109845. <https://doi.org/10.1016/j.dib.2023.109845>
 37. Moczydłowska, J.M., Moczydłowska, Z.S., Jeseviciute-Ufartiene, L. (2024). Green Competence Management in the Logistics Services Industry in Poland in the Light of Qualitative Research. *Economics and Environment*, 90(3), 795-795. <https://doi.org/10.34659/eis.2024.90.3.795>
 38. Nurcholis, G., Supriyono, B., Hakim, L., Hermawan, R. (2024). Green Competencies in Shipping Industry: Construct Development and Measurement Validation. *International Journal on Engineering Applications (IREA)*, 12(2), 126. <https://doi.org/10.15866/irea.v12i2.24440>
 39. Olekanma, O., Rodrigo, L.S., Adu, D.A., Gahir, B. (2024). Small- and medium-sized enterprises' carbon footprint reduction initiatives as a catalyst for green jobs: A systematic review and comprehensive business strategy agenda. *Business Strategy and the Environment*, 33(7), 6911-6939. <https://doi.org/10.1002/bse.3846>
 40. Opoku, A. (2019). Biodiversity and the built environment: Implications for the Sustainable Development Goals (SDGs). *Resources, Conservation and Recycling*, 141, 1-7. <https://doi.org/10.1016/j.resconrec.2018.10.011>
 41. Pekez, J., Stojanov, J., Mihajlovic, V., Marceta, U., Radovanovic, L., Palinkas, I., Vujic, B. (2025). The impact analysis of education on raising awareness towards climate change and energy efficiency. *International Journal of Technology and Design Education*, 35(1), 41-60. <https://doi.org/10.1007/s10798-024-09904-7>
 42. Rokochynskiy, A., Mazhayskiy, Y., Volk, P., Yeznah, J., Volchak, A., Meshyk, A., Chernikova, O., Prykhodko, N. (2021). Necessity and ways to increase adaptive potential of dried land in changeable climatic conditions. *Engineering for Rural Development*, 20, 63-73. <https://doi.org/10.22616/ERDev.2021.20.TF015>
 43. Rustam, A., Wang, Y., Zameer, H. (2020). Environmental awareness, firm sustainability exposure and green consumption behaviors. *Journal of Cleaner Production*, 268, 122016. <https://doi.org/10.1016/j.jclepro.2020.122016>
 44. Sakshi, Dhand, S., Singh, J.I.P. (2025). *Balancing Development and Sustainability in Emerging Economies*, pp. 113-131. https://doi.org/10.1007/978-3-031-95103-9_8
 45. Saqib, N., Usman, M., Radulescu, M., Șerbu, R.S., Kamal, M., Belascu, L.A. (2025). Synergizing green energy, natural resources, global integration, and environmental taxation: Pioneering a sustainable development goal framework for carbon neutrality targets. *Energy & Environment*, 36(6), 2966-2990. <https://doi.org/10.1177/0958305X231215319>

46. Sciortino, C., Sgroi, F., Napoli, S. (2025). Greenwashing in the agri-food industry: A discussion around EU policies and the Italian. *Food and Humanity*, 4, 100528. <https://doi.org/10.1016/j.foohum.2025.100528>
47. Shahzad, M., Qu, Y., Rehman, S.U., Zafar, A.U. (2022). Adoption of green innovation technology to accelerate sustainable development among manufacturing industry. *Journal of Innovation & Knowledge*, 7(4), 100231. <https://doi.org/10.1016/j.jik.2022.100231>
48. Sharma, S., Albishri, N., Zafar, H., Singhal, A.B., Singh, G. (2025). Shades of green and transformational leadership: Predicting employees' green creativity and green work engagement at work. *Acta Psychologica*, 259, 105393. <https://doi.org/10.1016/j.actpsy.2025.105393>
49. Stefanova, D., Bacheva, K., Vasilev, V. (2025). Conceptual Convergence: Disinformation, Fake News, and Information Influence as a Triad of Security Threats in the Context of Society 5.0. *Environment Technology Resources - Proceedings of the 16th International Scientific and Practical Conference*, 5, 291-296. <https://doi.org/10.17770/etr2025vol5.8470>
50. Su, X., Han, W., Liu, G., Zhang, Y., Lu, H. (2019). Substantial gaps between the protection of biodiversity hotspots in alpine grasslands and the effectiveness of protected areas on the Qinghai-Tibetan Plateau, China. *Agriculture, Ecosystems & Environment*, 278, 15-23. <https://doi.org/10.1016/j.agee.2019.03.013>
51. Sulich, A., Kozar, Ł.J. (2024a). Green economy and energy: Green labor market elements identification. *Journal of Infrastructure, Policy and Development*, 8(6). <https://doi.org/10.24294/JIPD.V8I6.4953>
52. Sulich, A., Kozar, Ł.J. (2024b). Green competences: A review and future research in the context of green human resource management. *Economics and Environment*, 89(2), 713. <https://doi.org/10.34659/eis.2024.89.2.713>
53. Surono, S. (2025). Establishing Competency Standards of Implementing Green Citizen Skills To Strengthen Employability of Green Jobs. *Asian Journal of Social and Humanities*, 3(5), 1055-1066. <https://doi.org/10.59888/ajosh.v3i5.499>
54. Tahir, A.H., Umer, M., Nauman, S., Abbass, K., Song, H. (2024). Sustainable development goals and green human resource management: A comprehensive review of environmental performance. *Journal of Environmental Management*, 370, 122495. <https://doi.org/10.1016/j.jenvman.2024.122495>
55. Tan, E., Wanganoo, L., Mathur M. (2023). Generation Z, sustainability orientation and higher education implications: An ecopedagogical conceptual framework. *Journal of Applied Learning & Teaching*, 6(1), 314-323. <https://doi.org/10.37074/jalt.2023.6.1.ss2>
56. Tarsitano, E. (2006). Interaction Between the Environment and Animals in Urban Settings: Integrated and Participatory Planning. *Environmental Management*, 38(5), 799-809. <https://doi.org/10.1007/s00267-005-0148-8>

57. Wodnicka, M. (2023). Greenwashing in the context of sustainable development and sustainable consumer choices. *Władza Sądzenia*, 25, 22-36. <https://doi.org/10.18778/2300-1690.25.02>
58. Wu, D., Zuo, X. (2025). Curbing financial Greenwashing: Policy tools, legal mechanisms, and corporate responsibility for sustainable development. *International Review of Economics and Finance*, 103. <https://doi.org/10.1016/j.iref.2025.104480>
59. Wu, Y., Awang, S.R., Ahmad, T. (2025). Leadership styles, employee green behavior, and organizational citizenship behavior for the environment: a systematic literature review. *Environment, Development and Sustainability*. <https://doi.org/10.1007/s10668-025-06573-x>
60. Xian, Y., Wang, H., Zhang, Z., Yang, Y., Zhong, Y. (2025). Driving factors and reduction paths dynamic simulation optimization of carbon dioxide emissions in China's construction industry under the perspective of dual carbon targets. *Environmental Impact Assessment Review*, 112, 107789. <https://doi.org/10.1016/j.eiar.2024.107789>
61. Yuan, D.Y., Chen, S.C., Gao, J., Wang, X.J. (2021). Intervention Algorithm for Distorted Information in Online Social Networks Based on Stackelberg Game. *Computer Science*, 48(3), 313-319. <https://doi.org/10.11896/jsjx.200400079>
62. Zahra, Y., Handoyo, S., Fajrianthi, F. (2025). A comprehensive overview of Generation Z in the workplace: Insights from a scoping review. *SA Journal of Industrial Psychology*, 51. <https://doi.org/10.4102/sajip.v51i0.2263>
63. Zainol Ariffin, Z., Sulaiman, A.J., Bidin, Z., Muhammad Jamil, C. Z. (2023). Green Tax Policy Model: Towards Green Growth Environment. *Compendium by PaperASIA*, 39(6(b)), 1-7. [https://doi.org/10.59953/cpa.v39i6\(b\).47](https://doi.org/10.59953/cpa.v39i6(b).47)
64. Zhang, M., Chen, S., Liu, W. (2023). Disentangling the Complexity of Regional Ecosystem Degradation: Uncovering the Interconnected Natural-Social Drivers of Quantity and Quality Loss. *Land*, 12(7), 1280. <https://doi.org/10.3390/land12071280>
65. Zhao, Z., Gong, Y., Li, Y., Zhang, L., Sun, Y. (2021). Gender-Related Beliefs, Norms, and the Link With Green Consumption. *Frontiers in Psychology*, 12, 710239. <https://doi.org/10.3389/fpsyg.2021.710239>
66. Zhong, J., Shao, X., Xiao, H., Yang, R., An, X. (2025). The research on the green leadership: a systematic review and theoretical framework. *Environment, Development and Sustainability*, Vol. 27, Iss. 1. Springer Science and Business Media B.V., pp. 377-408. <https://doi.org/10.1007/s10668-023-03960-0>

MOBBING IN HUMAN RESOURCE MANAGEMENT TAKING INTO ACCOUNT POST-PANDEMIC CONDITIONS

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Purpose: The main aim of the article is to illustrate the impact of mobbing on the functioning of enterprises, taking into account the impact of the COVID-19 pandemic on companies and society.

Design/methodology/approach: The research approach used in this work included descriptive-qualitative analysis, comparative analysis, non-participant observation and survey techniques based on literature research, internet domains and own research results.

Findings: The study concluded that mobbing may negatively impact work organization, atmosphere and human resources management, and the COVID-19 pandemic contributed to the intensification of this phenomenon and its occurrence in new forms.

Research limitations/implications: The research limitations presented in the paper result mainly from the limited scope of the research – the research was conducted in two companies belonging to the same owner, which may limit the possibility of generalizing the results; moreover, the results are based on the subjective opinions of employees, which may affect their objectivity.

Practical implications: It is possible to use the research results to develop effective anti-mobbing measures and improve human resources management in enterprises, especially in crisis situations such as a pandemic.

Originality/value: The scientific value of the article is based on combining the analysis of the mobbing phenomenon with the context of changes caused by the COVID-19 pandemic and showing its impact not only on individuals, but also on the human resources management system in enterprises.

Keywords: human resource management, pandemic, mobbing.

Category of the paper: Research paper.

Introduction

The main aim of the article is to illustrate the impact of mobbing on the functioning of enterprises, taking into account the influence of the COVID-19 pandemic on companies and society. The paper seeks to highlight the multidimensional nature of the phenomenon, showing

how psychological harassment affects both employees' well-being and the effectiveness of human resource management systems during crisis situations.

The research approach used in this work included descriptive-qualitative analysis, comparative analysis, non-participant observation, and survey techniques based on literature research, internet domains, and the author's own research results. The combination of theoretical and empirical methods made it possible to obtain a comprehensive view of mobbing as both an organizational and social problem.

The study concluded that mobbing may negatively impact work organization, atmosphere, and human resources management, and that the COVID-19 pandemic contributed to the intensification of this phenomenon and its occurrence in new forms. The results are intended to show how remote work, potentially inappropriate supervisory oversight and possible communication barriers influence the emergence of the risk of psychological violence in the workplace.

The research limitations presented in the paper result mainly from the limited scope of the research – the study was conducted in two companies belonging to the same owner, which may restrict the generalization of the results. Moreover, the conclusions are based on the subjective opinions of employees, which may affect their objectivity and require further research on a larger, more diverse sample.

It is possible to use the research results to develop effective anti-mobbing measures and improve human resources management in enterprises, especially in crisis situations such as a pandemic. The findings may also support HR professionals and organizational leaders in designing preventive strategies, training programs, and internal communication policies aimed at reducing mobbing risks.

The scientific value of the article is based on combining the analysis of the mobbing phenomenon with the context of changes caused by the COVID-19 pandemic and showing its impact not only on individuals, but also on the human resources management system in enterprises. The paper contributes to the discussion on post-pandemic management by emphasizing the importance of ethics, empathy, and communication in building healthy organizational cultures.

Human Resource Management

Human resource management (HRM) is described as a strategic and comprehensive approach to managing people within an organization (Armstrong, 2023). The term has been used in English literature since the 1960s, but its widespread use began only in the 1980s. A key characteristic of HRM is that this type of management treats employees as a key resource for the organization's success, rather than as a cost (Oleksyn, 2011).

HRM encompasses processes such as recruitment, employee development, motivation systems, interpersonal relations, organizational culture, and human resource planning (Pocztowski, 2008). The essence of HRM is the alignment of HR activities with the company's strategic goals and the perception of people as value-adding assets.

HRM has four basic functions: planning, organizing, motivating, and controlling (Griffin, 2017). Motivating means consciously influencing employee behavior to increase performance. It can be positive (rewards, vision) or negative (pressure, manipulation). Motivation must be based on clear principles, an understanding of goals, and an ethical approach on the part of management.

Human resources planning is based on competency analysis and workforce optimization. Hiring versatile individuals can provide greater flexibility, but it comes at a higher cost. Therefore, planning must be tailored to the needs and capabilities of the organization.

The onboarding of new employees and their adaptation to the work environment is crucial for their subsequent engagement and identification with the company. This process begins with recruitment and can determine motivation levels and employee turnover.

The concept of organizational culture is directly linked to human resources management. Organizational culture is a set of norms, values, and beliefs that dominate a company. It directly influences employee behavior and their identification with the organization's goals. Ethics, in turn, establishes moral boundaries for both individual and collective actions (Griffin, 2017).

In the context of HRM, the balance between individual freedom and the need to comply with organizational goals is also crucial (Kostera, 2005). Constraints must be rational and acceptable, and their implementation should be based on understanding and dialogue (Obłój, Koźmiński, 1998).

Human resource management is associated with management responsibility – poor decisions in this area can lead not only to financial losses but also to the destabilization of the entire organization (Król, Ludwiczynski, 2006).

Definition and introduction to the concept of mobbing

Mobbing, also known as psychological harassment, refers to persistent, long-term, and repetitive actions intended to humiliate, exclude, or dominate the victim (Mościcka-Tecke, Potocka, 2010; Jachnis, 2019). In an organizational context, this phenomenon negatively impacts employee morale, work quality, and team spirit.

The term "mobbing" was adapted to industrial relations by Heinz Leymann in the 1980s. He defined mobbing as psychological terror in a professional environment that can last for months and lead to profound psychological trauma (Marciniak, 2015). Mobbing often takes

subtle forms: ignoring, malicious comments, attribution for mistakes, exclusion from team communication, and excessive control.

According to the Labor Code, mobbing is defined as persistent harassment of an employee, resulting in humiliation, reduced professional self-esteem, or exclusion from the team. Actions that can be clearly defined as mobbing must meet the following criteria: duration (they must be long-term), repetition (they must occur frequently), and negative intent (the perpetrator's ill will) (Monks, Coyne, 2015). They can be divided into several categories, depending on the effects they have on the victim:

Table 1.
Criteria for behaviors that qualify as mobbing

Category	Behavior
First	Depriving victims of the ability to communicate with others, disrupting the social perception of the victim and discrediting them in their environment by ridiculing, insulting and humiliating them.
Second	Excessive criticism, control, obstructing social contacts leading to isolation of the person, use of gossip and slander, negative commenting on every behavior and every decision.
Third	Creating myths about the victim's professional, private and intimate life.
Fourth	Influencing the quality of life by changing professional tasks in such a way that they become a punishment, omitting promotions, violating a person's physical and mental integrity, and having a harmful effect on health.
Fifth	Violation of the secrecy of correspondence, theft of documents, threats.
Sixth	Excessive criticism, controlling, negative commenting on every action and every decision.
Seventh	Treating any attempt by an employee to defend themselves against attacks as unlawful rebellion.

Source: Monks, Coyne, 2015, p. 175.

Mobbing can be active (destructive and dominating actions) or passive (ignoring, avoiding, lacking support). Individual traits – such as neuroticism, low assertiveness, or strong empathy – may predispose individuals to the victim role, but this does not mean the victim is guilty (Field, 2001). Mobbing perpetrators, on the other hand, often exhibit narcissistic traits, low empathy, a lack of social skills, or a desire for power. Mobbing can take the form of individual-group conflict or internal political infighting within an organization (Gamian-Wilk, 2010).

Mobbing is a process and can occur in four phases (Leymann, 1996):

1. Initial phase – first signs of hostility (e.g. reluctance, minor spite).
2. Escalation phase – open exclusion, ridicule, questioning competence.
3. Advanced phase – the victim experiences isolation and becomes a scapegoat.
4. Apogee – physical violence, harassment or breaking the law may occur.

There are several tactics used by bullies (Zapf, 1999):

1. Isolation – exclusion from communication and social relationships.
2. Obstructing work – concealing information, overloading with responsibilities, disorganization.
3. Humiliation – public ridicule, questioning the employee's value.
4. Intimidation – threats, forced overtime, salary manipulation.

The consequences of bullying are profound and encompass both individual and organizational aspects. For the victim, this means, among other things (Nielsen, Einarsen, 2012; Agervold, Mikkelsen, 2004):

1. chronic stress, depression, psychosomatic disorders,
2. decreased self-esteem, feelings of shame, exclusion and loneliness,
3. post-traumatic stress disorder (PTSD), and in extreme cases – suicide attempts.

The costs of bullying to organizations are significant – not only direct (absenteeism, staff turnover, decreased productivity) but also indirect: deterioration of the organizational climate, reputational damage, and legal and financial risks. It is estimated that a single incident of bullying can cost a company between \$30,000 and \$100,000, depending on the duration and scale of the problem (Namie, Namie, 2009).

Bystanders also suffer from stress, a loss of trust, and the desire to quit. Perpetrators can also experience isolation, anxiety, and psychological distress, especially when formal legal action is taken (Rayner, Hoel, Cooper, 2002).

According to the law, employers are liable for mobbing regardless of whether they were aware of its occurrence (Skiba, 2012). Victims can pursue claims for damages and compensation. However, legal proceedings are difficult and their effectiveness is limited (Sobczyk, 2016).

Counteracting mobbing should be systemic and multi-level. The most important actions include (Tomaszewska, 2009):

1. implementation of an anti-mobbing policy and its publication,
2. providing training for management and employees,
3. creating a safe system for reporting mobbing cases,
4. appointment of an ethics commissioner or mediation committee,
5. promoting a culture of respect and open communication.

Prevention also includes monitoring the workplace climate, responding quickly to conflicts, and building trust between employees. Leaders also play a crucial role – their social skills, empathy, and management style can largely prevent situations that foster psychological violence.

The impact of the COVID-19 pandemic on mobbing and human resources management

The COVID-19 pandemic has disrupted the functioning of social and economic systems worldwide. In response to the sudden crisis, countries have introduced numerous legal changes – both internationally and domestically. In Poland, these included regulations related to remote work, health safety, employment flexibility, and financial support for businesses (Ma, 2020).

The new regulations were intended to ensure business continuity, but in practice, they often created uncertainty and organizational chaos. The lack of clear procedures, frequent regulatory changes, and communication difficulties negatively impacted relationships between employees and management (Szumowski, Pfeffer, 2020). This situation fostered tensions and conflicts, which could escalate to mobbing.

Many Polish companies struggled with reduced productivity, job cuts, downtime, and the need to reorganize work. The implementation of remote work – in many cases without adequate technological and procedural preparation – resulted in a lack of supervision, hindered communication, and increased distrust (Komarzańska, 2024).

According to data from the Central Statistical Office, there was a significant increase in the number of businesses that suspended operations in March and April 2020. In March, there was an increase of 18,239 businesses, while in April there were 20,961 more, for a total of 510,669 suspended businesses. Detailed data is presented in Table 2 - the visible increase in the number of businesses suspending operations can be interpreted as a defensive response to the uncertain economic situation and restrictions introduced by the state.

Table 2.
Changes in the number of business entities

Month/year	The number of national economy entities included in the REGON register		
	Newly registered	Deregistered	Suspended
December 2019	23 789	44 225	448 330
January 2020	35 178	30 698	467 198
February 2020	29 770	17 515	471 469
March 2020	24 337	13 693	489 708
April 2020	14 026	8 060	510 669
May 2020	22 836	8 108	494 500
June 2020	30 683	12 010	478 122
July 2020	31 478	11 341	465 563
August 2020	27 870	10 029	464 330

Source: own study based on ZUS data.

The consequences of the phenomena described above were changes in the labor market, which were manifested, among other things, by a decline in the overall number of jobs. Table 3 presents the number of newly created and liquidated jobs. Analyzing the presented data, it can be observed that in the second quarter there was a negative balance of job growth, with the number of liquidated jobs exceeding the number of newly created jobs by 11,700. This may be evidence of the impact of the pandemic on the labor market. According to research by the Central Statistical Office, job losses due to the spread of COVID-19 occurred almost exclusively in the private sector.

Table 3.*Changes in the number of jobs*

Positioning	Work [thousands]		
	Q4 2019	Q1 2020	Q2 2020
Newly created (A)	114.4	170.6	81.9
Liquidated (B)	61,3	119,9	93,6
Difference (A — B)	+ 53.1	+ 50.7	– 11.7

Source: own study based on ZUS data.

In a work environment that was previously hierarchical and based on face-to-face relationships, the introduction of isolation and remote work could lead to a loss of control over interpersonal processes. Individuals who were not adapted to the new conditions were more vulnerable to marginalization, lack of support, and increased pressure from superiors. These organizational conditions fostered bullying (Wojtczak-Stec, Czarniecka, Schwickert, 2025).

In some industries, this pressure stemmed from excessive expectations placed on employees (e.g., availability outside standard working hours, rapid adaptation to new tools). In others, it stemmed from fear of job loss, which fueled competition and conflict.

The pandemic has highlighted new forms of mobbing – primarily in the virtual space (Kowalska, 2021). Phenomena such as:

1. ignoring emails and online messages,
2. deliberate omission in videoconferencing,
3. imposing too many responsibilities without consultation,
4. lack of technical and organizational support.

The lack of direct contact hindered the identification of mobbing incidents and the effective response from HR departments. In many cases, employees did not know who to report the problem to or feared their complaints would go unanswered.

On the other hand, the pandemic also contributed to a greater awareness of mental health issues in the workplace. There has been increased interest in well-being, emotional support, and burnout prevention. Some companies have taken preventative measures, for example, organizing webinars with psychologists, implementing satisfaction surveys, or creating anonymous communication channels (Juchnowicz, 2020).

RM in the pandemic era has had to undergo a transformation – from traditional, procedural activities to flexible, responsive management in times of uncertainty. Key challenges included (Ulrich, Brockbank, 2020):

1. reorganization of work (including the implementation of remote work),
2. maintaining employee engagement in isolation conditions,
3. ensuring mental and physical safety,
4. dealing with the increasing number of complaints and interpersonal conflicts.

The pandemic has challenged traditional approaches to HRM, forcing companies to seek more empathetic and personalized management methods. Soft skills, communication skills, and crisis management skills have become particularly important.

Lessons learned during this period suggest that effective human resources management in the future requires not only knowledge of procedures but, above all, flexibility, trust, and the ability to create a culture based on respect and collaboration.

Research part – analysis of the impact of mobbing in two enterprises

The aim of the empirical part was to examine the scale and nature of workplace bullying in two companies operating in the same industry, both owned by the same owner. One company employed up to 50 people (retail), while the other employed up to 250 employees (manufacturing). The research also aimed to determine the impact of the COVID-19 pandemic on work organization and the incidence of workplace bullying. An anonymous survey was conducted among 50 employees of both companies, using descriptive and comparative analysis, as well as non-participant observation.

The research questions focused on:

1. the scale of mobbing in the opinion of employees,
2. the types of most frequently reported mobbing behaviors,
3. understanding of the sources of mobbing by the study participants,
4. the impact of mobbing on the atmosphere and work efficiency in the organization.

The majority of respondents were employees with several years of experience (3-10 years) and a diverse range of education (secondary and higher). The survey included both rank-and-file employees and those in specialist and managerial positions. This selection of respondents allowed for a diverse picture of the problem.

The question structure consists of three main sections:

1. Respondent details – questions about gender, education, position, length of service, number of employees at the company, and salary levels.
2. Core questions – supplementary questions about the workplace, manifestations of discrimination, knowledge of the concept of mobbing, its forms, frequency, perpetrators, and effects.
3. The section on considering and addressing management issues – questions about the occurrence of mobbing towards oneself or others, the possibility of failure, the use of collaborative human resources management, and its occurrence in the organization.

The questionnaire contained both closed-ended, single-choice questions (e.g., "How do you assess the atmosphere at work?" – a five-point scale from "hostile" to "very friendly") and multiple-choice questions (e.g., "What manifestations of mobbing occur in the workplace?"). Some questions were semi-open-ended, allowing for the addition of a personal response (e.g., "Other, what?"). Some questions used a frequency scale (e.g., "never", "rarely", "often", "very often", "every day") to assess the recurrence of negative behaviors.

The entire survey comprised approximately 25 questions, including both diagnostic and interpretative questions. The questionnaire's design was consistent with the study's objectives and enabled an analysis of the mobbing phenomenon in the context of companies' operations after the pandemic.

The study confirmed the existence of mobbing in both companies, with the scale and nature of the harassment varying depending on the organizational structure and type of business.

In a manufacturing company (more employees):

1. As many as 63% of employees declared that they had experienced behavior that could be considered mobbing,

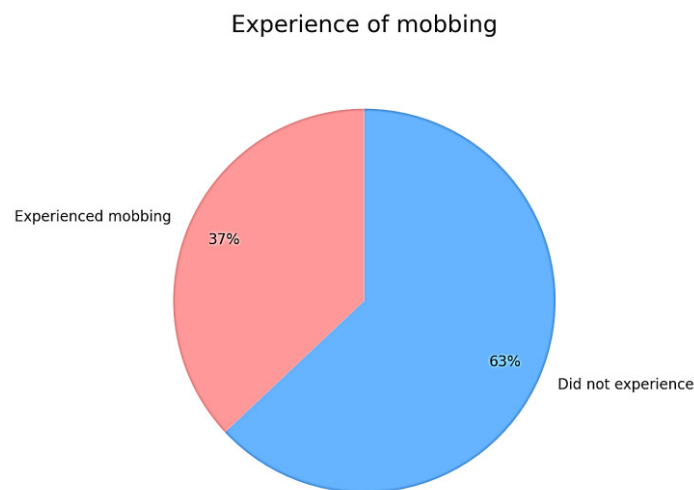


Figure 1. The scale of mobbing in the surveyed enterprises (expressed by the share of a specific group in the entire sample studied).

Source: own study.

2. Most frequently were mentioned: ignoring, excessive control, uneven distribution of responsibilities, omission in communication.

Axe x – percentage of respondents affected by certain form of mobbing

Axe y – forms of mobbing affecting respondents

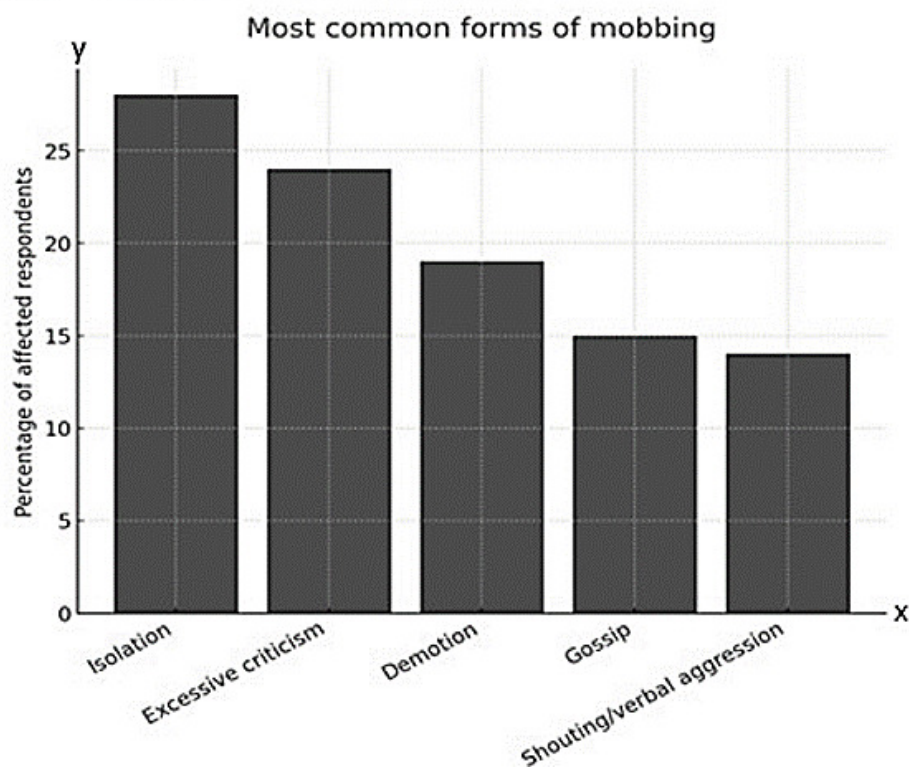


Figure 2. Forms of mobbing occurring in the surveyed enterprises.

Source: own study.

3. Mobbing was more often identified as a systemic phenomenon (e.g. related to organizational culture or management style).

Axe x – the effect of mobbing on the respondent

Axe y – percentage of respondents affected by a certain effect

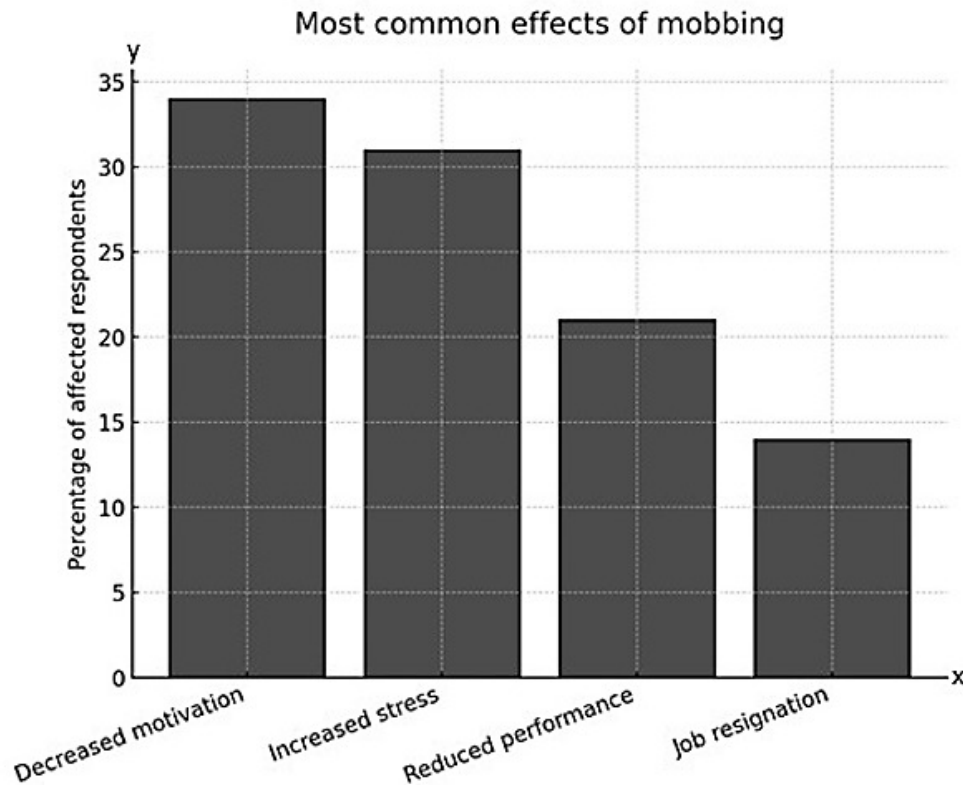


Figure 3. The most common forms of mobbing occurring in the surveyed enterprises.

Source: own study.

4. The pandemic has led to a deterioration of relations, increased tension and uncertainty. In a trading company (smaller scale of operations):
 1. 38% of respondents experienced mobbing behavior,
 2. personal sources of conflict were indicated more often (e.g. individual people – superiors, co-workers),
 3. the impact of the pandemic was less visible, which can be attributed to more direct and flexible communication in smaller teams.

Both groups of respondents admitted that mobbing negatively impacts the work environment, worsens the quality of collaboration, reduces engagement, and increases staff turnover.

Axe x – the frequency of occurrence of mobbing in the entire study sample expressed in %

Axe y – percentage of respondents affected by mobbing

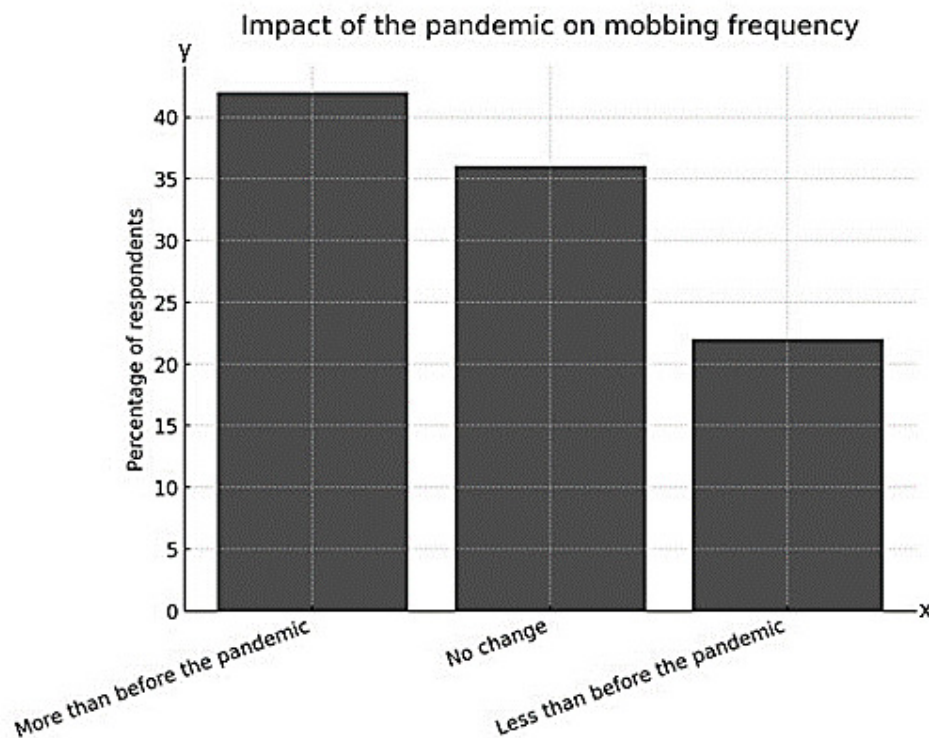


Figure 4. Impact of the COVID-19 coronavirus pandemic on the frequency of mobbing in the surveyed enterprises.

Source: own study

Comparing the two companies, it was noted that larger companies are characterized by greater bureaucracy and difficulties in managing interpersonal relationships, which can contribute to the occurrence of mobbing. In smaller organizations, mobbing is more personal than structural.

The COVID-19 pandemic has acted as a catalyst for negative phenomena, intensifying tensions and exposing shortcomings in communication and personnel management. At the same time, it has demonstrated the importance of building an organizational culture based on trust, empathy, and effective prevention.

Based on the results, several practical conclusions were drawn:

1. the need to develop clear anti-mobbing procedures,
2. the need for training for management staff in the field of communication and work ethics,
3. regular diagnosis of the organizational climate using anonymous surveys,
4. strengthening the role of HR as an active mediator and guardian of ethical values.

Conclusion and findings

This article explores the complex impact of mobbing on organizational functioning and human resources management, taking into account the specific context of the COVID-19 pandemic. Theoretical analysis and empirical research confirm that mobbing is not only an individual problem but also a serious challenge for the entire organizational system.

The phenomenon of mobbing is defined in detail as a form of long-term psychological harassment that negatively impacts an employee's emotional state, health, and professional functioning. A classification of its manifestations, stages of development, and examples of behavior are presented. The psychological characteristics of victims and perpetrators, as well as the environmental conditions that contribute to its occurrence, are also discussed.

The empirical section demonstrates that mobbing affects both large and smaller organizations, although its nature and mechanisms vary depending on the size and organizational culture of the company. Employees of larger companies more often perceive mobbing as a structural element related to the atmosphere and management style, whereas in smaller teams, it is more often the result of interpersonal conflicts.

The COVID-19 pandemic has significantly impacted the dynamics of mobbing. Remote work, limited supervision, lack of support, and deteriorating communication have contributed to increased tensions and a sense of alienation among employees. The phenomenon of mobbing has taken on new, more elusive digital forms, indicating the need to redefine anti-mobbing procedures in the post-pandemic era.

To be effective, human resources management must consider ethical, communicative, and psychological aspects. Not only operational efficiency is crucial, but also an organizational climate, a culture of trust, and proactive counteracting dysfunctional employee relationships.

Based on the analysis carried out, the following practical conclusions were formulated:

1. Mobbing prevention should become an integral element of every organization's HR policy. This includes clear procedures, educational activities, and psychological support.
2. Managing during a crisis like a pandemic requires flexibility, empathy, and openness to employee feedback. Failure to do so can lead to increased disruption.
3. Organizational culture is fundamental – companies with a positive climate of relations, transparent rules and fair treatment are less susceptible to mobbing.
4. The role of HR should evolve towards active conflict management and building support systems, not limited only to administrative procedures.

In summary, mobbing is a destructive phenomenon that impacts not only individuals but also the effectiveness and stability of organizations. Effective human resources management should therefore also include preventative and intervention measures to address psychological violence in the workplace – especially in times of dynamic social and economic change.

References

1. Agervold, M., Mikkelsen, E.G. (2004). *Relationships between bullying, psychosocial work environment and individual stress reactions*. Work & Stress.
2. Armstrong, M. (2003). *Human Resource Management Practice: A Guide to the Theory and Practice of People*, London: Kogan Page, p. 9.
3. Field, T. (2001). *Bully in Sight: How to Predict, Resist, Challenge and Combat Workplace Bullying*. Success Unlimited.
4. Gamian-Wilk, M. (2010). Podmiotowe uwarunkowania podatności na mobbing. In: A. Łukasik, B. Danieluk (eds.), *Spotkania z psychologią społeczną. Part 2* (pp. 179-195), Lublin: Olech.
5. Griffin, R.W. (2017). *Podstawy zarządzania organizacjami*. Warszawa: PWN.
6. Jachnis, A. (2019). *Psychologia organizacji*. Warszawa: Wydawnictwo Akademickie i Profesjonalne.
7. Juchnowicz, M. (2020). *Zarządzanie kapitałem ludzkim w czasach kryzysu: wyzwania pracy zdalnej*. Warszawa: PWE.
8. Kodeks Pracy. Ustawa z dnia 26 czerwca 1974 r., <https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU19740240141/U/D19740141Lj.pdf>, 26.05.2023.
9. Komarzańska, N. (2024). *Mobbing a praca zdalna – stare przepisy, nowe wyzwania*. Olesiński Wspólnicy, <https://olesinski.com/mobbing-a-praca-zdalna-stare-przepisy-nowe-wyzwania/>
10. Kostera, M. (2005). *Antropologia organizacji*. Warszawa: PWE.
11. Kowalska, M. (2021). Mobbing w erze pracy zdalnej: wyzwania i zagrożenia. *Psychologia Organizacji*, 15(3), 45-60.
12. Król, H., Ludwiczynski, A. (2006). *Zarządzanie zasobami ludzkimi. Tworzenie kapitału ludzkiego organizacji*. Warszawa: PWN.
13. Leymann, H. (1996). The content and development of mobbing at work. *European Journal of Work and Organizational Psychology*, 5(2), 165-184.
14. Ma, Y. (2020). The impact of COVID-19 on global governance. *International Journal of Public Law and Policy*, 7(4), 345-358.
15. Marciniak, J. (2015). *Mobbing, dyskryminacja, molestowanie. Przeciwdziałanie w praktyce*. Warszawa: Wolters Kluwer SA.
16. Monks, C., Coyne, L. (2015). *Bullying in Different Context*. Cambridge: Cambridge University Press.
17. Mościcka-Teske, A., Potocka, A. (2010). *Mobbing i jego konsekwencje zdrowotne*. Łódź: Instytut Medycyny Pracy.
18. Namie, G., Namie, R. (2009). *The Bully at Work: What You Can Do to Stop the Hurt and Reclaim Your Dignity on the Job*. Naperville: Sourcebooks.

19. Nielsen, M.B., Einarsen, S. (2012). *Outcomes of exposure to workplace bullying: A meta-analytic review*. Work & Stress.
20. Obłój, K., Koźmiński, A.K. (eds.) (1998). *Zarządzanie przez wartości – w poszukiwaniu tożsamości firmy*. Warszawa: PWE.
21. Oleksyn, T. (2011). *Zarządzanie zasobami ludzkimi w organizacji*. Warszawa: JAK, p. 28.
22. Pocztowski, A. (2008). *Zarządzanie zasobami ludzkimi. Strategie – procesy – metody*. Warszawa: PWE.
23. Rayner, C., Hoel, H., Cooper, C.L. (2002). *Workplace Bullying: What We Know, Who Is to Blame and What Can We Do?* London: Taylor & Francis.
24. Skiba, J. (2012). *Mobbing w pracy. Aspekty prawne i praktyka*. Warszawa: C.H. Beck.
25. Sobczyk, A. (2016). *Prawo pracy*. Warszawa: Wolters Kluwer.
26. Szumowski, F., Pfeffer, J. (2020). *COVID-19 zmienia wszystko – i nic – w zarządzaniu pracownikami*. MIT Sloan Management Review Polska.
27. Tomaszewska, E. (ed.) (2009). *Mobbing w miejscu pracy. Studium interdyscyplinarne*. Warszawa: C.H. Beck.
28. Ulrich, D., Brockbank, W. (2020). *HR Transformation: Building Human Resources from the Outside In*. New York: McGraw-Hill Education.
29. Wojtczak-Stec, D., Czarniecka, K., Schwickert, A. (2025). *Mobbing w nowej odsłonie*. EY, https://www.ey.com/pl_pl/insights/law/mobbing-w-nowej-odslonie
30. Zapf, D. (1999). Mobbing at work: Conceptual and empirical issues. *Journal of Community & Applied Social Psychology*, 9(3), 199-212.

DETERMINANTS OF SUCCESS IN EU FRAMEWORK PROGRAMME PROPOSALS: INSIGHTS FROM EVALUATORS' PERSPECTIVES

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Purpose: This study investigates how evaluators in the European Union's Framework Programmes (Horizon 2020 and Horizon Europe) conceptualise and operationalise success in research proposal assessment. It examines how formal criteria - Excellence, Impact, and Implementation - are interpreted in practice and how evaluative judgments are shaped by scientific, organisational, and human factors.

Design/methodology/approach: The research adopts a qualitative design based on sixteen semi-structured interviews with European Commission evaluators representing diverse scientific disciplines and institutional sectors. Thematic analysis was employed to identify recurrent reasoning patterns and interpretive frameworks underpinning evaluation practices.

Findings: Seven interrelated determinants of success were identified: (1) scientific excellence understood as a composite of conceptual rigour, methodological integrity, and relevance; (2) credible innovation grounded in feasibility; (3) clarity and narrative coherence as mediators of evaluative perception; (4) organisational capacity and distributed leadership; (5) institutional and administrative support as enablers of proposal quality; (6) realistic and traceable societal impact pathways; and (7) the human and ethical dimension of peer review, where fairness and interpretive judgment coexist. Evaluation is thus shown to be a hybrid process - structured yet inherently interpretive.

Research limitations/implications: The study focuses on evaluators' perspectives and should be complemented by applicants' viewpoints and scoring data in future mixed-method research.

Practical implications: Findings provide actionable guidance for applicants, research managers, and policymakers on how to align scientific ambition with feasibility, enhance institutional support systems, and foster ethical and transparent evaluation practices.

Originality/value: This is one of the few qualitative studies to capture evaluators' interpretive reasoning within the EU funding system, revealing how excellence and impact are socially constructed in practice. The findings also provide a structured checklist for proposal authors and research managers to enhance alignment with EC evaluation criteria.

Keywords: Horizon 2020, Horizon Europe, proposal evaluation, research funding, success determinants.

Category of the paper: Research paper.

1. Introduction

The concept of peer review constitutes the cornerstone of modern systems of research evaluation and funding (Hillard, Baber, 2021). It functions simultaneously as a quality assurance mechanism, a process of knowledge legitimisation, and a gatekeeping tool that regulates access to limited scientific resources. Yet despite its central role, surprisingly little is known about how evaluators themselves define and operationalise success in competitive research funding (Arnold et al., 2005; Bornmann et al., 2010; Murray et al., 2016; Oztaysi et al., 2017; Pina et al., 2015; Rodriguez Rincon et al., 2022).

Existing literature on grant evaluation tends to focus on applicants' characteristics - such as institutional capacity, prior experience, or network centrality (Ajdarpašić, Qorraj, 2019; Bol et al., 2018; Boyack et al., 2018a; Smith et al., 2019; Wanzenböck et al., 2020) - rather than on the reasoning processes of evaluators. Studies addressing peer review have highlighted issues of bias, fairness, and cumulative advantage (Bol et al., 2018; Murray et al., 2016; Smith et al., 2019), but they rarely explore how reviewers translate formal criteria - excellence, impact, and implementation - into practical judgments under conditions of uncertainty (Lamont, 2015; Langfeldt, 2021; Langfeldt, Scordato, 2015).

The concept of *excellence*, which formally anchors European research policy, remains particularly elusive. While it is central to EU Framework Programmes, its operational meaning often varies across panels, disciplines, and contexts (Bornmann, Marewski, 2019). Similarly, evaluative dimensions such as *innovation* and *impact* have become policy imperatives, yet their assessment depends heavily on reviewers' interpretive frameworks and experience (Hunter et al., 2021; Sauer, Gabbi, 2019; Veugelers et al., 2015). As a result, the review process is not merely administrative but inherently interpretive - a human practice balancing rational criteria with tacit judgment (Whitley et al., 2010).

Despite the expansion of research on evaluation systems, there remains a notable lack of empirical studies analysing evaluators' perspectives directly. Most existing evidence derives from bibliometric data or applicant surveys (Hörlesberger et al., 2013; Seeber et al., 2022; Wanzenböck et al., 2020), while the reasoning of evaluators - their heuristics, values, and interpretations - remains largely invisible. Understanding these interpretive mechanisms is essential for designing fairer and more effective funding systems, and for strengthening institutional support structures that help researchers navigate evaluation processes.

Therefore, this study aims to explore how European Commission evaluators conceptualise and apply the notion of *success* in the assessment of research proposals under EU Framework Programmes. By examining their narratives, it seeks to identify the implicit determinants that shape positive evaluations - ranging from scientific quality and innovation to communication, feasibility, leadership, and institutional context. Building on an interpretive approach to

research evaluation, the following section outlines the theoretical framework that informs this analysis.

2. Theoretical background

The peer review process has long stood at the centre of modern science as both a mechanism of quality assurance and a gatekeeping system for the allocation of limited research resources. It is the principal means through which academic communities legitimise knowledge, distribute prestige, and define what counts as “excellent” research (Bornmann, 2011; Hillard, Baber, 2021; Lamont, 2015; Laudel, 2006; Whitley et al., 2010). Although peer review is formally framed as an objective and rule-based exercise, a growing body of scholarship has demonstrated that it also operates as an interpretive and socially embedded practice shaped by disciplinary norms, institutional routines, and tacit professional judgments (Bornmann, Marewski, 2019). Within this interpretive perspective, evaluators do not merely measure quality - they construct it. Decisions about which projects deserve funding are therefore not only administrative outcomes but also cultural artefacts of how scientific communities define credibility, feasibility, and innovation.

A central concept in this process is scientific excellence, which serves as the main evaluative currency of research funding systems. However, as multiple studies have shown, the meaning of excellence is fluid, negotiated, and context-dependent (Neufeld et al., 2013; Seeber et al., 2022; van Rijnssoever, Hessels, 2021). While the European Commission presents it as a universal criterion, reviewers interpret it through situated reasoning grounded in their own disciplinary expertise and experience. Excellence tends to be associated with a synthesis of methodological rigour, conceptual clarity, and the feasibility of implementation (Bornmann, Marewski, 2019; Groves et al., 2012). In practice, reviewers translate abstract criteria into concrete judgments - evaluating whether research questions are clearly formulated, whether the proposed methodology is credible, and whether the applicant or institution can realistically deliver on the plan. As Kwiek (2022) and Beaver (2013) argue, excellence in contemporary science has become a distributed attribute - emerging not from individual genius alone, but from the collective competence of teams and institutions. This understanding reflects a broader shift toward organisational models of excellence, in which scientific merit is inseparable from managerial capacity and institutional reliability.

Alongside excellence, innovation and impact have become defining pillars of modern research assessment. Yet both concepts remain notoriously difficult to operationalise. Reviewers are expected to reward originality and societal relevance, but they must also remain sceptical of exaggerated or speculative claims (Veugelers et al., 2015). In the context of EU Framework Programmes, innovation is often interpreted not as radical novelty but as

credible advancement - something that extends existing knowledge, methods, or applications demonstrably (Hunter et al., 2021). Evaluators therefore rely on heuristics that combine creativity with feasibility, judging whether the proposed work offers tangible intellectual or practical progress. Similarly, the notion of impact has evolved from a simple expectation of dissemination to a multidimensional category encompassing social, economic, and policy relevance (Wanzenböck et al., 2020). For reviewers, impact is convincing only when applicants articulate a plausible pathway from research to real-world benefit, supported by concrete actions and stakeholder engagement. As such, “impact” functions not only as a criterion of assessment but also as a rhetorical construct legitimising public investment in science - a way of connecting academic inquiry to societal accountability (D’Este et al., 2018).

Institutional and organisational contexts further shape how evaluation criteria are applied. Research evaluation does not occur in isolation but within institutional environments that structure both expectations and performance. Over the past decade, universities and research organisations have professionalised their support systems - establishing grant offices, pre-award teams, and internal review mechanisms - to enhance proposal quality and compliance (Langley, 2012). Empirical evidence indicates that applicants affiliated with well-resourced institutions benefit from administrative guidance, internal feedback, and language editing, all of which improve clarity and coherence (Vidmar et al., 2018). Moreover, prior experience in international projects or previous coordination roles enhances reviewers’ confidence in feasibility and risk management (Agarwal et al., 2006). These patterns reveal that success in competitive funding environments depends not only on individual intellectual merit but also on collective organisational competence - a synergy between personal expertise and institutional infrastructure. Excellence, therefore, operates at multiple levels: individual, organisational, and systemic.

At the same time, evaluation remains an inherently (Seeber et al., 2022). While assessment procedures are codified through formal templates, scoring systems, and consensus meetings, decision-making ultimately relies on interpretation and judgment. Reviewers draw on professional intuition, empathy, and moral reasoning when faced with ambiguous cases (Lamont, 2015; Langfeldt, 2021). Rather than being sources of bias alone, these subjective dimensions are constitutive features of evaluative practice. They allow reviewers to balance rigour with fairness and to adapt formal rules to the diversity of research cultures and disciplines. describe this as a system of “organised trust”, where credibility and expertise substitute for purely mechanical verification. Recognising this human dimension helps explain why evaluation outcomes cannot be fully predicted by measurable indicators alone: the process is interpretive, communicative, and embedded in social interaction.

Taken together, these insights highlight that peer review in the EU Framework Programmes should be understood as a *hybrid practice* - combining bureaucratic rationality with interpretive flexibility. Evaluators operate within an institutional framework that codifies criteria such as excellence, impact, and implementation, yet they constantly translate these criteria into situated

judgments informed by experience, disciplinary conventions, and contextual awareness. Understanding this interplay is essential for grasping how success is defined and rewarded in European research funding. Accordingly, the present study adopts an interpretive approach, exploring how evaluators themselves conceptualise and apply the notion of success in practice. By analysing their narratives, it reveals how formal evaluation categories are enacted, negotiated, and embodied in everyday decision-making processes (Arnold et al., 2005; Pina et al., 2015; Rodriguez Rincon et al., 2022; Seeber et al., 2021).

3. Methodology

3.1. Research philosophy and approach

This study is grounded in the interpretivist paradigm, which assumes that social reality is constructed through human interaction and meaning-making (Denzin, Lincoln, 2018; Creswell, Poth, 2018). Within this epistemological orientation, the study seeks to uncover how evaluators of the European Commission perceive, interpret, and negotiate their professional judgments in assessing research proposals.

Interpretivism contrasts with positivist approaches by prioritising understanding over measurement. Rather than seeking causal relationships or statistical generalisations, this study aims for depth of insight - capturing the subjective reasoning, heuristics, and evaluative logics of experts operating within institutionalised assessment systems. The research is thus exploratory and inductive, allowing theoretical patterns to emerge from empirical evidence rather than imposing them a priori.

Qualitative inquiry is particularly suited to this purpose. As Braun and Clarke (2006) argue, qualitative approaches enable the exploration of meanings, values, and experiences that cannot be reduced to numerical indicators. Thematic analysis, applied here, offers a systematic framework for identifying shared conceptual structures and the implicit norms underlying evaluators' judgments. It facilitates the interpretation of *how* formalised criteria such as "Excellence", "Impact", and "Implementation" are understood and operationalised in practice.

3.2. Research design

The study employed a qualitative, multi-case design focusing on sixteen evaluators of the European Commission who had participated in reviewing proposals within the Horizon 2020, Horizon Europe) programmes. Each evaluator represented an individual case, enabling both within-case depth and cross-case comparison. This design provided contextual richness while ensuring thematic coherence across cases (Yin, 2014). The aim was not to generalise

statistically but to generate analytical generalisations about evaluative reasoning in competitive funding environments.

Data collection took place in 2023, during the policy transition between Horizon 2020 and Horizon Europe - a period marked by heightened debate over excellence, impact, and innovation. This timing offered a unique opportunity to capture evaluators' reflections on shifting expectations, procedural changes, and emerging challenges in EU research governance.

3.3. Sampling and participants

A purposive sampling strategy was adopted to ensure the inclusion of evaluators with direct and diverse experience in assessing EU research proposals. Two inclusion criteria were applied: (1) documented experience as a reviewer or panel member for EU Framework Programme proposals, and (2) active engagement in research or research management. The interviewed evaluators had experience assessing proposals submitted to various types of actions within the EU Framework Programmes, including Research and Innovation Actions (RIA), Innovation Actions (IA), Coordination and Support Actions (CSA), and Marie Skłodowska-Curie Actions (MSCA).

The final sample comprised sixteen evaluators representing a wide range of scientific disciplines - engineering, natural sciences, life sciences, social sciences, and humanities - and affiliated with universities, research institutes, and private-sector organisations. The participants represented two countries: Spain and Poland. Spain was selected because, at the time of the interviews, it had the largest number of active evaluators registered in the European Commission's databases for the EU Framework Programmes (CORDIS, 2023). Poland was included as the country of residence of the author, which facilitated access to experts and the organization of the interviews. Experience levels ranged from three to over fifteen years of evaluation activity, with several participants having served as panel chairs or rapporteurs. Gender distribution was approximately balanced (nine women and seven men). This heterogeneity enhanced the analytical depth and allowed comparison of perspectives across career stages, disciplinary contexts, and evaluation cultures.

A summary of participants' profiles is provided in Table 1. Respondents' Profile (n = 16). The table provides contextual information on participants' academic degree, institutional affiliation, disciplinary background, type of evaluated action, number of assessed proposals, and average evaluation time per proposal. This profile underpins the interpretation of interview data by highlighting the diversity and representativeness of perspectives captured in the study.

3.4. Data collection

Data were collected through semi-structured interviews conducted online via Microsoft Teams between February and September 2023. The online format allowed for participation from multiple countries and ensured a consistent interview environment. Each interview lasted between 30 and 60 minutes, depending on the participant's availability and depth of discussion.

The semi-structured interview protocol was developed to explore evaluators' experiences and perspectives regarding the assessment of research proposals submitted to the EU Framework Programmes. The interview guide consisted of three core questions:

1. How do you usually approach the evaluation of a research proposal?
2. Which elements or sections of the proposal do you consider most critical in shaping your assessment?
3. In your opinion, what factors most strongly contribute to a proposal being recommended for funding?

The open-ended structure of the questions allowed participants to elaborate on their individual experiences and professional judgments. In line with the semi-structured design, the interviewer posed additional probing and follow-up questions to clarify specific aspects or to deepen understanding, depending on the natural flow of each conversation.

The interview guide was informed by previous research on peer review and grant evaluation processes (Bornmann, 2011; Carpenter et al., 2015; File et al., 2023.; Hillard, Baber, 2021; Langfeldt, 2021; Laudel, 2006; Pina et al., 2021; Recio-Saucedo et al., 2022) and by a systematic literature review of determinants of success in international research funding applications conducted by the author. The final version of the guide was tailored to capture evaluators' reasoning processes and their perceptions of success factors in EU-funded research proposals (Ajdarpašić, Qorraj, 2019, 2020; Bol et al., 2018; Boyack et al., 2018b; Pina et al., 2015, 2021; Seeber et al., 2022; Smith et al., 2019; Wanzenböck et al., 2020).

Interviews were conducted in English or Polish, depending on the participant's preference. Interviews were conducted in English or Polish according to the respondent's preference. All interviews were recorded with informed consent and transcribed verbatim. Transcripts were subsequently cleaned linguistically to remove repetitions, filler expressions, and digressions while preserving tone and meaning. The semi-structured format ensured comparability across cases while allowing the interviewer flexibility to probe deeper into emerging insights.

3.5. Data analysis

Data analysis followed the six-phase model of thematic analysis outlined by Braun and Clarke (2006). This method enables the systematic identification, organisation, and interpretation of patterns within qualitative datasets. The analytical process proceeded through the following stages:

- familiarisation – repeated reading of transcripts to gain an overview of content and context,
- initial coding – generating descriptive and interpretive codes reflecting evaluators' statements,
- theme development – clustering codes into candidate themes based on conceptual similarity,
- reviewing themes – verifying internal consistency and distinctiveness,
- defining and naming themes – formulating the core meaning of each category,
- integrating results – producing the final thematic framework and narrative synthesis.

Coding was carried out manually and with MAXQDA 2022 software, which supported data organisation, memoing, and traceability of analytic decisions. Each transcript was independently coded by two researchers, and discrepancies were resolved through iterative discussion until consensus was achieved. This procedure enhanced inter-coder reliability and conceptual validity.

The final analytical structure consisted of seven overarching themes and twenty-three subthemes, encompassing evaluators' cognitive frameworks, decision-making heuristics, and perceptions of proposal success. These themes are presented in detail in Section 4 (Results).

3.6. Limitations of the methodology

As with any qualitative study, certain limitations must be acknowledged. First, the sample size (16 evaluators) limits the generalisability of findings; however, the aim was depth rather than breadth. Second, interviews rely on self-reported perceptions, which may be affected by recall bias or self-presentation effects. Third, the study did not include direct observation of evaluation meetings or access to actual proposal documents, which could provide additional triangulation.

Nevertheless, these limitations are balanced by the richness of the interview data, the diversity of participants, and the methodological rigour of the analysis. The findings thus offer credible insights into evaluators' sense-making and the informal norms shaping EU research evaluation. In summary, this study adopts a qualitative, interpretive approach to explore how European Commission evaluators conceptualise and enact the criteria of excellence, impact, and implementation in the context of international research proposals. The combination of semi-structured interviews, thematic analysis, and rigorous validation techniques provides a robust empirical foundation for understanding the complex dynamics of peer review in EU research funding.

The next section presents the empirical results - the seven key themes that emerged from the analysis, illustrating the evaluators' reasoning and their perceptions of determinants of success.

Table 1.

Respondents' Profile (n = 16)

Code	Degree	Type of institution	Research field	Type of action	Number of evaluated proposals	Average evaluation time (per proposal)
E1	PhD	university	social science	RIA	100<	1 day
E2	PhD Eng.	university	social science	RIA	100<	1 day
E3	Professor	university	medicine and health science	RIA, MSCA	100<	1 day
E4	PhD Eng.	research institute	science and engineering	RIA, MSCA	100<	1/3 day
E5	PhD Eng.	university	science and engineering	CSA, MSCA	100<	2-2,5 hours
E6	Professor	university	science and engineering	MSCA	100<	4< hours
E7	M. Sc.	other	other	RIA, CSA, SME instrument, Teaming, Twinning	100<	6-10 hours
E8	PhD	university	social science	RIA, MSCA	>100	3 hours
E9	PhD	research institute	science and engineering	MSCA	>100	1-2 days, at least 1 day, MSCA 1/2
E10	Professor	university	arts	CSA, MSCA	>100	2-3 hours
E11	PhD	university	science and engineering	RIA, MSCA	100<	2 days, 10 hours at least
E12	PhD	SME	social science	SME instrument	>100	4-6 hours
E13	M. Sc.	SME	social science	RIA	>100	2-3 hours
E14	Professor	university	biological sciences	SME instrument	100<	3-4 hours
E15	PhD Eng.	research institute	environmental science	SME instrument	100<	1 day
E16	PhD	university	biological sciences	RIA, MSCA	100<	1 day

4. Results

The thematic analysis of sixteen semi-structured interviews with European Commission evaluators revealed a multidimensional understanding of what constitutes success in the EU Framework Programme evaluation process. Rather than a single dominant factor, success was described as the outcome of seven interrelated determinants, encompassing scientific and conceptual excellence, credible innovation, clarity of communication, organisational capacity and leadership, institutional support, societal impact, and the human dimension of evaluation. The results presented below synthesise evaluators' own accounts, supported by illustrative quotations, and are structured around seven thematic determinants identified through thematic analysis.

Each determinant comprises several specific components - such as feasibility, interdisciplinarity, clarity of structure, and leadership quality - that together form a coherent evaluative framework. These components, along with representative quotations and analytical interpretations, are presented in Table 2, which provides a detailed breakdown of the elements underpinning the seven overarching determinants.

4.1. Scientific and conceptual excellence

Evaluators consistently identified scientific excellence as the foundation of any successful proposal. However, they rejected the notion of excellence as a purely abstract or quantitative measure. Instead, it was defined through methodological rigour, conceptual coherence, and clear articulation of research objectives. Proposals that convincingly demonstrated a critical gap in the state of the art, formulated testable hypotheses, and presented a logically structured research plan were seen as inherently strong (see Table 2: Scientific Excellence). As one evaluator noted, *Excellence is not only about the idea; it is about depth, logic, and a credible plan for how to get there* (E6). Another emphasised, *We reward clarity and rigour - not fashion or hype* (E12). This reflects a relational understanding of excellence, in which scientific merit is inseparable from precision, feasibility, and internal coherence - qualities that make complex ideas assessable under time constraints (Lamont, 2015).

4.2. Innovation and originality

A second determinant was innovation, understood not as rhetorical novelty but as credible advancement beyond the current state of knowledge. Evaluators made a clear distinction between *declared* and *demonstrated* innovation (see Table 2: Innovation and Originality). The most competitive proposals substantiated originality through comparative analysis, realistic pathways to implementation, and explicit explanation of why their approach constituted genuine advancement. *Every proposal claims to be innovative. Real innovation changes how we see the problem - not just the tools we use* (E9). Evaluators valued innovation that was bold yet grounded, aligning creative thinking with feasible methodology and relevance to societal or scientific needs. Overstated or speculative claims tended to reduce credibility: *You can feel when innovation is real and when it's just marketing* (E3).

4.3. Clarity, structure, and narrative coherence

A central theme emerging from the interviews was the decisive influence of language and communication quality on how evaluators perceived scientific excellence. Respondents consistently described successful proposals as *clear, concise, and intellectually engaging documents that tell a coherent story*. Beyond the intrinsic quality of ideas, reviewers valued the ability of applicants to present complex concepts in a way that was both *accessible* and *logically structured*.

Several evaluators emphasised that proposals “read like a coherent narrative,” where each section naturally leads to the next, forming a seamless intellectual progression (E3, E8, E12). As one respondent explained, *If the evaluator has to guess what you mean, the proposal loses points* (E8). Clarity was repeatedly described not as a cosmetic virtue, but as a marker of professionalism and respect for the reviewer’s cognitive effort.

Participants noted that the use of discipline-specific jargon should be carefully balanced: it demonstrates expertise but can also alienate reviewers from other fields, particularly in interdisciplinary calls. Overly technical or obscure formulations were perceived as defensive or exclusionary, whereas clear definitions and accessible explanations were associated with intellectual maturity. One evaluator summarised this tension succinctly: *Show that you know the field, but don’t hide behind words*.

The visual organisation of the proposal—tables, diagrams, flowcharts, and Gantt charts—was also praised, not for aesthetic reasons but for their cognitive function. Such elements were said to “anchor” understanding, allowing evaluators to process large volumes of information efficiently under time pressure. Conversely, dense paragraphs, inconsistent formatting, or fragmented arguments generated confusion and undermined trust in the proposal’s overall credibility.

Several interviewees stressed that linguistic and structural precision are integral to the perception of excellence itself, particularly within competitive programmes such as RIA and MSCA, where proposals often differ only marginally in scientific merit. As one evaluator put it: *At the end, all ideas are good, but only some are easy to read*.

4.4. Organizational capacity and leadership

Beyond intellectual merit, the evaluators assessed the consortium’s ability to deliver. Strong proposals balanced expertise and complementarity within the consortium and demonstrated established collaboration. *A strong consortium is about fit, not size* (E1). Leadership emerged as a particularly critical factor: coordinators needed not only academic authority but also project management and interpersonal skills (see Table 2: Consortium and Leadership Quality). *It’s not enough to be a professor - you have to be a communicator and organiser* (E2). Feasibility was interpreted as realism - calibrated objectives, transparent budgeting, and credible risk mitigation. *Better to promise less and deliver more* (E11). Evaluators were sensitive to disproportionate ambitions or vague resource allocations. Projects with clear internal governance structures and well-defined milestones were perceived as more trustworthy and fundable.

4.5. Institutional support and infrastructure

Evaluators consistently highlighted the hidden yet decisive role of institutional environments. Researchers backed by professional support structures - grant offices, project managers, internal reviewers, or legal advisors - tended to produce clearer, more compliant, and ultimately more competitive proposals (see Table 2: Institutional Support and Infrastructure). *Where the researcher stands alone, the proposal often fails. A good research office makes a visible difference* (E13). Such institutional scaffolding reduces administrative burdens, enhances linguistic and formal quality, and ensures internal coherence between sections. These insights suggest that institutional maturity and pre-award professionalisation contribute directly to perceived feasibility and excellence.

4.6. Societal Impact and Policy Relevance

While excellence remains central, evaluators recognised that success increasingly depends on how credibly a proposal articulates its expected societal or policy impact. Effective proposals presented realistic pathways to uptake - through stakeholder engagement, dissemination strategies, or alignment with EU strategic priorities such as the Green Deal and Digital Europe (see Table 2: Societal Impact and Policy Relevance). *Impact is convincing only when you can see the pathway from research to results* (E10).

Evaluators discouraged vague or inflated impact statements, preferring those that specify who benefits, how change occurs, and over what timeframe. Impact, in their view, was meaningful only when grounded in plausible mechanisms of translation from science to society.

4.7. The human and ethical dimension of evaluation

Finally, evaluators acknowledged that assessment is not purely mechanical. Human judgment, intuition, empathy, and professional ethics inevitably shape scoring decisions (see Table 2: Human and emotional factors). *We are humans, not algorithms. Our judgments are interpretive, but we try to be fair* (E15).

Consensus meetings mitigated individual biases but did not eliminate subjectivity. Reviewers described how emotional engagement, narrative persuasiveness, and credibility of tone influenced their perception of proposals. This human dimension, far from undermining objectivity, was seen as essential to interpretive fairness - allowing experts to navigate uncertainty through reflective reasoning and shared deliberation. Taken together, the seven determinants identified by evaluators - scientific and conceptual excellence, credible innovation, clarity of presentation, organisational and leadership capacity, institutional support, societal relevance, and the human dimension of judgment - constitute an integrated model of proposal success in EU Framework Programmes. Rather than isolated variables, these elements form a relational system in which intellectual quality, communication, organisational maturity,

and human interpretation interact to shape evaluative outcomes. The following discussion elaborates on how these dimensions intersect with existing theoretical frameworks and what they imply for research policy and management practice.

Table 2.

Key Determinants of Success in EU Framework Programme Proposals

Determinant (Category)	Illustrative quotes (evaluators' statements)	Analytical interpretation
Scientific excellence	"We do not assess just the idea but its scientific depth and clarity." "Excellence means clear hypotheses and a sound methodology."	Scientific excellence is defined by methodological rigor, coherence, and the ability to justify the project's relevance in its research context.
Innovative approach	"Every proposal claims innovation. Real innovation shows what actually changes." "Sometimes innovation lies not in technology but in a new perspective."	Innovation combines novelty with feasibility, linking creative thinking to concrete scientific or societal impact.
Clarity and logical consistency	"Good proposals read as a coherent story from start to finish." "If reviewers have to guess what the author means, the project loses points."	Logical clarity and well-structured argumentation enable evaluators to follow and trust the applicant's reasoning.
Feasibility and realism	"Most frequent mistake? Too many promises." "Better to promise less and deliver more."	Feasible projects align ambitions with realistic goals, timeframes, and resources.
Consortium quality	"A strong consortium is not the largest but the most complementary one." "Partners with prior collaboration perform better."	Effective consortia show balance, clear division of roles, and established trust.
Leadership competence	"The coordinator is the heart of the project." "It's not enough to be a professor - you must be a manager and a communicator."	Leadership requires not only expertise but also interpersonal and managerial skills essential for sustaining motivation and coherence.
Language and communication quality	"The best proposals read like a story - clear, logical, structured." "We prefer clarity over marketing language."	Clear, engaging language enhances readability and builds trust; writing style is part of scientific excellence.
Visual and structural clarity	"A well-structured proposal signals professionalism." "Visual logic - not decoration - helps us follow complex ideas."	Visual design supports comprehension and demonstrates organizational maturity.
Interdisciplinarity	"The best projects have interdisciplinarity in their DNA." "True integration happens when fields meet to solve a shared problem."	Successful interdisciplinarity emerges from genuine collaboration and integration of methods, not from formal inclusion.
Project management and budgeting	"We value realistic cost plans - not wishful thinking." "You can see immediately who thought through the logistics."	Management quality and realistic budgeting are signs of organizational credibility and maturity.
Institutional reputation	"Trust is a currency in this system." "Experienced institutions increase confidence in delivery."	Institutional reputation supports reliability, credibility, and successful implementation.
Institutional and administrative support	"Researchers in strong institutions are never alone." "Professional project offices make a huge difference."	Institutional assistance in proposal preparation and management improves overall proposal quality.
Human and emotional factors	"We are not machines - sometimes intuition plays a role." "If a proposal engages me, I score it higher."	Evaluation is never purely mechanical; emotional engagement and narrative persuasiveness matter.

5. Discussion

The interviews with sixteen European Commission evaluators revealed that proposal success in EU Framework Programmes results from the interplay of multiple, interdependent determinants. Seven key dimensions emerged from the analysis: scientific and conceptual excellence, innovation grounded in feasibility, clarity and narrative coherence, organisational capacity and leadership, institutional support, societal impact and policy relevance, and the human and ethical dimension of evaluation. These determinants collectively demonstrate that evaluative judgment is not merely technical but interpretive, combining cognitive, communicative, and organisational factors. The quotations presented throughout the section 4 illustrate how evaluators translate formal criteria into situated reasoning, balancing intellectual merit with credibility, feasibility, and fairness. The seven determinants identified in this study reveal that evaluative success in EU Framework Programmes emerges not from any single dimension of performance but from the interplay between intellectual quality, organisational credibility, and communicative effectiveness. These findings confirm that excellence, innovation, and impact - the formal pillars of the evaluation process - are enacted as interpretive practices rather than fixed standards. They also demonstrate that factors traditionally treated as peripheral, such as institutional support or narrative clarity, play a decisive role in shaping reviewers' perceptions of feasibility and trustworthiness.

The following discussion situates these empirical insights within the broader theoretical debates on peer review, research governance, and evaluative cultures. It explores how evaluators' reasoning practices reconfigure the meaning of excellence, impact, and fairness in a complex, transnational funding environment.

5.1. Scientific and Conceptual Excellence

In the context of EU Framework Programmes, the notion of scientific excellence operates less as an absolute benchmark and more as a relational construct, negotiated among evaluators within a multidimensional framework. Interviews revealed that excellence is assessed not as a singular attribute but as a synthesis of conceptual innovation, methodological soundness, and implementation feasibility. This interpretation aligns with research describing excellence as a socially mediated assessment of credibility and potential rather than a purely objective criterion (Bornmann, Marewski, 2019).

Evaluators consistently emphasised that excellent proposals are those which present a clear and significant research question, demonstrate solid theoretical and empirical grounding, and outline a methodologically coherent and achievable plan. In highly competitive EU calls - where success rates often fall below 15% (Horizon Europe - Statistics, 2023) - excellence is understood as readiness to deliver robust, verifiable knowledge within the proposed timeframe.

Accordingly, reviewers value projects that balance ambition with methodological discipline and that clearly articulate why *this project*, by *this team*, at *this time*, deserves to be funded.

A key element of excellence is the strength of the research question. Reviewers repeatedly identified the clarity, novelty, and testability of the central question as decisive. Proposals that framed questions too broadly or relied on speculative assumptions were perceived as weak, regardless of their technical detail. This mirrors evidence showing that flaws in design and hypothesis formulation are among the primary reasons for grant rejection (Gallo et al., 2021; Koppelman, Holloway, 2012). Conversely, a precise, theory-driven question - supported by relevant background data or pilot findings - signals intellectual maturity and increases credibility (Ainsbury et al., 2009; Kan et al., 2021).

Another critical component is methodological rigour. Evaluators viewed detailed, logically structured methods sections as strong predictors of success. They expected applicants to demonstrate familiarity with appropriate techniques, statistical design, and analytical strategies, but also to provide evidence that the proposed approach is feasible and proportionate to the project's aims. These views are also confirmed in the literature (Kaplan, 2012; Arthurs, 2014). Comprehensive risk assessment and contingency planning were particularly valued, as they conveyed preparedness and realism (Chung, Shauver, 2008; Suebtrakul et al., 2020). In contrast, vague descriptions of methodology or overly ambitious timelines were frequently cited as indicators of weak conceptual control.

Excellence also extends to the integration of objectives, methods, and expected outcomes. Evaluators described high-quality proposals as those where every section contributes to a coherent research logic. Well-formulated objectives must be specific, measurable, and achievable, while expected results should directly correspond to them. This structural integrity is seen as evidence of the applicant's analytical competence and their understanding of how the research contributes to wider scientific and societal needs. The inclusion of measurable milestones and realistic deliverables further enhances confidence that the project can achieve its stated aims.

An additional dimension of excellence lies in the scientific and societal relevance of the proposed work. Reviewers seek assurance that the project addresses a meaningful research gap and holds the potential to advance its field or inform policy and innovation agendas. According to the literature, proposals that articulate this dual relevance - scientific and practical - are perceived as more competitive (Hunter et al., 2021; Koppelman, Holloway, 2012). This reflects a broader shift in EU research policy, where excellence encompasses not only intellectual originality but also contribution to societal transformation.

Taken together, these findings point to a composite understanding of excellence built around four interdependent dimensions:

- conceptual innovation – a clear, relevant, and theoretically grounded research problem,
- methodological robustness – rigorous design, adequate data strategy, and realistic feasibility,

- coherence and integration – alignment between aims, methods, outputs, and resources,
- relevance and contribution – significance for both the scientific community and broader societal challenges.

In contemporary EU evaluation practice, excellence thus functions as a holistic indicator of research maturity - where intellectual originality must be matched by methodological integrity and strategic feasibility. It is less a static measure of prestige and more a demonstrated capability to produce credible, high-impact knowledge under real-world constraints.

5.2. Innovation and credibility

In EU Framework Programmes, innovation remains a central evaluative criterion, yet its meaning is far more complex than rhetorical claims of novelty suggest (Andrijauskiene et al., 2021; Europe's Framework Programmes, 2023; Rodriguez et al., 2023). The findings indicate that evaluators interpret innovation as a demonstrable process rather than a declarative label - a synthesis of conceptual advancement, methodological precision, and operational feasibility. This understanding aligns with prior studies showing that reviewers reward *demonstrated* rather than *declared* novelty, valuing projects that clearly show how new approaches, technologies, or perspectives advance the state of the art (Brownson et al., 2015; Chen et al., 2019; Sauer, Gabbi, 2019; Veugelers et al., 2015).

The literature consistently emphasises that innovation must be both credible and feasible. As Groves et al. (2012) note, proposals that overstate novelty without substantive justification risk undermining their own legitimacy. Similarly, evaluators in this study cautioned against speculative claims lacking pilot evidence or methodological control. They distinguished between linguistic innovation - ideas that “sound new” - and empirical innovation - ideas that can be operationalised and verified. As one expert stated, “Innovation has to be visible in the work plan, not only in the rhetoric”. High-scoring proposals embedded novelty throughout their logic: in the problem framing, methodological choices, and expected outcomes.

Innovation also functions as a heuristic of advancement. Reviewers assess whether a project challenges established paradigms, introduces new analytical perspectives, or expands methodological capacity. Proposals that merely extend existing approaches tend to be viewed as incremental, whereas those that shift conceptual or methodological boundaries are perceived as transformative. However, excessive radicalism may reduce credibility - “being too innovative without showing control”, as one evaluator noted, signals risk rather than promise.

The findings confirm that evaluators reward what can be described as responsible innovation - novelty that is ambitious yet auditable, grounded in empirical reasoning, and aligned with broader policy objectives. Technical innovation (e.g., new tools or data techniques) and conceptual innovation (e.g., redefined theoretical frameworks or interdisciplinary syntheses) are equally valued, provided they demonstrate the capacity to reshape understanding rather than merely refine it (Kan et al., 2021). In this sense, innovation

represents a dual construct - epistemic and organisational - requiring both intellectual creativity and structured feasibility.

From a policy and management perspective, this interpretation carries clear implications. Institutional training and internal review systems should focus less on rhetorical “buzzword innovation” and more on helping researchers articulate the *mechanics of novelty*: what precisely is new, why it matters, and how it can be achieved within the project’s scope. In contemporary EU evaluation, innovation has thus evolved from a symbolic marker of excellence into an operational indicator of credibility - convincing reviewers that change is not only desirable but also deliverable.

5.3. Communication and presentation quality

Among the most striking findings of this study is the extent to which evaluators emphasised clarity, coherence, and narrative flow as decisive factors in the success of EU Framework Programme proposals. While the formal evaluation criteria refer to *Excellence*, *Impact*, and *Implementation* (Eligibility and Evaluation Criteria, 2023), interviewees repeatedly underlined that the way in which these dimensions are communicated significantly shapes evaluative judgments. As one expert noted, “Sometimes the science is good, but I cannot follow the story”. This comment encapsulates a central insight of the study: strong ideas can fail if they are not expressed through a coherent and accessible narrative.

The literature provides robust support for this observation. Clear, concise, and logically structured writing facilitates reviewers’ understanding of a project’s objectives, methods, and potential contributions (Groves et al., 2012; Kaplan, 2012; Kwekkeboom, 2014). Given the time constraints under which evaluators operate, linguistic clarity and structural order act as cognitive aids, allowing reviewers to assess complex proposals efficiently and fairly. Studies show that well-organised proposals, written in a professional and reader-oriented manner, tend to receive higher scores than equally strong but poorly communicated ones (Kaplan, 2012; Langille, Mackenzie, 2007).

From the evaluators’ perspective, the most persuasive proposals are those that “tell a story” - explaining why the research matters and how it will achieve its aims. This finding echoes recent scholarship highlighting the rise of *performative writing* in competitive funding systems (van den Besselaar, Mom, 2021). As competition intensifies, applicants are increasingly expected to master rhetorical and structural strategies that make their scientific logic intelligible and compelling. In this context, textual performance becomes part of the evaluative landscape itself: linguistic precision, rhetorical balance, and readability function as indicators of credibility and professional competence.

Evaluators in this study confirmed that successful proposals combine conceptual sophistication with communicative discipline. They frequently described well-written proposals as “feeling professional” and noted that “clarity reflects control”. This perception aligns with Kaplan’s (2012) observation that clarity and confidence in scientific writing signal

mastery of both the research and the process of presenting it. Similarly, Groves et al. (2012) emphasised that visually legible and well-edited applications - with coherent formatting, concise headings, and appropriate graphical aids - enhance the reviewer's engagement and comprehension. By contrast, proposals overloaded with jargon, acronyms, or overly dense layouts were described as "mentally exhausting", often resulting in lower scores even when the scientific content was strong.

The relationship between style, readability, and credibility has also been documented empirically. Even minor linguistic flaws - such as inconsistent terminology or grammatical errors - can disrupt the flow of reading and create doubt about the applicant's attention to detail (Wisdom et al., 2015). Evaluators echoed this point, observing that such lapses "break the rhythm of reading" and "signal carelessness". Clarity thus operates not merely as an aesthetic quality but as an epistemic indicator - a proxy for rigour, organisation, and trustworthiness.

A convergence between empirical and theoretical evidence also emerges in relation to narrative design. Research shows that proposals using narrative techniques - structured sequencing, plain language, or rhetorical emphasis - are more memorable and persuasive to reviewers (Boyack et al., 2018a). Several evaluators expressed a preference for proposals that "read smoothly" and "explain complex concepts in simple terms". However, both literature and practice caution against excessive dramatization or informality. The most effective narrative, as Smith et al. (2019) argue, strikes a balance between technical precision and rhetorical clarity, enabling both specialist and non-specialist reviewers to follow the argument without oversimplification.

Conciseness emerged as another critical dimension of communicative success. Reviewers consistently valued applications that were well structured and free from unnecessary elaboration (Arthurs, 2014; Groves et al., 2012; Kaplan, 2012). Overly verbose or repetitive writing often obscured the core argument, while precise phrasing, short paragraphs, and clear transitions created a sense of focus and confidence. Evaluators highlighted that "less is often more", and that proposals which guide the reader logically - from a compelling abstract to a coherent methodology and realistic outcomes - convey intellectual maturity and professionalism.

Finally, both literature and interviews emphasise that clarity and coherence are not peripheral stylistic features but central determinants of success in competitive research funding. They mediate the relationship between intellectual merit and evaluative perception. A proposal is not merely a collection of sections but a persuasive narrative that must sustain attention and trust. Clarity, therefore, becomes an integral component of excellence itself - the bridge between scientific substance and evaluative understanding. For policy and practice, this implies that training in research communication and writing should be treated as a strategic investment in research quality, not as a supplementary skill.

5.4. Organisational capacity and leadership

The interviews make clear that proposal success in EU Framework Programmes depends not only on the intrinsic merit of the research idea but also - crucially - on the composition, complementarity, and governance of the consortium. This observation echoes a long tradition in research management literature, which shows that teams with the right mix of competencies, credible leadership, and prior collaborative experience are systematically advantaged in competitive evaluations (Groves et al., 2012; Hardavella et al., 2016; Wisdom et al., 2015).

Complementarity and interdisciplinarity were identified as key determinants of success. Evaluators favoured consortia that demonstrated a fit-for-purpose distribution of expertise rather than size or prestige. What convinced reviewers was a transparent mapping between objectives, tasks, and partner capacities - “not a collection of names, but a team that works together,” as one expert put it. This aligns with evidence that interdisciplinary teams integrating diverse competencies - methods, domain knowledge, stakeholder access - are more capable of addressing complex challenges holistically (Turner et al., 2014). Evaluators in this study confirmed that the absence of specific expertise, such as statistical or clinical ownership, undermined credibility even in otherwise strong proposals (Expert 9).

Track record and prior collaboration further shaped evaluative perceptions. Both the literature and interview data indicate that a documented history of joint publications, completed grants, or pilot projects enhances credibility (Agarwal et al., 2006; Turner et al., 2014). Such evidence signals trust, feasibility, and established workflows. Evaluators contrasted ad hoc consortia with those built on prior cooperation, describing the latter as “executable” and “less risky”. Empirical studies similarly show that prior participation in EU projects reduces coordination costs and enhances proposal quality through accumulated relational and procedural capital (Enger, 2018; Nokkala et al., 2011; Vidmar et al., 2018).

Leadership emerged as the second crucial pillar of organisational capacity. Evaluators viewed coordination as a dual competence - combining scientific authority with managerial skill. This finding resonates with policy frameworks (Enger, Castellacci, 2016). Reviewers valued evidence of prior coordination experience, robust communication structures, and internal quality assurance procedures. As one evaluator remarked, “It’s not enough to be a professor; you must be a manager and a communicator”.

Institutional scaffolding also played a decisive role. Strong institutional infrastructures - grant offices, financial units, and data stewardship systems - reinforced reviewers’ trust in a consortium’s ability to deliver (Agarwal et al., 2009). Evaluators noted that such organisational maturity was often visible in coherent budgets, realistic staffing, and clear governance structures. Conversely, when this backbone was missing, proposals were described as “ambitious but not executable”.

Interestingly, both the literature and interviews reveal a nuanced stance toward prestige and reputation, often linked to the “Matthew effect” (Bol et al., 2018; Merton, 1968). While institutional reputation can act as an initial signal of reliability, evaluators emphasised that it is neither necessary nor sufficient for success. Panels reward proposals where excellence is distributed across roles, interfaces, and institutions - where coordination transforms individual brilliance into collective performance.

Finally, the choice of coordinator was recognised as a strategic decision. Acting as both leader and mediator, the coordinator must balance scientific vision with managerial discipline and resource mobilization (ESE, 2023; Valsecchi, 2019). Evaluators highlighted that the most competitive proposals came from institutions combining academic leadership with robust administrative support, sometimes through dual coordination models separating scientific and managerial roles.

Taken together, these insights demonstrate that organisational capacity and leadership constitute a systemic property rather than an individual attribute. Strong consortia are characterised by fit-for-purpose complementarity, prior collaboration, and transparent governance that make execution auditable on the page. For applicants, this implies designing teams around the work rather than prestige, and articulating coordination logic explicitly. For institutions, building leadership and management capacity - through training, mentoring, and procedural support - represents a strategic investment in competitiveness. For policymakers, recognising coordination as a skill and institutional function could enhance fairness and efficiency in EU research evaluation.

5.5. Feasibility and institutional support

Feasibility represents one of the most tangible yet frequently underestimated dimensions of proposal success. While the EU evaluation templates define it under the criterion of “implementation”, evaluators in this study described feasibility as a *discipline of realism* - the ability to translate ambitious research objectives into a credible, manageable, and auditable plan. As one expert noted, “A good proposal is not the one that promises the most, but the one that delivers realistically.” This understanding aligns with prior studies showing that realism in scheduling, budgeting, and risk management strongly predicts positive funding outcomes (Chung, Shauver, 2008; Kaplan, 2012; Suebtrakul et al., 2020).

Interviewees identified several recurring markers of feasibility. Proposals with clear work breakdown structures, traceable resource allocation, and proportionate risk registers were perceived as more trustworthy and professionally managed. Evaluators repeatedly emphasised the value of *traceability* - when every euro and person-month could be logically linked to a task or deliverable. Conversely, inflated cost lines, generic risk tables, or overambitious timelines often signalled weak project control. These insights mirror findings from research management studies that associate detailed planning with organisational credibility and evaluator confidence (Ainsbury et al., 2009; Arthurs, 2014).

Closely intertwined with feasibility is the dimension of institutional support, which evaluators identified as a structural determinant of success. The literature has long noted that competitive research funding depends not only on the applicant's intellectual capacity but also on the organisational ecosystem surrounding them (Holm, Kim, 2010; Langley, 2012). Professional research management and administrative support act as enabling infrastructures, mediating between scientific creativity and bureaucratic accountability (Vidal et al., 2015). Evaluators in this study confirmed that proposals originating from institutions with experienced grant offices and dedicated pre-award teams displayed a markedly higher level of internal consistency. As one evaluator summarised, "Where the researcher stands alone, the proposal often fails. A professional project office makes a visible difference".

Institutional maturity was visible not only in procedural compliance but also in cognitive coherence: well-supported proposals tended to articulate clearer objectives, feasible work plans, and realistic budgets. This reinforces earlier observations that administrative expertise forms part of the *epistemic infrastructure* of science - shaping how ideas are formatted, justified, and rendered credible for peer assessment (Green, Langley, 2009, 2012). However, both evaluators and prior studies acknowledged that such support remains unevenly distributed across Europe. Institutional asymmetries - particularly between long-established Western universities and emerging research centres in Central and Eastern Europe - continue to translate into differential success rates (Vidal et al., 2015).

Taken together, these findings illustrate that feasibility and institutional support function as two sides of the same coin: feasibility represents the project's internal realism, while institutional support provides the external scaffolding that makes realism executable. Success in EU funding competitions thus emerges not only from scientific excellence but also from *organisational literacy* - the ability to design, structure, and resource a project in a way that builds evaluator confidence. From a policy and management perspective, strengthening research offices, investing in training for proposal managers, and fostering knowledge exchange between institutions are essential strategies to reduce structural inequality and enhance overall competitiveness.

5.6. Societal impact and policy relevance

The increasing emphasis on societal impact in EU Framework Programmes reflects a policy shift toward demonstrating the public value of science. However, both the literature and the evaluators interviewed for this study indicate that *impact* remains one of the most ambiguously interpreted criteria in peer review (Bornmann, 2013; Wanzenböck et al., 2020). While formally codified as the second evaluation dimension, its practical assessment relies heavily on reviewers' interpretation of plausibility and credibility rather than rhetorical ambition. As one evaluator summarised, *Impact is convincing only when you can see the pathway from research to results*.

Evaluators consistently reported that the most persuasive impact sections articulated clear pathways connecting research outputs to societal or economic outcomes. They valued logical sequences showing *who benefits, how, and through what mechanisms*. Impact was judged convincing when applicants identified specific beneficiaries, realistic routes to uptake, and measurable indicators of change. This finding corresponds with empirical analyses of successful Horizon 2020 projects, which show that impact narratives grounded in actionable mechanisms - rather than abstract claims - receive higher scores (Wanzenböck et al., 2020; Veugelers et al., 2015).

Interviewees also emphasised that impact is not a one-dimensional construct. They distinguished between direct and indirect effects - for example, technological innovation, policy uptake, or capacity-building - and highlighted that proposals rarely succeed on the strength of visionary statements alone. Instead, evaluators look for credible engagement strategies: stakeholder mapping, co-creation workshops, dissemination plans, and exploitation routes. In their words, “Impact is not what you promise - it’s what you plan to deliver”. This aligns with the literature showing that stakeholder integration enhances not only legitimacy but also implementation success (Langille, Mackenzie, 2007; Bornmann, 2013).

A recurring concern in both the interviews and previous research was the tendency toward “impact inflation.” Evaluators described a pattern where applicants overstate societal or economic benefits to satisfy programme expectations. Such overgeneralised claims, often unsupported by concrete pathways, were perceived as formulaic and unconvincing. As Veugelers et al. (2015) argue, the credibility of impact depends on balancing ambition with feasibility - demonstrating how scientific advances can realistically be translated into usable outcomes. Reviewers in this study confirmed that they reward precision over persuasion: “Better a modest impact that is achievable than a visionary one that cannot be traced”.

Although the overall quality of impact sections has improved across recent Framework Programme cycles, several evaluators noted persistent disparities in how impact is articulated and operationalised across Europe. Proposals originating from less research-intensive regions - particularly Central and Eastern Europe - were sometimes characterised by generic or aspirational descriptions of impact, lacking concrete pathways or stakeholder engagement mechanisms. This observation echoes previous analyses highlighting structural inequalities in research management capacity and institutional support within the European Research Area (Vidal et al., 2015; Langley, 2012). Enhancing professional support and impact literacy in these contexts could therefore play a crucial role in levelling proposal competitiveness across the EU.

Another recurrent theme concerns the alignment of projects with EU strategic priorities (EU Priorities 2024-2029, 2025), including the Green Deal (Green Deal, 2025), Digital Europe (Digital Europe, 2025), and Horizon Europe’s mission-oriented agenda (Horizon Europe, 2025). Evaluators acknowledged that alignment can strengthen a proposal, but only when it emerges organically from the research logic rather than being retrofitted into policy rhetoric. Successful proposals are those that genuinely connect their scientific objectives to European

societal challenges, demonstrating how the research contributes to sustainability, digital transformation, or social resilience.

From a policy and research management perspective, these findings carry several implications. First, impact literacy should become an integral component of researcher training, helping applicants to translate scientific results into societal narratives that are both ambitious and credible. Second, institutional support structures - impact officers, communication specialists, and knowledge brokers - should be embedded within pre-award services to assist researchers in identifying realistic pathways to uptake. Finally, funding agencies could improve transparency and consistency by clarifying evaluative expectations and offering exemplars of effective impact plans.

Taken together, the study shows that societal impact in EU research evaluation is neither purely a scientific nor a political construct - it is a *narrative of translation* connecting knowledge production with public value. Evaluators reward proposals that make this translation visible: those that specify beneficiaries, outline realistic mechanisms of change, and demonstrate alignment with collective priorities. In this sense, the assessment of impact becomes not a test of imagination but a test of plausibility - an appraisal of how convincingly science is positioned to make a difference.

5.7. Human and ethical dimension of evaluation

Peer review is commonly portrayed as a rational, rules-based process, yet evaluators themselves recognise that judgment in science is fundamentally interpretive and moral. As one expert noted, *We are humans, not algorithms. Our judgments are interpretive, but we try to be fair.* This statement encapsulates the central paradox of peer evaluation: while designed as an objective mechanism of quality assurance, it inevitably operates through human perception, experience, and ethical reasoning (Lamont, 2015; Langfeldt, 2021; Whitley et al., 2010).

Across interviews, reviewers openly acknowledged that intuition, empathy, and professional experience shape their decisions, especially in cases where proposals lie at the frontier of knowledge. Under such conditions, evaluators rely on tacit disciplinary understanding and interpretive heuristics - forms of expertise that cannot be fully codified (Bornmann, 2011; Bornmann et al., 2008; Reinhart, 2009). Far from being a flaw, this interpretive dimension enables evaluators to discern coherence, originality, and potential beyond what metrics alone can reveal. In this sense, judgment functions as an epistemic practice rather than a procedural bias.

At the same time, evaluators were acutely aware of the ethical tensions inherent in their role. They described constant efforts to balance fairness across disciplines, genders, and institutional hierarchies, while acknowledging that unconscious biases and social heuristics inevitably intrude. The *Matthew Effect* (Merton, 1968; Bol et al., 2018) - where prestige functions as a shortcut for trust - remains a subtle but persistent undercurrent. Established researchers and elite institutions may benefit from reputational momentum, while newcomers face higher scrutiny despite comparable merit (Enger, Castellacci, 2016; Viner et al., 2004). Such patterns illustrate how systemic inequality can reproduce itself within ostensibly meritocratic procedures.

To mitigate these risks, evaluators highlighted the importance of collective deliberation and transparency. Consensus meetings were seen as spaces where individual biases are moderated through open discussion and where competing interpretations are tested against shared standards. Yet these settings are also social arenas, characterised by persuasion, compromise, and emotion (Lamont, 2015). The process is thus neither purely technical nor fully subjective - it is dialogical. Ethical reflexivity, or the explicit recognition of uncertainty and value judgments, was described as a defining feature of mature evaluation cultures (Langfeldt, Scordato, 2016).

Several evaluators advocated for structured training in bias awareness and reflective judgment, arguing that ethical competence should be treated as part of evaluative professionalism. This view resonates with emerging calls for a “reflexive turn” in research governance, where fairness is pursued not through eliminating subjectivity but through making it visible and accountable (Bornmann, Marewski, 2019).

Ultimately, the findings affirm that the human dimension is both a vulnerability and a source of legitimacy within peer review. Perfect neutrality may be unattainable, but fairness is sustained through dialogue, transparency, and shared responsibility. Evaluation, in this light, becomes not merely a bureaucratic procedure but a moral practice - a collective exercise in maintaining integrity, trust, and justice within the scientific community. Recognising its interpretive and ethical nature does not weaken its authority; it strengthens it by humanising it.

5.8. Alignment of the Seven Determinants with the European Commission Evaluation Criteria

The European Commission formally evaluates proposals in EU Framework Programmes on the basis of three overarching criteria: Excellence, Impact, and Quality and Efficiency of the Implementation. These categories constitute the official architecture of evaluation, framing how proposals are scored and ranked. However, as revealed through the interviews conducted for this study, evaluators’ reasoning extends well beyond the explicit form of these criteria. The seven determinants identified empirically reflect how evaluators *interpret* and *operationalise* the Commission’s framework in practice.

While Excellence remains the most heavily weighted criterion, evaluators' accounts indicate that it is understood relationally rather than purely substantively. In their narratives, excellence is inseparable from *clarity, internal coherence, and communicative precision*. Evaluators emphasised that even a scientifically strong proposal can receive lower scores if it is poorly structured or difficult to follow. Determinants such as *scientific and conceptual excellence, credible innovation, and clarity and narrative coherence* therefore jointly constitute what evaluators consider a multidimensional form of excellence—one that integrates intellectual merit with readability and persuasiveness. This interpretation expands the traditional EC definition, which focuses primarily on scientific quality and innovation potential.

The second criterion, Impact, encompasses how the proposed research is expected to generate benefits beyond academia—social, economic, or policy-related. Yet, in the evaluators' reflections, impact was often assessed not only in terms of measurable outcomes but also as a *narrative of credibility and trustworthiness*. Successful proposals were those that clearly articulated *who benefits, how, and why it matters now*. Determinant six, *societal impact and policy relevance*, aligns with this logic but also reveals the growing demand for *traceable impact pathways* and for emotional resonance: evaluators described being convinced not only by data but by the proposal's sense of purpose. This points to a widening of the EC's official framework toward a more interpretive, human-centred understanding of impact.

The third official pillar, Implementation, focuses on feasibility, governance, and resource management. Evaluators viewed this as both a technical and a relational domain. Determinants such as *organisational capacity and leadership* and *institutional support and infrastructure* correspond directly to the implementation criterion but also highlight what evaluators called the "credibility of coordination". Beyond formal compliance, reviewers valued leadership clarity, prior collaboration experience, and institutional maturity as signals of reliability. In other words, implementation was judged not only on *what* was planned but on *who* would deliver it and *how trustful the system appeared*.

Finally, the seventh determinant—the *human and ethical dimension of evaluation*—does not fit neatly into any single EC criterion. Instead, it cuts across all three. Evaluators spoke of fairness, respect for diversity, and awareness of the ethical context of research as underlying their judgments. This dimension functions as a connective tissue of the evaluation process, shaping interpretive decisions even when not explicitly scored. It also reminds us that excellence and impact are not assessed in a moral vacuum: they are mediated by human perception, professional ethos, and the implicit norms of the scientific community.

Taken together, these findings suggest that evaluators operationalise the EC framework in a *relational and interpretive* manner. Formal criteria provide the scaffolding, but the meaning of excellence, impact, and implementation is co-constructed through communication quality, credibility, and ethical awareness. In this sense, the seven determinants identified in this study do not replace the EC framework; they *translate* it into the lived practice of peer review. Recognising this interpretive layer could help applicants align more effectively with evaluators'

expectations and promote a more transparent and human-centred understanding of research excellence in the European context.

The alignment between the seven determinants and the EC evaluation criteria also allows for the formulation of practical recommendations for future applicants. Drawing on evaluators' testimonies, these insights have been synthesised into a structured checklist that translates conceptual findings into actionable guidance. Table 3 presents this checklist, summarising how each determinant corresponds to the European Commission's evaluation framework and outlining concrete strategies to improve proposal quality and alignment with evaluators' expectations.

Table 3.

Practical implications and checklist for future applicants (based on the seven determinants)

Determinant	EC criterion link	What evaluators expect	Checklist
1. Scientific and conceptual excellence	Excellence	Conceptual rigour, clear objectives, methodological integrity	☐ Define a specific, testable research question ☐ Link objectives to methodology ☐ Include visual schema of the research logic
2. Credible innovation	Excellence / Impact	Novelty grounded in feasibility	☐ Explicitly state what is new and why it matters ☐ Provide evidence or pilot data ☐ Avoid overstatement – show control
3. Clarity, structure, and narrative coherence	Cross-cutting	Clear, concise, and coherent writing	☐ Write for a non-specialist reviewer ☐ Use consistent headings and transitions ☐ Ensure visual clarity and formatting consistency
4. Organisational capacity and leadership	Implementation	Complementarity of partners, coordination ability	☐ Define roles of each partner clearly ☐ Demonstrate previous collaboration ☐ Present governance structure and communication plan
5. Institutional support and infrastructure	Implementation	Administrative maturity and reliability	☐ Mention internal project office / EU support ☐ Show experience in managing EU funds ☐ Describe internal quality assurance procedures
6. Societal impact and policy relevance	Impact	Realistic and traceable pathways to uptake	☐ Identify specific beneficiaries and outcomes ☐ Present concrete dissemination / exploitation actions ☐ Align with EU missions (Green Deal, Digital Europe)
7. Human and ethical dimension of evaluation	Cross-cutting	Fairness, integrity, and interpretive judgment	☐ Maintain transparency and inclusivity ☐ Acknowledge ethical implications ☐ Use responsible research and innovation (RRI) principles

Source: Author's elaboration based on interviews with 16 evaluators and EC evaluation criteria (Horizon Europe, 2023).

6. Conclusion

This study has examined how evaluators within the EU Framework Programmes conceptualise and operationalise success in research proposal assessment. Drawing on sixteen semi-structured interviews, it has revealed that evaluation is not a mechanical exercise of applying formal criteria but a complex interpretive process in which meaning is constructed through professional reasoning, negotiation, and moral judgment. Success emerges from the interplay of intellectual merit, communicative clarity, organisational capacity, and the human dynamics of evaluation.

The findings show that *scientific excellence* is understood as a composite construct, integrating conceptual innovation, methodological rigour, and contextual relevance. *Innovation*, in turn, is valued not for rhetorical novelty but for credible feasibility - the ability to demonstrate change that is both desirable and achievable. Evaluators reward *clarity and coherence* as epistemic indicators of professionalism, viewing well-written and well-structured proposals as reflections of cognitive control. Meanwhile, *organisational capacity* and *institutional support* function as structural enablers of success: strong leadership, realistic planning, and professionalised pre-award services collectively transform good ideas into fundable projects. Finally, evaluators emphasise that *impact* and *ethical judgment* are inseparable from excellence - the former ensures societal legitimacy, while the latter sustains fairness and trust in peer review.

The practical framework proposed in this paper (Table 3) offers a tangible bridge between evaluators' interpretive reasoning and applicants' preparation strategies.

6.1. Theoretical implications

Theoretically, this study contributes to the growing body of work on the sociology of evaluation and interpretive institutionalism (Lamont, 2009; Bevir, Rhodes, 2010). It advances three interrelated propositions. First, evaluation in the EU Framework context operates as a hybrid practice, combining bureaucratic rationality with interpretive flexibility. Reviewers translate abstract criteria into context-sensitive judgments informed by disciplinary norms and experiential heuristics. Second, *excellence* functions as a socially negotiated construct rather than a fixed metric - co-produced through dialogue between evaluators, institutions, and policy frameworks. Third, *impact* acts as both an epistemic and rhetorical category - a narrative device through which scientific work is legitimised in the public sphere. Together, these insights extend existing theories of peer review by situating evaluation within the broader ecosystem of European science policy, where knowledge production, governance, and legitimacy intersect.

6.2. Practical implications

From a policy and research management perspective, the study underscores the importance of developing systemic support for excellence as a distributed property. For institutions, this means professionalising research management, investing in pre-award offices, and training staff in both administrative compliance and narrative communication.

For researchers, the findings highlight the need to cultivate “evaluation literacy”: the ability to articulate ideas clearly, align ambition with feasibility, and translate novelty into credible pathways for implementation and impact. As summarised in Table 3, the proposed checklist translates evaluators’ insights into actionable guidance for future applicants.

For funders and policymakers, the results point to the value of clearer guidance on evaluative expectations, bias-awareness training for reviewers, and greater transparency in panel deliberations. Such measures would not only enhance proposal quality but also promote fairness, consistency, and inclusivity across the European Research Area.

6.3. Methodological reflection

Methodologically, this research demonstrates the value of qualitative inquiry in a domain dominated by quantitative metrics. By eliciting evaluators’ own narratives, it uncovers the tacit reasoning that underpins peer review decisions - reasoning often invisible in scoring data. Future studies could build on this approach by combining textual analysis of proposals with panel observation or comparative studies across funding schemes, further illuminating how formal criteria are translated into interpretive practice.

In sum, evaluation in the EU Framework Programmes should be understood not merely as an administrative control mechanism but as a *social practice of judgment* - one that balances rigour with empathy, ambition with realism, and individual excellence with collective responsibility. Recognising this dual nature of evaluation offers a more human, transparent, and ultimately more just foundation for the governance of science.

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References

1. Agarwal, R., Chertow, G.M., Mehta, R.L. (2006). Strategies for successful patient oriented research: why did I (not) get funded? *Clinical Journal of the American Society of Nephrology*, 1(2), 340-343.
2. Ainsbury, E.A., Cassidy, A., Downey, F., Hartline, B.K., Lin, J.G., McCray, C., Dawson, S.P., Horton, R.K., Kaicher, C.M. (2009). Successful proposals, fund raising, and project leadership. *AIP Conference Proceedings*, 16-19.
3. Ajdarpašić, S., Qorraj, G. (2019). Does university performance matter for EU programmes in South East Europe: Case study Horizon 2020. *Management - Journal of Contemporary Management Issues*, 24(2), 1-10.
4. Ajdarpašić, S., Qorraj, G. (2020). The impact of the EU programs in the Western Balkans. *InterEULawEast*, 7(1), 65-88.
5. Andrijauskiene, M., Dumciuviene, D., Stundziene, A. (2021). EU framework programmes: positive and negative effects on member states' innovation performance. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 16(3), 471-502.
6. Arnold, E., Clark, J., Muscio, A. (2005). What the evaluation record tells us about European Union Framework Programme performance. *Science and Public Policy*, 32(5), 385-397.
7. Arthurs, O.J. (2014). Think it through first: questions to consider in writing a successful grant application. *Pediatric Radiology*, 44(12), 1507-1511.
8. Beaver, D. (2013). The many faces of collaboration and teamwork in scientific research: Updated reflections on scientific collaboration. *Collnet Journal of Scientometrics and Information Management*, 7(1).
9. Bol, T., De Vaan, M., Van de Rijdt, A. (2018). The Matthew effect in science funding. *Proceedings of the National Academy of Sciences of the United States of America*, 115(19), 4887-4890.
10. Bornmann, L. (2011). Scientific peer review. *Annual Review of Information Science and Technology*, 45(1), 197-245.
11. Bornmann, L., Marewski, J.N. (2019). Heuristics as conceptual lens for understanding and studying the usage of bibliometrics in research evaluation. *Scientometrics*, 120(2), 419-459.
12. Bornmann, L., Leydesdorff, L., Van den Besselaar, P. (2010). A meta-evaluation of scientific research proposals: Different ways of comparing rejected to awarded applications. *Journal of Informetrics*, 4(3), 211-220.
13. Bornmann, L., Wallon, G., Ledin, A. (2008). Does the committee peer review select the best applicants for funding? *PLoS ONE*, 3(10).
14. Boyack, K.W., Smith, C., Klavans, R. (2018). Toward predicting research proposal success. *Scientometrics*, 114(2), 449-461.

15. Braun, V., Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
16. Brownson, R.C., Colditz, G.A., Dobbins, M., Emmons, K.M., Kerner, J.F., Padek, M., Proctor, E.K., Stange, K.C. (2015). Concocting that magic elixir: Successful grant application writing in dissemination and implementation research. *Clinical and Translational Science*, 8(6), 710-716.
17. Carpenter, A.S., Sullivan, J.H., Deshmukh, A., Glisson, S.R., Gallo, S.A. (2015). A retrospective analysis of the effect of discussion in teleconference and face-to-face scientific peer-review panels. *BMJ Open*, 5(9).
18. Chen, K., Zhang, Y., Fu, X. (2019). International research collaboration: An emerging domain of innovation studies? *Research Policy*, 48(1), 149-168.
19. Chung, K.C., Shauver, M.J. (2008). Fundamental principles of writing a successful grant proposal. *Journal of Hand Surgery*, 33(4), 566-572.
20. CORDIS, European Commission (2023). Retrieved from: <https://cordis.europa.eu/>, 09.2025.
21. Creswell, J.W., Poth, C.N. (2018). *Qualitative Inquiry and Research Design*. CA: SAGE Publications. Retrieved from: <https://uk.sagepub.com/en-gb/eur/qualitative-inquiry-and-research-design/book266033>, 09.2025.
22. D'Este, P., Ramos-Vielba, I., Woolley, R., Amara, N. (2018). How do researchers generate scientific and societal impacts? Toward an analytical and operational framework. *Science and Public Policy*, 45(6).
23. Denzin, N.K., Lincoln, Y.S. (2018). *The Sage handbook of qualitative research [El manual SAGE de investigación cualitativa]*. CA: SAGE Publication.
24. *Eligibility and evaluation criteria - H2020 Online Manual* (2020). Retrieved from: https://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/from-evaluation-to-grant-signature/evaluation-of-proposals/elig_eval_criteria_en.htm, 09.2025.
25. Enger, S.G. (2018). Closed clubs: Network centrality and participation in Horizon 2020. *Science and Public Policy*, 45(6), 884-896.
26. Enger, S.G., Castellacci, F. (2016). Who gets Horizon 2020 research grants? Propensity to apply and probability to succeed in a two-step analysis. *Scientometrics*, 109(3), 1611-1638.
27. *EU Missions in Horizon Europe - Research and Innovation* (2025). Retrieved from: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe_en, 09.2025.
28. *Europe's Framework Programmes – a key element of research policy in Europe. Research and Innovation* (2023). Retrieved from: <https://projects.research-and-innovation.ec.europa.eu/en/horizon-magazine/europes-framework-programmes-key-element-research-policy-europe>, 09.2025.

29. *European Union priorities 2024-2029 - European Union* (2025). Retrieved from: https://european-union.europa.eu/priorities-and-actions/eu-priorities/european-union-priorities-2024-2029_en, 09.2025.
30. *Europejski Zielony Ład - Komisja Europejska* (2025). Retrieved from: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_pl, 09.2025.
31. File, J., Holm-Nielsen, L.B., Marklund, G., Melin, G., Naczinsky, C., Puukka, J., Winckler, G., Ziarko, W., (2023). *Poland's higher education and science system: Horizon 2020 Policy Support Facility: peer review*. European Commission. Directorate-General for Research and Innovation.
32. Gallo, S.A., Schmalings, K.B., Thompson, L.A., Glisson, S.R. (2021). Grant review feedback: Appropriateness and usefulness. *Science and Engineering Ethics*, 27(2).
33. *Getting ready to apply for Horizon Europe. ESE* (2023). Retrieved from: <https://www.es-hormones.org/research/european-research-funding/your-funding-journey/getting-ready-to-apply-for-horizon-europe/>, 09.2025.
34. Green, J., Langley, D. (2009). Professionalising research management. *Research Global*, 6-7. Retrieved from: <https://arma.ac.uk/wp-content/uploads/2021/08/Professionalising-research-management.pdf>, 09.2025.
35. Groves, P.S., Rawl, S.M., Wurzbach, M.E., Fahrenwald, N., Cohen, M.Z., Beckett, D.O., Zerwic, J., Given, B., Algase, D.L., Alexander, G.L., Conn, V. (2012). Secrets of successful short grant applications. *Western Journal of Nursing Research*, 34(1), 6-23.
36. Hardavella, G., Karampini, E., Jacinto, T., Saad, N.J. (2016). Doing science: How to submit a successful funding application. *Breathe (Sheffield, England)*, 12(1), 73-77.
37. Hillard, T., Baber, R. (2021). *Peer review: The cornerstone of scientific publishing integrity*. Retrieved from: <https://doi.org/10.1080/13697137.2021.1882140>, 09.2025.
38. Holm, K., Kim, M.J. (2010). Writing research grants: An overview of the process. *Journal of Nursing Regulation*, 1(3), 20-22. Retrieved from: www.journalofnursingregulation.com, 09.2025.
39. *Horizon 2020 – statistics* (2020). Retrieved from: <https://webgate.ec.europa.eu/dashboard/sense/app/93297a69-09fd-4ef5-889f-b83c4e21d33e>, 09.2025.
40. Hörlesberger, M., Roche, I., Besagni, D., Scherngell, T., François, C., Cuxac, P., Schiebel, E., Zitt, M., Holste, D. (2013). A concept for inferring “frontier research” in grant proposals. *Scientometrics*, 97(2), 129-148.
41. Hunter, C.J., Goldstein, A.M., Locke, J., Cho, C.S., Gosain, A. (2021). Significance and innovation: Cornerstones of a successful grant application. *Surgery (United States)*, 170(4), 1080-1082.
42. Kan, P., Mokin, M., MacK, W.J., Starke, R.M., Sheth, K.N., Albuquerque, F.C., Levitt, M.R. (2021). Strategies for writing a successful National Institutes of Health grant proposal

- for the early-career neurointerventionalist. *Journal of NeuroInterventional Surgery*, 13(3), 283-286.
43. Kaplan, K. (2012). Funding: Got to get a grant. *Nature*, 482, 429-431. Retrieved from: www.naturejobs.com, 09.2025.
 44. Koppelman, G.H., Holloway, J.W. (2012). Successful grant writing. *Paediatric Respiratory Reviews*, 13(1), 63-66.
 45. Kwekkeboom, K.L. (2014). Overview and tips for successful grant writing for infusion nurses. *Journal of Infusion Nursing*, 37(5), 371-378.
 46. Kwiek, M. (2022). *Globalna nauka, globalni naukowcy*. Warszawa: PWN.
 47. Lamont, M. (2015). *How Professors Think*. Cambridge, MA: Harvard University Press.
 48. Langfeldt, L. (2021). *The many dilemmas of grant peer review*. Retrieved from: www.r-quest.no, 09.2025.
 49. Langfeldt, L., Scordato, L. (2015). Assessing the broader impacts of research: A review of methods and practices. *Sociology*.
 50. Langille, L., Mackenzie, T. (2007). Navigating the road to success: A systematic approach to preparing competitive grant proposals. *Evidence Based Library and Information Practice*, 2(1), 23-31.
 51. Langley, D. (2012). Research management and administration: A reflection of where we are and where we need to go as a profession. *Perspectives: Policy and Practice in Higher Education*, 16(3), 71-76.
 52. Laudel, G. (2006). Conclave in the Tower of Babel: How peers review interdisciplinary research proposals. *Research Evaluation*, 15(1), 57-68.
 53. Merton, R.K. (1968). *Social Theory and Social Structure*. New York: The Free Press.
 54. Murray, D.L., Morris, D., Lavoie, C., Leavitt, P.R., MacIsaac, H., Masson, M.E.J., Villard, M.A. (2016). Bias in research grant evaluation has dire consequences for small universities. *PLoS ONE*, 11(6).
 55. Neufeld, J., Huber, N., Wegner, A. (2013). Peer review-based selection decisions in individual research funding: The case of the ERC Starting Grants. *Research Evaluation*, 22(4), 237-247.
 56. Nokkala, T., Heller-Schuh, B., Paier, M. (2011). *Ranking lists and European Framework Programmes. In Public Vices, Private Virtues? Assessing the Effects of Marketization in Higher Education*, 111-139. Dordrecht: Springer.
 57. Oztaysi, B., Onar, S.C., Goztepe, K., Kahraman, C. (2017). Evaluation of research proposals for grant funding using interval-valued intuitionistic fuzzy sets. *Soft Computing*, 21(5), 1203-1218.
 58. Pina, D.G., Buljan, I., Hren, D., Marušić, A. (2021). A retrospective analysis of the peer review of more than 75,000 Marie Curie proposals between 2007 and 2018. *ELife*, 10, 1-12.

59. Pina, D. G., Hren, D., Marušić, A. (2015). Peer review evaluation process of Marie Curie Actions under EU's seventh framework programme for research. *PLoS ONE*, 10(6).
60. Recio-Saucedo, A., Crane, K., Meadmore, K., Fackrell, K., Church, H., Fraser, S., Blatch-Jones, A. (2022). What works for peer review and decision-making in research funding: A realist synthesis. *Research Integrity and Peer Review*, 7(1).
61. Reinhart, M. (2009). Peer review of grant applications in biology and medicine: Reliability, fairness, and validity. *Scientometrics*, 81(3), 789-809.
62. Rodriguez Rincon, D., Feijao, C., Stevenson, C., Evans, H., Sinclair, A., Thomson, S., Guthrie, S. (2022). *Study on the proposal evaluation system for the EU R&I framework programme: Final report*. Brussels: European Commission.
63. Rodriguez Rincon, D., Feijao, C., Stevenson, C., Evans, H., Sinclair, A., Thomson, S., Guthrie, S., European Commission. Directorate-General for Research and Innovation., & RAND Europe (2023). *Study on the proposal evaluation system for the EU R&I framework programme: Final report*. Brussels: European Commission.
64. Sauer, R.M., Gabbi, C. (2019). Grantsmanship writing tips: Significance, innovation and impact. *European Journal of Internal Medicine*, 65, 26-28.
65. Seeber, M., Alon, I., Pina, D.G., Piro, F.N., Seeber, M. (2022). Predictors of applying for and winning an ERC Proof-of-Concept grant: An automated machine learning model. *Technological Forecasting and Social Change*, 184.
66. Seeber, M., Vlegels, J., Reimink, E., Marušić, A., Pina, D.G. (2021). Does reviewing experience reduce disagreement in proposals evaluation? Insights from Marie Skłodowska-Curie and COST Actions. *Research Evaluation*, 30(3), 349-360.
67. Smith, C., Boyack, K., Klavans, R. (2019). *Toward predicting proposal success: An update*. ISSI 2019 Proceedings, 770-781. Retrieved from: <https://www.researchgate.net/publication/338434681>, 09.2025.
68. Suebtrakul, S., Adams, P., Vutikes, P., Titapiwatanakun, B., Kaewkungwal, J. (2020). Perceptions of successful domestic and international research grant applications among experienced and novice researchers. *Journal of Health Research*, 35(6), 527-539.
69. *The Digital Europe Programme. Shaping Europe's digital future* (2025). Retrieved from: <https://digital-strategy.ec.europa.eu/en/activities/digital-programme>, 09.2025.
70. Turner, S., Davidson, P., Stanton, L., Cawdeary, V. (2014). Features of successful bids for funding of applied health research: A cohort study. *Health Research Policy and Systems*, 12(1).
71. Valsecchi, V. (2019). Horizon 2020 – European research funding. *Nuovo Cimento Della Societa Italiana Di Fisica C*, 42(4).
72. van den Besselaar, P., Mom, C. (2021). *Writing style and research grant success – a linguistic analysis*. Retrieved from: <https://www.researchgate.net/publication/348522864>, 09.2025.

73. van Rijnsoever, F.J., Hessels, L.K. (2021). How academic researchers select collaborative research projects: A choice experiment. *Journal of Technology Transfer*, 46(6), 1917-1948.
74. Veugelers, R., Cincera, M., Frietsch, R., Rammer, C., Schubert, T., Pelle, A., Renda, A., Montalvo, C., Leijten, J. (2015). The impact of Horizon 2020 on innovation in Europe. *Intereconomics*, 50(1), 4-30.
75. Vidal, S., Laureano, R., Trindade, M. (2015). Assessing the impact of grant managers on the success of grant applications. *Perspectives: Policy and Practice in Higher Education*, 19(3), 84-91.
76. Vidmar, U., Jezikov, P., Tina, S.P., Vukasović, V. (2018). Identifying elements for a successful approach to applying projects. *International Journal of Management, Knowledge and Learning*, 7(2), 217-243. Retrieved from: www.issbs.si/press/ISSN/2232-5697/7_217-243.pdf, 09.2025.
77. Viner, N., Powell, P., Green, R. (2004). Institutionalized biases in the award of research grants: A preliminary analysis revisiting the principle of accumulative advantage. *Research Policy*, 33(3), 443-454.
78. Wanzenböck, I., Lata, R., Ince, D. (2020). Proposal success in Horizon 2020: A study of the influence of consortium characteristics. *Quantitative Science Studies*, 1(3), 1136-1158.
79. Whitley, R., Gläser, J., Engwall, L. (2010). *Reconfiguring Knowledge Production: Changing Authority Relationships in the Sciences and Humanities*. Oxford: Oxford University Press.
80. Wisdom, J.P., Riley, H., Myers, N. (2015). Recommendations for writing successful grant proposals: An information synthesis. *Academic Medicine*, 90(12), 1720-1725.
81. Yin, R.K. (2014). *Case Study Research: Design and Methods (5th ed.)*. CA: SAGE Publications.

EFFICIENCY OF ELECTROMOBILITY IMPLEMENTATION INTO EUROPEAN PUBLIC PASSENGER TRANSPORT IN 2019-2023

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Purpose: The article identifies countries that are influencing the implementation of electromobility in bus transport. The second objective is to assess the impact of macroeconomic factors contributing to the aforementioned influence.

Design/methodology/approach: The first objective is based on the utilisation of the DEA (Data Envelopment Analysis) method and the second one on the estimation of the parameters of a panel probit model.

Findings: The study identified a group of European countries that have achieved a notable level of success in electromobility implementation for bus transport. Some of them have assumed the role of influence leaders for other countries. The real GDP per capita and the difference between the income from taxes on environmental pollution for a given year and the previous year are the macroeconomic factors that were significant in becoming an influence leader.

Research limitations: The study considered the sole appearance of the effective DMU in the benchmarking formula. Future research should evolve to apply a procedure for determining the target share of inputs in a target technology based on the inputs “contributed” to the target technology by the benchmark DMU.

Practical implications: The panel model allows us to formulate scenarios in which the probability of a country's status changing from zero to one and becoming an influence leader can be affected by a predetermined change in the value of the explanatory variables. In this way, the government will be able to plan its policy for developing e-mobility in public transport.

Social implications: The government measures mentioned above may contribute to the development of sustainable public transport. This will enhance the quality of life in urban areas and alleviate pressure on the environment.

Originality/value: We present a novel approach to using benchmarking formulas from the DEA method to create binary variables and then using them in a panel probit model.

Keywords: DEA method, electromobility, public transport, panel data.

Category of the paper: Research paper.

1. Introduction

For more than a dozen years, electromobility has been undergoing intensive development. This transformation of transportation is expected to improve the environment and the living conditions of the population, because electric vehicles emit far fewer greenhouse gases and air pollutants than vehicles powered by traditional engines. The European Union's (EU) climate policy supports the development and large-scale implementation of electromobility using regulations and financial encouragements. Two packages of EU's initiatives are most associated in the media space: European Green Deal announced in 2019 and the Fit for 55 announced in 2021, which was supposed to incorporate the European Green Deal's climate goals into concrete law regulations. The new legislation covers virtually every area of the EU's activities and is expected to lead to climate neutrality by 2050. The planned transformation also includes public transportation. Thus, among other things, it was announced a reduction of the use of fossil fuels in transportation and a reduction of greenhouse gases emissions. Carbon dioxide emissions from passenger cars should be decreased by 37.5% by 2030 compared to 2021, while a 31% reduction was assumed for commercial vehicles.

Electromobility has become an integral part of many countries' sustainable development strategies. The comprehensive nature of the plans made obviously affects public transportation. "White Paper. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system", from 2011, has already drawn attention to urban transportation. Fleets of buses, taxi cars and vans have been identified as particularly suitable for the introduction of alternative powertrains and fuels. In this article, we will focus specifically on electric-powered public transportation vehicles.

Research on the electrification of public transport is clearly less prevalent than research on individual electromobility. Meanwhile, public transport, especially urban transport, is instrumental in achieving sustainable development goals. We have identified a research gap in the field of electromobility implementation in European public transport. The effectiveness of this implementation has not yet been thoroughly analysed, and there is a need for models to support policies that promote this specific aspect of electromobility.

European countries differ in their involvement and effectiveness in implementing both individual and mass electromobility. This is the result of several different factors. For this reason, some countries are doing better than others and it is possible to identify a leader or leaders in the process of implementing electromobility in transport. The activities of a market leader entail the emergence of followers. In public space, some countries are identified as those that are considered to be leaders in the implementation of electromobility. The suggestion that other countries should follow these leaders usually comes next. The leader-follower relationship is the starting point of our considerations. The possession of followers is not a prerequisite for success. Sometimes it is simply impossible to repeat the achievements of

a top-performing individual, which may result in a lack of subsequent followers. Therefore, we will identify a special category of “influence leader” who has followers, as opposed to a leader in the classical sense. Given the above considerations, two goals were formulated:

1. Identification of countries that are influence leaders of electromobility implementation in bus transport. This will be achieved by comparing the efficiency of the process.
2. The direction and strength of influence of macroeconomic factors contributing to the leadership in the implementation of electromobility in public transport will be then studied.

Our study is significant for two primary reasons. Firstly, it identifies benchmarks thanks to DEA method. Secondly, it demonstrates how a given country can enhance the effectiveness of its implementation of electromobility. The author's methodological contribution is a proposal for a three-stage analysis combining benchmarking with the DEA method and the estimation of probit panel models.

The rest of the article is divided into four sections. The first part provides a critical review of the literature on the implementation of electromobility in Europe. This section concludes with the formulation of research questions. The second part of the report presents the methods used. The third part of the article is devoted to the presentation of results. The fourth part of the report contains a discussion. The article concludes with conclusions.

2. Literature review

The primary motivations behind the planned transition to electromobility are the desire to reduce greenhouse gas emissions and the pursuit of sustainable development. These goals provide the context for our study.

Implementation of electromobility by of EU countries is due to the need to adapt to the EU's climate policy as expressed in the European Green Deal (2019) and the Fit for 55 (2021) packages of documents. They are accompanied by more detailed documents, regulating specific aspects of the process like Regulation (EU) 2023/1804 on the development of alternative fuel infrastructure.

Among Leading Initiatives of “Sustainable and Smart Mobility” strategy (EUSSTM) is the Initiative Number 3 dedicated to sustainable mobility in and between cities. One of the objectives of the EUSSTM is to ensure that regular public transport services within the EU, covering distances of up to 500 km, are carbon neutral. Therefore, the European Commission has identified the issue of public transportation in urban areas as being of importance. However, the literature on the transition of public transportation to the electric option is less numerous than that discussing individual electromobility.

Member states implement their own regulations to achieve EU-wide environmental and economic goals. An example in Poland is the Act of January 11, 2018, on electromobility and alternative fuels (Journal of Laws 2021, vol. 2269) and the related “National Policy Frameworks for the Development of Alternative Fuel Infrastructure”. Therefore, scientific papers are being written analyzing the implementation and development of electromobility in Europe and around the world. Selected aspects of EU’s climate policy are described in (Györfy, 2024; Motowidlak, Bukowska-Piestrzyńska, 2024; Nikolaidou et al., 2023), among others. The topic of reducing greenhouse gases emissions was addressed by (Tucki et al., 2019; Tucki, et al., 2020; Tsakalidis et al., 2020). Some authors have studied the current state and perspectives of the European electromobility sector (Frej et al., 2021; Marotta et al., 2023; Nanaki et al., 2022; Rokicki et al., 2022). Furthermore, the availability of transportation infrastructure is described in the papers (Klimach, Figurska, 2022; Kubás et al., 2022; Mazur et al., 2024; Tucki, Orynycz, Dudziak, 2022).

When considering whether to innovate, there are several criteria to take into account. Therefore, Nalmpantis et al. (2019) used the AHP method to create an innovation ranking for urban public road transportation. The transition to low- or zero-emission urban transportation is intended to bring environmental benefits. Pietrzak and Pietrzak (2020) identified and analyzed the environmental effects of implementing zero-emission buses in urban public transportation using the example of the city of Szczecin (Poland). Their research demonstrated that public transportation could assist in decreasing road congestion and air pollution. However, in order to achieve environmental effects in the transition to zero-emission public transport, government support is needed (Rodrigues et al., 2024).

Implementing electromobility in public transport also requires technical solutions. One of the key challenges currently being faced is the limited range of electric buses, which is a result of the installed battery capacity being insufficient (Varga et al., 2019; Bi et al., 2018). Electric buses need to be charged at charging stations, and the required charging time is important for the efficiency of fleet usage (Rogge et al., 2018). The localization of charging stations is very important for the effective operation of the electric bus network (Schmidt et al., 2021; Jóźwiak et al., 2018).

In addition to multi-criteria methods, the efficiency of implementing and operating electromobility and public transportation is analyzed. Data Envelopment Analysis (DEA) is suitable for this purpose and is also the first stage of the procedure described in Chapter 3. Rivero Gutiérrez, De Vicente Oliva and Romero-Ania (2022) reviewed studies on bus choice in various cities around the world using the DEA method, citing eight publications published between 2001 and 2021. These studies focus on dedicated areas – primarily specific cities.

In the DEA method, the choice of inputs and outputs is crucial, which depends on the optimization goal. Almeida Neves et al. (2020) analyzed the efficiency of electromobility implementation of 20 EU countries between 2010 and 2018. Inputs included such macroeconomic variables as: labor force, gross investment expenditures per capita, electricity

consumption intensity of the economy, oil price, industrial production index. Their model included two effects: new BEV (Battery Electric Vehicle) registrations relative to total new vehicle registrations and the cumulative number of policies supporting electric mobility. Six models of environmental performance of European countries were proposed by Kucukvar et al. (2022). As inputs, they used such variables describing the state of the environment as atmospheric particulate emissions, metal depletion status, soil acidification and urban agglomeration area. The output was the environmental impact of electric vehicles measured by the distance they traveled. Xu et al. (2020) studied the environmental effectiveness of road transportation in 30 regions in China. Among the inputs they used were fuel consumption, total highways length, total trucks tonnage, number of passenger seats. Among the effects were passenger and freight traffic and adverse effects: noise, CO₂ emissions, and direct material losses from traffic accidents. Very often, the DEA method is used at the micro level, to evaluate the effectiveness of the decision to purchase an electric vehicle (Jahromi et al., 2013; Svoboda, Lagasse, 2013) or to plan the location of charging stations (Khalkhali et al., 2015; Wang et al., 2018; Kubás, 2022).

Efficiency analysis can be accompanied by regression models, as a second stage of research. The specifics of the phenomenon and the available data cause researchers to turn to estimation methods other than classical least squares method. Almeida Neves, et al. (2020) used a panel model in which the explanatory variable was efficiency derived from the DEA. Among the explanatory variables used, it is worth to mention: production of renewable electricity per capita, number of publicly accessible charging stations (per 100,000 people), value-added services, percentage of the population living in single-family homes and others. Rietmann and Lieven (2018) estimated the parameters of a panel model explaining the combined BEV and PHEV (Plug-in Hybrid Electric Vehicle) EV market share using the partial least squares (PLS) method. Estimation was also employed in our study. In the third stage of the procedure, the parameters of the probit panel model were estimated.

Electromobility has been implemented across the European countries, yet the extent of research comparing these countries is limited. Fanti et al. (2017) presented interactions of stakeholders in the electromobility network by nine macro-areas: industry, information technology providers, charging infrastructure, decision makers, public authorities, energy, European and international organizations, end users, and complementary services. The issue of electric vehicle exploitation was raised by Skrucany et al. (2019), who provided a detailed examination of the impact of such vehicles on the environmental footprint of energy efficiency when utilizing primary generation sources. The statistical study consisted of comparing a set of parameters for seven countries in the Central European region. Gruetzmacher, Vaz, and Ferreira (2021) used panel data to analyze variables that could impact the adoption rate of electric vehicles in EU countries between 2015 and 2019. Tucki et al. (2022) analyzed in detail the development of electromobility in Poland compared to other EU countries, calculating, among other things, correlation coefficients for individual variables. Kubás et al. (2022) determined

the efficiency of electric vehicle charging infrastructure implementation and, consequently, the efficiency of electromobility in all EU countries.

As outlined in the introduction, we are proposing a novel research procedure that begins with the DEA method and then employs benchmarks from this method in a panel model. This combination has not been presented in the literature to date, but we can find the methods and tools we used at each stage. The DEA method at the country level was used by Kucukvar et al. (2022), Rivero Gutiérrez et al. (2022), and Wang et al. (2018). Benchmarks obtained from statistical analysis were used in (Kolibaba et al., 2025; Tucki et al., 2022). The use of logit or probit models in electromobility research can be found in (Almeida Neves et al., 2020).

A substantial proportion of the referenced sources concentrate on public policies and charging infrastructure, which are regarded as pivotal to enhancing EV market penetration in Europe. These sources examine the broader context of managing transport innovations, such as Mobility-as-a-Service (MaaS) and autonomous vehicles, to promote more integrated and sustainable urban systems. The rapid growth of electromobility in recent years has prompted further research into this process. In light of the EU's strategic initiative to transition to zero-emission transport in the near future, the development of electromobility has emerged as a pivotal research area. The following research questions were therefore posed:

1. Is the process of introducing electromobility in public transport in European countries proceeding with similar efficiency?
2. Have there been any significant changes among the leaders in the introduction of electromobility in public transport between 2019 and 2023?
3. Which macroeconomic factors have a significant impact on the ability to lead the implementation of electromobility?

3. Methods

3.1. Research description

The study was conducted in accordance with the proposed approach, which was divided into three stages. The scheme of this approach is presented in Figure 1 below.

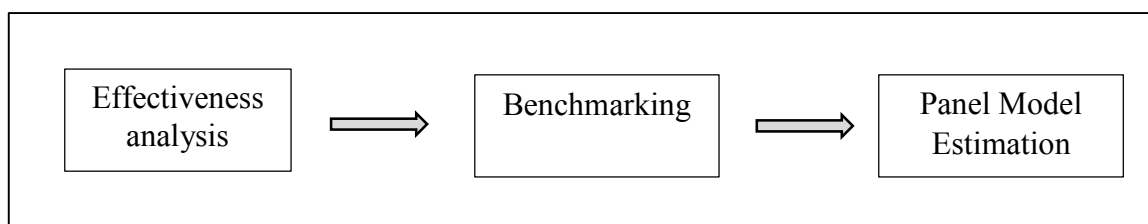


Figure 1. Research stages.

Source: own work.

The first stage of the process is to assess the efficiency of electromobility solutions in public transport across all EU countries. Efficiency δ is defined here as the relation of multiple outputs to multiple inputs and takes value between 0 and 1. The goal of this stage is to divide the EU countries into two groups: those that demonstrate effective implementation of electromobility processes ($\delta = 1$) and those that demonstrate ineffective implementation ($\delta \neq 1$). The DEA method was used to evaluate efficiency. The DEA is a non-parametric method that does not require the user to specify a formalized input-output relationship. A further advantage is that it does not require inputs and outputs to be in the same units. The efficiency of the implementation of electromobility in public transport was examined separately for each year of the 2019 - 2023 period.

The second stage of the study (benchmarking) aims to identify countries that can be described as so-called “influence leaders”. Based on the results from the first stage, those EU countries that are originally efficient will be identified, and there is at least one inefficient country for which they are a benchmark. This means that not all the countries previously identified as efficient will play the role of influence leaders. The second stage of the procedure results in the creation of a vector containing binary values. A value of 1 indicates that a country should be considered an influence leader, while 0 indicates the opposite.

The final stage of the research is the construction of a probit panel model, which will be used to identify the macroeconomic variables contributing to the leadership of electromobility implementation in public transport. Additionally, this section of the study aims to analyze the direction and strength of their influence in achieving this position. In this model, the explanatory variable is a binary vector of countries that are influence leaders in a given year. The data in this stage has a panel structure, in which observations for countries have been arranged by consecutive years. The explanatory variables used for the construction of the panel model are different from those used in the effectiveness analysis in the first stage.

3.2. Efficiency evaluation

A key element in assessing the efficiency with which EU countries are implementing electromobility solutions in public transport is to identify the set of inputs and outputs. The following inputs were selected:

- number of buses at least 10 years old.
- total area of urban agglomerations [km²].

The first input is justified by the fact that the oldest vehicles are being replaced the fastest. Their replacement by electric vehicles has a measurable effect in reducing CO₂ emissions and other harmful chemicals. The selection of this input is further supported by a variety of government programs that encourage the replacement of outdated transportation fleets with new low-emission ones (Su et al., 2021).

The second input - total area of urban agglomerations is also reasonable. Electric public transportation largely concerns cities. This is determined by both the potential range of vehicles, as well as the spatial availability of charging infrastructure. A further benefit of electrifying city transport is the increased potential for creating connected, pollution-free zones (e.g. in city centers). A country's larger size is indicative of a greater tendency to use road transportation, which is characterized by the highest degree of spatial accessibility.

The outputs used in the study are as follows:

- number of new electric buses registered,
- final consumption of electricity by the road transport sector [GWh].

A natural result of the implementation of electromobility in public transportation is the number of registrations of new electric vehicles (buses). In contrast, the final electricity consumption of the road transport sector is an undesirable effect. An increase in the number of electric vehicles has the potential to increase demand for electricity and put pressure on power grids (Pariz, Keivanimehr, 2024).

As outlined above, we utilized the DEA method to assess the efficiency with which EU countries were implementing electromobility solutions in public transport. One of the earliest and most well-known DEA models is the CCR model, which was proposed by Charnes, Cooper and Rhodes. They defined efficiency as the ratio of the sum of weighted outputs to the sum of weighted inputs (Cooper, Seiford, Tone, 2007). The CCR is a mathematical programming model, more specifically, quotient programming. The objective is to find the optimal quantities of weights using empirical quantities of inputs and outputs, thereby maximizing efficiency. Graphically, the solution is a fragmentary linear function connecting the most effective Decision Making Units (DMUs). This curve is called the efficiency border. DMUs (objects) lying on the curve are identified as efficient, those located beneath the curve are considered dominated. The quotient form of the objective function makes a nonlinear programming problem. However, it is possible to transform it into a linear model, and then solve it in its dual form, which is the most common approach. Following the presentation of the CCR (Charnes-Cooper-Rhodes) model, a number of other models have been proposed. The BCC (Banker-Charnes-Cooper) model with variable economies of scale has proved particularly popular (Banker et al., 1984).

The DEA method is highly sensitive to changes in the number of objects being evaluated, since efficiency is measured relative to other objects. This method is also characterized by a high degree of subjectivity, which is evident in the selection of the inputs and outputs. Efficiency optimization in the DEA can be understood in two ways. The first means reducing the inputs while keeping values of outputs constant. The second way involves increasing outputs while maintaining inputs at their current level. In this study, the second approach was used (variability of outputs and invariability of inputs) because the levels of the proposed inputs could not be changed. Thus, inefficient DMUs will be characterized by an efficiency index value greater than 1. In addition, one of the outputs (final electricity consumption by the road

transport sector) is the undesirable output. This means that its smaller values leads to greater efficiency. The optimization model used is thus as follows:

$$\max \delta_o \quad (1)$$

$$x_{io} \geq \sum_{j=1}^n x_{ij} \lambda_{jo} \quad (2)$$

$$\delta_o y_{ro}^d \leq \sum_{j=1}^n y_{rj}^d \lambda_{jo} \quad (3)$$

$$\delta_o y_{ro}^u \geq \sum_{j=1}^n y_{rj}^u \lambda_{jo} \quad (4)$$

$$\sum_{j=1}^n \lambda_j = 1 \quad (5)$$

$$\lambda_j \geq 0 \quad (6)$$

where:

δ_o – the efficiency index of the o -th object,

x_{io} – the i -th input for the o -th object,

y_{ro}^d – the r -th output for the desirable o -th object,

y_{ro}^u – the r -th output for the undesirable o -th object,

λ_{jo} – intensity variables,

$i = 1, \dots, m$,

$r = 1, \dots, s$.

In the following part of the paper, benchmarking formulas will be determined for all inefficient DMUs ($\delta_o > 1$). They determine how the outputs should be changed in order for DMU to be on the efficiency border. These formulas are a linear combination of the efficient DMUs outputs. The optimal values of the intensity weights λ_{jo} are parameters in these formulas and determine new output values (Guzik, 2009). However, the purpose of the second stage is not to calculate the new values of the outputs, which inefficient DMUs should obtain. The goal is to identify efficient objects that can be used as benchmarks for inefficient objects. The final result of the second stage is a binary vector indicating influence leaders (Efficient DMUs, which are benchmarks for inefficient DMUs). This vector is the starting point for the construction of the panel model described in the next section of this paper.

DEA models based on Farrell efficiency can be analysed in a dynamic way, without being limited to static analyses. Furthermore, it is possible to study changes in efficiency dynamics. This is based on Shephard's distance. As outlined in the 2007 study by Cooper, Seiford and Tone, this is the inverse of optimal efficiency from an input-oriented model. The most widely used measure of efficiency changes between periods t and $t+1$ is the Malmquist index. In its basic form, it is presented as the product of the change in technical efficiency (TE), which determines the relative change in the efficiency of an object between periods t and $t+1$ without taking into account the change in the position of the efficiency curve and the technical change related to technological progress (TP). This decomposition was proposed in an article (Färe et al., 1994). Ray and Desli (1997) highlighted the issue of internal inconsistency arising from combining assumptions about constant returns to scale (CRS) and variable returns to scale (VRS). They proposed an alternative decomposition based solely on VRS technology. This is the approach that has been adopted in our article. According to this approach, the Malmquist index (MI) is derived as the product of the following sub-indices:

$$MI = TE_v \cdot TP_v \cdot SE \quad (7)$$

where:

TE_v – change of the input-oriented technical efficiency between periods t and $t+1$, assuming variable economies of scale,

TP_v – change of the position of the empirical production function between periods t and $t + 1$, assuming variable returns to scale,

SE – scale efficiency change.

More variants of the Malmquist productivity index decomposition can be found in (Ćwiakła-Małys, Nowak, 2011).

3.3. Estimation of panel model parameters

In the final stage of the study, a panel model was constructed in order to describe the data formed by combining observations from different DMUs (countries) over a specified period. There are two key parameters in the panel model: the number of units N and the number of time periods T . The behavior of variables depends on individual factors and factors that affect all the variables under consideration (Danska-Borsiak, 2011).

There are two types of panel models (Maddala, 2008):

- fixed effect models (FE),
- random effect models (RE).

In this study a binomial model is used, in which the explanatory variable is equal 1 (efficient countries – influence leaders for inefficient countries, and 0 otherwise). The mathematical model is as follows (Gruszczynski, 2012):

$$y_{it}^* = \alpha_i + \beta' \mathbf{x}_{it} + \varepsilon_{it} \quad (8)$$

$$y_{it} = \begin{cases} 1, & \text{if } y_{it}^* \geq 0 \\ 0, & \text{if } y_{it}^* < 0 \end{cases} \quad (9)$$

where:

y_{it}^* – binomial vector of observations for the explained variable,

$\mathbf{x}_{it}$ – vector of observations for explanatory variables,

α_i – individual effect for the object i ,

β – parameter vector for explanatory variables,

ε_{it} – random component,

$i = 1, \dots, N, t = 1, \dots, T$.

If we assume that the random component follows a normal distribution, then we have a probit model. However, if the distribution is specified as logistic, then we have a logit panel model.

In our research, a probit panel model was used, in which individual effects are treated as random variables and included in the stochastic part of the model. They are also independent of the explanatory variables. This type of model, as opposed to the fixed effects model, allows for wider interpretation of estimated parameters. The model allows us to determine the probabilities of the value of the explanatory variable changing from 0 to 1, given the estimated parameter values and the values of the explanatory variables (Bland, Cook, 2019; Hahn, Soyer, 2005). As previously stated, in the used panel probit model, the dependent variable was a binary vector taking the value of 1 when a country was considered to be the influence leader. Influence leaders were appointed separately for each year.

Continuous economic growth (measured by GDP) directly contributes to the development of the road transport sector (Tucki et al., 2020). In order to increase the market share of BEVs, it is essential to make efficient use of resources such as labour (Almeida Neves et al., 2020; Mazur et al., 2024).

The primary obstacle hindering the growth of the electromobility sector in Poland and other nations is the significant disparity in purchase price between electric vehicles and their conventional counterparts. The high prices are primarily due to the cost of batteries and the research and development costs incurred by manufacturers (Kolibaba et al., 2025). In countries with higher GDP and therefore higher incomes, a greater number of combustion engine cars and BEVs per thousand inhabitants can be expected.

The operating costs of vehicles with conventional engines are influenced by the price of oil, with higher oil prices making electric vehicles more attractive. The development of electromobility is influenced by two key factors: the level of consumption of crude oil and its derivatives, and the pursuit of sustainable forms of transport and alternative fuels (Motowidlak, Bukowska-Piestrzyńska, 2024). Electricity generation from renewable energy sources (RES)

has been shown to have a positive and statistically significant association with a country's efficiency in adopting BEVs, thereby bringing inefficient countries closer to the efficiency frontier (Almeida Neves et al., 2020). In countries where the energy mix is dominated by fossil fuels, the economic benefits of implementing zero-emission buses are limited. The full environmental and economic effects of electromobility on a macroeconomic scale (across the entire country) therefore depend on the simultaneous diversification of energy sources towards RES (Pietrzak, Pietrzak, 2021).

The development of the BEV market is largely dependent on subsidies and financial incentives. Research has demonstrated that financial incentives have a favourable effect on the market share of EVs (Rietman, Lieven, 2018). Another tool used by governments is the taxation of activities that increase CO₂ emissions. Some countries, for example France, use a bonus-malus system that rewards the purchase of cars that emit less CO₂ and penalises those that emit more (by increasing or decreasing the bonus/tax). In countries such as Germany, Denmark, and Norway, policy is not dependent on CO₂ emissions (Nanaki et al., 2022).

The electrification of public transport (including buses) is considered a positive step towards reducing emissions in urban areas (Kucukvar et al., 2021). City buses that do not emit any emissions are given priority when it comes to electrification. This is because they have regular routes, which makes it easier to plan the charging infrastructure and allows for the use of smaller batteries (Pietrzak, Pietrzak, 2021).

Based on the analysis of the literature, the following explanatory variables were selected:

- GDPPC: real GDP per capita [EUR] (Tucki et al., 2019; Tucki, Orynycz, Mitoraj-Wojtanek, 2020).
- UNLAB: the quotient of the number of unemployed to the number of employed (Almeida Neves, Marques, Moutinho, 2020; Mazur, Dybała, Kluczek, 2024).
- CARS1000: number of passenger cars per 1,000 inhabitants] (Tucki et al., 2019, Tucki et al., 2020; Kolibaba et al., 2020).
- PUBTR: share of public transport in total passenger transport (Kucukvar et al., 2021).
- RESELE: share of renewable energy sources (RES) in total produced electricity (Almeida Neves et al., 2020; Pietrzak, Pietrzak, 2021).
- OILCONS: consumption of oil and petroleum products [thousands of tons] (Motowidlak, Bukowska-Piestrzyńska, 2024).
- GHGTRPC: greenhouse gas emissions from the transport and warehouse sector [kg per capita] (Fit for 55, 2021).
- POLTINC: income from taxes on environmental pollution [millions EUR] (Nanaki et al., 2022).

The first two variables refer to a country's economic situation. A rise in real GDP per capita is expected to lead to an increase in the number of electric vehicles purchased, rather than an increase in the number of unemployed people compared to the number of employed. The number of passenger cars per 1000 residents and the share of public transportation in total passenger transportation reflect the tendency to use public transportation services, and thus the tendency to replace traditional vehicles with electric ones. In the first case, the growth of individual transportation is likely to have a negative effect on the number of electric public transport vehicles, as opposed to a positive effect on the use of public transport. The next two explanatory variables (share of RES in total produced electricity and consumption of oil and petroleum products) refer to energy consumption and its impact on electromobility. A higher share of RES in overall energy production reduces the overall cost of electricity, stimulating the tendency to purchase electric vehicles (as it was in Norway, for example), that is, to the detriment of public transportation, as does the increase in oil and gasoline consumption. The final two explanatory variables are intended to indirectly encourage efforts to increase the propensity of traditional fleets being replaced with electric ones. This should be done through government or local government programs (resulting from financial penalties imposed for excessively high greenhouse gas emissions), or through fiscal policy tools that burden producers (and consequently buyers) of traditionally powered vehicles.

Data were collected from the EUROSTAT database. The estimation was carried out using the STATA software package.

4. Results

The efficiency of each EU country, obtained using the BCC model of the DEA method, is presented in Table 1.

The number of countries with an efficiency index of 1 (100%) in 2019-2023 is 5, 4, 9, 6 and 9 respectively. Moreover, it was possible to indicate several countries whose efficiency was very close to 1. Latvia or Portugal are countries where the efficiency index has not exceeded 1.01 since 2019. This means that outputs of these countries should increase by less than 1% while keeping input unchanged. Approximately 35-55% of countries (depending on the year) can be considered efficient in implementing electromobility processes in public transport over the period considered. Luxembourg, Slovenia, France and the Netherlands achieved the efficiency index equal 1 at least three times.

Table 1.*Efficiency of implementing electromobility based on the DEA model*

DMU	2019	2020	2021	2022	2023	DMU	2019	2020	2021	2022	2023
AUT	1.144	1.175	1.209	1.113	1.185	LAT	1.03	1.003	1.005	1.005	1.001
BEL	1.154	1.138	1.188	1.228	1.353	LIT	1.043	1.036	1.028	1.015	1.01
CRO	1	1.001	1.002	1	1	LUX	1	1	1	1	1
CZE	1.084	1.067	1.049	1.025	1.03	NET	1	1	1	2.767	1.453
DEN	1.029	1.099	1	1	1.131	NOR	2.367	1.735	2.007	1.016	1
EST	1.017	1.01	1.008	1	1	POL	1.03	1.038	1	1.03	1.041
FIN	1.084	1.124	1.038	1.068	1.204	POR	1.008	1.004	1	1.005	1
FRA	1	1.495	1	1	1	ROM	1.039	1	1.109	1.048	1.001
GER	1.18	1.145	1	1.044	1	SLO	1	1	1	1	1
HUN	1.051	1.054	1.046	1.042	1.037	SPA	1.17	1.217	1.248	1.224	1
ITA	1.16	1.205	1.128	1.295	1.035	SWE	1.068	1.166	1	1.049	1.307

* AUT - Austria, BEL - Belgium, CRO - Croatia, CZE - Czech Republic, DEN - Denmark, EST - Estonia, FIN - Finland, FRA - France, GER - Germany, HUN - Hungary, ITA - Italy, LAT - Latvia, LIT - Lithuania, LUX - Luxembourg, NET - Netherlands, NOR - Norway, POL - Poland, POR - Portugal, ROM - Romania, SLO - Slovenia, SPA - Spain, SWE - Sweden.

Source: own work.

Noteworthy is the very high inefficiency of the Netherlands in 2022 (also the highest of all 22 countries). Energy prices in the Netherlands were unstable in 2022. In some months, they rose by up to 200% compared to the previous year. This led to high inflation. Compared to internal combustion engines, this could make the operation of electric buses less profitable. In turn, local authorities, the main stakeholders in the implementation of electromobility in public transport, had to limit their investments in new vehicles.

The average efficiency index values for inefficient countries in 2019-2023 are at a similar level: 1.16 ± 0.31 ; 1.15 ± 0.18 ; 1.16 ± 0.26 , 1.19 ± 0.42 , and 1.14 ± 0.15 . Norway deserves special attention here, as its efficiency should be considered the lowest among all 22 countries (in three consecutive years the efficiency index was close to 2). This is the result of the success in the implementation of electromobility, but in the group of passenger cars. Incentives offered by the Norwegian government have helped to boost BEV sales. Residents who switched to electric cars stopped using public transport. Consequently, the sector experienced a decline and was unable to allocate additional funds to low- and zero-emission mobility.

The average efficiency index of inefficient countries (with the exception of Norway and the Netherlands) has decreased marginally in the period under review and amounts to approximately 1.09 ± 0.09 . The median for all inefficient countries in subsequent years was: 1.07, 1.11, 1.05, 1.05, and 1.04, respectively. Thirteen out of 22 countries have efficiently implemented electromobility processes in public transport at least once in 2019-2023, as evidenced by the values of the efficiency index. These include Croatia, Denmark, Estonia, Germany, Luxembourg, Latvia, France, the Netherlands, Norway, Italy, Poland, Portugal, Slovenia, and Spain. Moreover, the median should be considered as low, which is the result of uniform rules imposed on countries as part of EU's climate policy.

A preliminary review of the performance indicators in Table 1 indicates clear variations between countries. The averages and corresponding standard deviations provide a clearer indication of these trends. They remain visible even when Norway is excluded. Therefore, the answer to the first research question is in the affirmative. The same table also shows that a small group of countries were effective for most, or even all, of the period under review. This addresses the second question raised.

The second part of the study was to establish benchmarking formulae for all inefficient countries to identify the efficient DMUs that are influence leaders. Influence leaders were countries that appeared at least once in the benchmarking formula for any country with an efficiency index of $\delta > 1$. Table 2 presents twelve countries for which the efficiency index was equal to 1 at least once in the years 2019-2023 and which were also influence leaders at the same time.

Table 2.

The frequency of occurrence of efficient countries that created benchmarks

DMU	2019	2020	2021	2022	2023	Sum
CRO	2	0	0	7	9	18
DEN	0	0	3	9	0	12
EST	0	0	0	2	0	2
FRA	5	0	1	1	2	9
GER	0	0	1	0	0	1
LUX	14	4	7	15	2	42
NET	2	5	0	0	0	7
NOR	0	0	0	0	2	2
POL	0	0	11	0	0	11
POR	0	0	0	0	13	13
ROM	0	15	0	0	0	15
SLO	10	13	9	0	1	33
SPA	0	0	0	0	2	2
SWE	0	0	1	0	0	1

Source: own work.

The values in Table 2 indicate the number of times a given country appeared in the benchmarking formula in a given year for a country considered inefficient, i.e. it was an influence leader for that country. Luxembourg and Slovenia were the most common benchmarks for inefficient countries. They were the influence leaders every year. Croatia, Poland, Portugal and Romania are also included among the countries that are frequently used as benchmarks for the largest number of countries. In 2021 and 2020, Poland and Romania achieved the efficiency index of one, respectively. However, they appeared in a significant number of benchmarking formulas (11 and 15 times, respectively).

The second objective of the study was to identify macroeconomic factors impacting the achievement of influence leader status in the implementation of electromobility in public transportation, and to examine the direction and strength of their influence on this status. In order to do so, the parameters of a probit panel model were estimated. All variables included 88 observations – 22 observations for each of the four years of the study period. Although the

study covered five years, a one-period lag was applied. Hence, the data series were limited to the years 2020–2023.

Of the potential explanatory variables mentioned earlier, only two were found to be significant: GDPPC - real GDP per capita [EUR] and dPOLTINC - the difference between the POLTINC variable for a given year and the previous year [millions EUR]. The results of the panel model estimation are presented in Table 3.

Table 3.

The results of the panel model estimation

Variable	Coef.	Std. Err.	z	P> z	Odds ratio
GDPPC	0.00002	0.00001	1.89	0.058	1.00002
dPOLTINC	0.0018	0.011	1.65	0.099	1.0018
const	-1.4705	0.4419	-3.33	0.001	

Source: own work.

The signs of the coefficients correctly reflect the direction of the changes previously assumed (Coef. – the second column of the table). Research indicates that an increase in real GDP per capita is associated with a higher probability of becoming an influence leader in the implementation of electromobility in public transport. It is estimated that an increase of 1000 EUR in real GDP per capita would result in a 2% rise in the DMU's chances of becoming an efficient country and an influence leader (see the Odds ratio column).

The sign at the estimated coefficient of the dPOLTINC variable is also positive. It was not the level of the income from taxes on environmental pollution that proved significant; rather, it was the increase compared to the previous year that was important. In this manner, national and local budgets are able to obtain funds that can be allocated to reduce the negative impact of human activity on the environment. One potential solution to this issue would be to reduce emissions from public transport by introducing electric vehicles. According to the odds ratio, an increase in revenue growth of 1 million EUR would increase the chances of achieving full efficiency by 0.2%.

The estimated parameters of the probit panel model will form the basis of further analysis. It is possible to formulate scenarios in which the probability of a DMU's status changing from zero to one and becoming an influence leader can be affected by a predetermined change in the value of the explanatory variables. Such scenarios were specified for those countries that had an efficiency index $\delta > 1$ in 2023. Two “improvement” scenarios were assumed. The first one assumes a 5% increase in GDPPC and dPOLTINC, while the second one assumes a 10% increase in these variables. These scenarios do not assume a specific time horizon, only the probability of a positive change. Therefore, these are optimistic scenarios. The results of the calculations are presented in Table 4.

Table 4.*The scenario analysis for non-efficient countries in 2023 (probability of status change [%])*

DMU	δ	5% improv.	10% improv.	DMU	δ	5% improv.	10% improv.
AUT	1,185	29.2	31	LAT	1,001	13.6	14.1
BEL	1,353	31.8	35.4	LIT	1,001	19.8	20.8
CZE	1,03	15.5	16	NET	1,453	86.6	93.9
DEN	1,131	37.8	41.7	POL	1,041	18.2	20.3
FIN	1,204	28	29.5	ROM	1,001	11.4	11.7
HUN	1,037	10.2	10.9	SWE	1,307	29.7	32.2
ITA	1,035	23.1	25.7				

Source: own work.

Improvements to GDP per capita and the income from taxes on environmental pollution by 10% do not result in a substantial increase in the likelihood of becoming an influence leader for other countries. It is also worth noting that the countries that were closest to the efficiency border ($\delta < 1.01$), i.e. Latvia, would still need significant improvements to become influence leaders. Quite high probabilities appeared for the Scandinavian countries: Denmark, Finland, and Sweden. These countries have been engaged in sustainable development activities for many years.

5. Discussion

Let us compare first the list of influential leaders in Table 2 with the leaders in electromobility identified in the literature. As it turns out, the same countries appear in both cases. Research has been carried out in a number of countries, including Norway (Tucki et al., 2019; Rietman, Lieven, 2018) and the Netherlands (Rietman, Lieven, 2018; Kolibaba et al., 2025; Tucki et al., 2022). With regard to the cumulative number of new electric car registrations, the Netherlands, France, Germany, the United Kingdom, and Norway are mentioned (Tucki et al., 2019). In turn, Kucukvar et al. (2022) identified the countries that are most effective in terms of environmental efficiency in the use of BEVs. The following countries are the leaders in the article by Kucukvara et al. and in Table 2: Slovenia, Sweden, France, the Netherlands, Portugal and Denmark. The results of our study have been corroborated by existing literature, while concurrently adding value through the identification of leaders in the electrification of public transport.

The development of electromobility in public transport is primarily driven by the European Union's ambitious policy goals, which are focused on achieving climate neutrality. The overarching objective is to achieve climate neutrality by 2050, with a targeted intermediate goal of reducing greenhouse gas emissions by a minimum of 55% by 2030 (Fanti et al., 2017; Marotta et al., 2023). In accordance with EU Regulation (EU) 2019/631, a ban on the registration of new vehicles with internal combustion engines (ICE) in EU member states is to

come into force in 2035 (Mazur et al., 2024). The findings of our study suggest that top-down measures by the authorities may prove effective, at least in the case of the electrification of public transport.

As shown in Table 4, the countries with the highest probability of achieving full efficiency in electromobility adoption for public transport are also the countries best placed to transform the current mobility model (3.0) into the Mobility 4.0 model described by Motowidlak and Bukowska-Piestrzyńska (2024). It assumes the creation of new value through interactions between the transport sector, the automotive industry, the electricity sector, and other industries. This appears to be a logical conclusion, given the substantial impact of GDP on the panel model. Overall economic development is both the driver and beneficiary of electromobility.

As Nanaki et al. (2022) have noted, such scenarios can inform government decisions. However, it should be noted that, in their opinion, at least in the case of Greece, subsidies are the most effective measure, and they considered the CO₂ tax to be insufficiently effective in making EVs more competitive.

The second research question addressed the issue of changes in efficiency over the five-year period covered by the study. Therefore, Table 5 includes the values of the Malmquist productivity index and sub-indices.

As shown in Table 5, there are significant differences between countries in terms of the implementation of electromobility in public transport. MI values range from 0.22 to 5.639. The most significant enhancement in efficiency was achieved in Italy, with an increase exceeding 450%. Portugal, Spain, Romania and Poland also recorded very high increases. In contrast, the Netherlands and Luxembourg recorded declines of 70-78%. Half of the countries surveyed had an MI index of no more than 0.779, indicating a decline in efficiency of over 20%. An increase was recorded in nine countries.

An analysis of the sub-indices reveals the reasons for this situation. It is important to note that only two countries (Italy and Portugal) demonstrated an increase in technical efficiency. The median TE_v was only 0.357. A decline of considerable significance was observed in most countries, with a concomitant shift away from the efficiency frontier. TP_v values fluctuate around 1 (with a median of 1.004). It is notable that Norway is the only country in which there has been an increase, and that increase is almost 140%. From 2019 to 2023, no significant changes in the efficiency of electromobility implementation in public transport due to technological changes were observed in Europe.

Table 5.*Efficiency dynamics between 2023 and 2019*

	MI	TE _v	TP _v	SE		MI	TE _v	TP _v	SE
AUT	0.361	0.191	0.965	1.965	LAT	0.700	0.275	1.029	2.473
BEL	1.186	0.993	0.853	1.399	LIT	0.685	0.292	1.032	2.274
CRO	0.700	0.421	1.000	1.663	LUX	0.289	0.289	1.000	1.000
CZE	0.682	0.444	1.053	1.459	NET	0.220	0.240	0.688	1.329
DEN	1.301	0.487	0.910	2.938	NOR	0.878	0.174	2.366	2.134
EST	0.646	0.630	1.017	1.008	POL	3.261	0.750	0.989	4.394
FIN	0.857	0.346	0.900	2.751	POR	4.134	1.138	1.008	3.604
FRA	1.618	0.305	1.000	5.312	ROM	3.908	0.750	1.038	5.019
GER	2.379	0.321	1.180	6.282	SLO	0.588	0.368	1.000	1.596
HUN	0.692	0.403	1.013	1.694	SPA	3.911	0.273	1.170	12.269
ITA	5.639	1.120	1.120	4.497	SWE	0.390	0.182	0.817	2.623

MI – Malmquist productivity index, TE_v – change in technical efficiency, TP_v – change in the position of the empirical production function, SE – scale efficiency change.

Source: own work.

All countries except Luxembourg experienced a significant increase in economies of scale. This was particularly evident in Spain, but the median of 2373 clearly demonstrates a qualitative change in the utilisation of electric rolling stock in the countries surveyed over the five-year period.

6. Conclusions

The first goal of the article was to identify European countries that demonstrated a high degree of efficiency in implementing electromobility processes in public transport during the 2019-2023 period. For this purpose, the DEA method, specifically the BCC model, was used. This approach enabled the identification of a group of countries that, with minor exceptions, demonstrated a relatively high level of success over the five-year period: Croatia, Denmark, Estonia, France, Germany, Luxembourg, Netherlands, Portugal, Poland and Slovenia. Some of them: Luxembourg, Slovenia, Denmark, Croatia and France have taken on the role of influence leaders for other countries.

The second goal of the paper (and the third research question) was to identify the macroeconomic factors that were important in becoming an influence leader in the implementation of electromobility in public transportation. The factors identified in this study included real GDP per capita and the difference between the income from taxes on environmental pollution for a given and the previous year. The panel model results confirmed the predicted direction of change for the explanatory variables. Furthermore, they enabled the estimation of the likelihood of positive changes in the implementation of electromobility in public transport, a key consideration for countries with inefficient processes.

The scenario analysis based on the panel model presented in section 4 is a useful tool to support government decisions. It demonstrates which factors should be selected and how they should be modified to enable the country to successfully introduce electric public transport. This approach offers significant benefits in both scientific research and macro-level management.

The study's limitations have been identified by other researchers. Rietman and Lieven (2018) suggested that a sample of 20 countries might be considered too small, but ultimately deemed it sufficient. There were 22 countries in our study. Almeida Neves et al. (2020) highlighted in the section of their study utilising DEA that only a limited number of countries were positioned on the efficiency frontier. In their view, this may impact how well the model aligns with the data. We too encountered this issue.

The authors are aware that their study, which examined the efficiency of electromobility processes in public transport, does not cover the entire problem. The results obtained using the DEA method may be sensitive to the number of DMUs, which has been limited as a result of data availability. Therefore, further efforts should be made to fully complete the data. In addition, the authors considered the sole appearance of the effective DMU in the benchmarking formula, ignoring the number of its appearances in all formulas. Future research should evolve to apply a procedure for determining the target share of inputs in a target technology based on the inputs “contributed” to the target technology by the benchmark DMU (Guzik, 2009). Following the implementation of this procedure, we will obtain a share of that part of the target input (output) contributed by effective DMU's technology in the final technology.

References

1. “European Green Deal”, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM/2019/640.
2. “Fit for 55”: delivering the EU's 2030 Climate Target on the way to climate neutrality, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM/2021/550.
3. “White Paper - Roadmap to a single European transport area - Towards a competitive and resource-efficient transport system”, European Commission, Directorate-General for Mobility and Transport, COM (2011) 144.
4. Act of 11 January 2018 on electromobility and alternative fuels, Journal of Laws 2021, item 2269. <https://www.dziennikustaw.gov.pl/D2021000226901.pdf>, 15.10.2025

5. Almeida Neves, S., Cardoso Marques, A., Moutinho, V. (2020). Two-Stage DEA Model to Evaluate Technical Efficiency on Deployment of Battery Electric Vehicles in the EU Countries. *Transportation Research Part D: Transport and Environment*, 86 (September), 102489. DOI: 10.1016/j.trd.2020.102489.
6. Banker, R.D., Charnes, A., Cooper, W.W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30, 1078-1092.
7. Bi, J., Wang, Y., Shao, S., Cheng, Y. (2018), Residual range estimation for battery electric vehicle based on radial basis T function neural network. *Measurement*, 128, 197-203, DOI: 10.1016/j.measurement.2018.06.054
8. Cooper, W.W., Seiford, L.M., Tone, K. (2007). *Data Envelopment Analysis. A Comprehensive Text with Models, Applications, References and DEA-Solver Software*. Springer Science+Business Media, LLC.
9. Ćwiąkała-Małys, A., Nowak, W. (2011) Dekompozycja Indeksu Produktyności Malmquista w Modelu DEA. *Przegląd Prawa i Administracji, Acta Universitatis Wratislaviensis*, 85, pp. 273-284.
10. Dańska-Borsiak, B. (2011). *Dynamiczne modele panelowe w badaniach ekonomicznych*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.
11. Fanti, M.P., Pedroncelli, G., Roccotelli, M., Mininel, S., Stecco, G., Ukovich, W. (2017). Actors' interactions and needs in the European electromobility network. *IEEE International Conference on Service Operations and Logistics and Informatics (SOLI)*. DOI: 10.1109/soli.2017.8120988
12. Färe, R., Grosskopf, S., Lindgren, B., Roos, P. (1994). *Productivity Developments in Swedish Hospitals: A Malmquist Output Index Approach*. In: A. Charnes, W.W. Cooper, A.Y. Lewin, L.M. Seiford. Springer Netherlands, DOI: 10.1007/978-94-011-0637-5_13
13. Frej, D., Grabski, P., Szumska, E. (2021). The Importance of Alternative Drive Vehicles in Road Transport in Poland and the European Union. *LOGI - Scientific Journal on Transport and Logistics*, 12(1), 67-77. DOI: 10.2478/logi-2021-0007
14. Gruetzmacher, S.B., Vaz, C.B., Ferreira, Â.P. (2021). A Panel Data Analysis of the Electric Mobility Deployment in the European Union. *Communications in Computer and Information Science*, 1488 CCIS, 555-570. DOI: 10.1007/978-3-030-91885-9_41
15. Gruszczyński, M. (ed.) (2012). *Mikroekonometria. Modele i metody analizy danych indywidualnych*. Warszawa: Wolters Kluwer business.
16. Guzik, B. (2009). *Podstawowe modele DEA w badaniu efektywności gospodarczej i społecznej*. Poznań: Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu.
17. Györffy, D. (2024). Liberal and illiberal industrial policy in the EU: the political economy of building the EV battery value chain in Sweden and Hungary. *Comparative European Politics*, 22(5), 574-593. DOI: 10.1057/s41295-023-00374-0

18. Jóźwiak, A., Guciewski, Ł., Misztal, A. (2018). Metoda rozmieszczenia infrastruktury ładowania autobusów elektrycznych w miejskim transporcie zbiorowym. *Zeszyty Naukowe Politechniki Poznańskiej*, 78, 51-64, DOI: 10.21008/j.0239-9415.2018.078.04
19. Khalkhali, K., Abapour, S., Moghaddas-Tafreshi, S.M., Abapour, M. (2015). Application of Data Envelopment Analysis Theorem in Plug- in Hybrid Electric Vehicle Charging Station Planning. *IET Generation, Transmission & Distribution*, 9(7), 666-76. DOI: 10.1049/iet-gtd.2014.0554
20. Klimach, A., Figurska, M. (2022). Electromobility infrastructure and vehicles in the context of Polish legislation. *Acta Scientiarum Polonorum, Administratio Locorum*, 21(3), 379-394. DOI: 10.31648/aspal.7511
21. Kolibaba, M., Piersiala, L., Kabus J., Kana, R. (2025). Electromobility - an Innovative and Environmentally Friendly Transport Solution. *Management and Quality*, 7(1), pp. 55-65.
22. *Krajowe ramy polityki rozwoju infrastruktury paliw alternatywnych [National Policy Framework for the Development of Alternative Fuel Infrastructure]* (2017). Warszawa: Ministerstwo Energii.
23. Kubás, J., Ballay, M., Ristvej, J., Záborská, K. (2022). Empirical measurement of electromobility efficiency in the environment of the European Union. *Communications - Scientific Letters of the University of Žilina*, 24(3), A123-A132. DOI: 10.26552/com.C.2022.3.A123-A132
24. Kucukvar, M., Onat, N.C., Kutty, A.A., Abdella, G.A., Bulak M.E., Ansari, F., Kumbaroglu G. (2022). Environmental Efficiency of Electric Vehicles in Europe Under Various Electricity Production Mix Scenarios. *Journal of Cleaner Production*, 335 (February): 130291. DOI: 10.1016/j.jclepro.2021.130291
25. Maddala, G.S. (2008). *Ekonometria*. Warszawa: PWN.
26. Marotta, A., Lodi, C., Julea, A., Gómez Vilchez, J.J. (2023). European governments' electromobility plans: an assessment with a focus on infrastructure targets and vehicle estimates until 2030. *Energy Efficiency*, 16(8). DOI: 10.1007/s12053-023-10163-z
27. Mazur, M., Dybała, J., Kluczek, A. (2024). Suitable law-based location selection of high-power electric vehicles charging stations on the TEN-T core network for sustainability: a case of Poland. *Archives of Transport*, 69(1), 75-90. DOI: 10.61089/aot2024.1mrj1x75
28. Motowidlak, U., Bukowska-Piestrzyńska, A. (2024). Determinants of electromobility development from the perspective of a zero emission, innovative and resilient economy. *Economics and Environment*, 88(1), 732. DOI: 10.34659/eis.2024.88.1.732
29. Nalmpantis, D., Roukouni, A., Genitsaris, E., Stamelou, A., Naniopoulos, A. (2019). Evaluation of innovative ideas for Public Transport proposed by citizens using Multicriteria Decision Analysis (MCDA). *European Transport Research Review*, 11, 22.
30. Nanaki, E.A., Kiartzis, S., Xydis, G.A. (2022). Are only demand-based policy incentives enough to deploy electromobility? *Policy Studies*, 43(2), 370-386. DOI: 10.1080/01442872.2020.1718072

31. Nikolaidou, A., Kopsacheilis, A., Gavanis, N., Politis, I. (2023). The Dynamic Relation of Climate Change and Energy Transition with Transport and Mobility Policies in the EU Through Social Media Data Mining. *Lecture Notes in Intelligent Transportation and Infrastructure, Part F, 1378*, 17-28. DOI: 10.1007/978-3-031-23721-8_2
32. Pietrzak, K., Pietrzak, O. (2020). Environmental Effects of Electromobility in a Sustainable Urban Public Transport. *Sustainability, 12(3)*, 1052. DOI: 10.3390/su12031052
33. Ray, S.C., Desli, E. (1997). Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries: Comment. *The American Economic Review, 87(5)*, pp. 1033-1039.
34. Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU
35. Rietmann, N., Lieven, T. (2018). A Comparison of Policy Measures Promoting Electric Vehicles in 20 Countries. *The Governance of Smart Transportation Systems*. DOI: 10.1007/978-3-319-96526-0_7
36. Rivero Gutiérrez, L., De Vicente Oliva, M.A., Romero-Ania, R. (2022). Economic, Ecological and Social Analysis Based on DEA and MCDA for the Management of the Madrid Urban Public Transportation System. *Mathematics, 10(2)*, 172. DOI: 10.3390/math10020172
37. Rodrigues, A., Cipcigan, L., Potoglou, D., Dattero-Snell, D., Seixas, S. (2024). Diffusion Evaluation of Battery Electric Buses Under Policy Interventions: A Participatory System Dynamics Approach. *Available at SSRN: <http://dx.doi.org/10.2139/ssrn.4685024>*, 15.10.2025
38. Rogge, M., van der Hurk, E., Larsen, A., Sauer, D.U. (2018). Electric bus fleet size and mix problem with optimization of charging infrastructure. *Applied Energy, 211*, 282-295, DOI: 10.1016/j.apenergy.2017.11.051
39. Rokicki, T., Bórawski, P., Beldycka-Bórawska, A., Żak, A., Koszela, G. (2022). Development of electromobility in European Union countries under COVID-19 conditions. *Energies, 15(1)*. DOI: 10.3390/en15010009
40. Schmidt, M., Żmuda-Trzebiatowski, P., Kiciński, M., Sawicki, P., Lasak, K. (2021). Multiple-Criteria-Based Electric Vehicle Charging Infrastructure Design Problem, *Energies, 14*, 3214. DOI: 10.3390/en14113214.
41. Seiford, L.M., Zhu, J. (2002). Modeling undesirable factors in efficiency evaluation, *European Journal of Operational Research, 142*, 16-20.
42. Shabnam, J., Tudori A., Anderson, T. (2013). Forecasting Hybrid Electric Vehicles Using TFDEA. *2013 Proceedings of PICMET 2013: Technology Management in the IT-Driven Services*, 2098-2107.

43. Skrócaný, T., Kendra, M., Stopka, O., Milojević, S., Figlus, T., Csiszár, C. (2019). Impact of the Electric Mobility Implementation on the Greenhouse Gases Production in Central European Countries. *Sustainability*, 11(18). DOI: 10.3390/su11184948
44. Sustainable and Smart Mobility Strategy – putting European transport on track for the future, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM/2020/789
45. Svoboda, J., Lagasse, D. (2013). Purchasing Efficiency Measurement of Selected Electric Vehicles in the United States Utilizing Data Envelopment Analysis. *Undergraduate Review* 12, 161-69.
46. Tsakalidis, A., Krause, J., Julea, A., Peduzzi, E., Pisoni, E., Thiel, C. (2020). Electric light commercial vehicles: Are they the sleeping giant of electromobility? *Transportation Research Part D: Transport and Environment*, 86. DOI: 10.1016/j.trd.2020.102421
47. Tucki, K., Orynycz, O., Dudziak, A. (2022). The Impact of the Available Infrastructure on the Electric Vehicle Market in Poland and in EU Countries. *International Journal of Environmental Research and Public Health*, 19(24). DOI: 10.3390/ijerph192416783
48. Tucki, K., Orynycz, O., Mitoraj-Wojtanek, M. (2020). Perspectives for mitigation of CO2 emission due to development of electromobility in several countries. *Energies*, 13(6). DOI: 10.3390/en13164127
49. Tucki, K., Orynycz, O., Swic, A., Mitoraj-Wojtanek, M. (2019). The development of electromobility in Poland and EU states as a tool for management of CO2 emissions. *Energies*, 12(15). DOI: 10.3390/en12152942
50. Varga, B.O., Sagoian, A., Mariasiu, F. (2019). Prediction of Electric Vehicle Range: A Comprehensive Review of Current Issues and Challenges, *Energies*, 12, 946, DOI: 10.3390/en12050946.
51. Wang, K., Mi, Z., Wei, Y. (2018). Will Pollution Taxes Improve Joint Ecological and Economic Efficiency of Thermal Power Industry in China? A DEA-based Materials Balance Approach. *Journal of Industrial Ecology*, 23(2), 389-401. DOI: 10.1111/jiec.12740
52. Xu, H., Wang, Y., Liu, H., Yang, R. (2020). Environmental Efficiency Measurement and Convergence Analysis of Interprovincial Road Transport in China. *Sustainability*, 12(11), 4613. DOI: 10.3390/su12114613

MOTIVATIONAL FACTORS INFLUENCING JOB PERFORMANCE AT SMALL AND MEDIUM SIZE ENTERPRISES OF ADDIS ABABA

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Purpose: The main objective of the study is to assess those motivational factors influencing job performance in selected small and medium size enterprises (SMEs) that are found in Addis Ababa, Ethiopia.

Design/methodology/approach: A self-administered questionnaire is the instrument used to gather the data from a sample size of 91 respondents where a quantitative research approach together with an explanatory research design are applied. A descriptive analysis, regression and correlation analysis techniques are applied for analysis purpose.

Findings: The study discovered that three motivational factors—remuneration, recognition, and training and development—affect about 61.1 percent of the variation in job performance remuneration taking the first, rank followed by development, training, and recognition.

Research limitations/implications: Inadequate sources of information, reluctance from the side of the respondents with inability to use electronic data collecting techniques are some of the limitations that the researcher faced in the process of the research.

Practical implications: The study's findings can be used by policy makers and local government officials to plan initiatives pertaining to small and medium-sized businesses in Addis Ababa.

Originality/value: The study contributes to enhancing the productivity and profitability of small and medium-sized enterprises by providing insights into project financing challenges.

Keywords: Motivational factors, Job performance, Small and Medium Size Enterprises.

Category of the paper: Research paper.

1. Introduction

Motivation is the main reason why human beings do things or behave in a certain way. Therefore, management of any organization should be able to harness the motivation of its employees in order to create a more motivated workforce to achieve its organizational objectives (Quick, Nelson, 2009) and to get a competitive advantage over its competitors (Wagner, Hollenbeck, 2010). The concept of motivation is one of the more difficult and complex topics in public management. It originates from the Latin word *movere*, which means

“to move” (Quick, Nelson, 2009). There is no one best definition for the word motivation; there are more than 140 in the literature (Kleinginna, Kleinginna, 1981; cited in Wilson, 2010). (Vroom, 1964) defines motivation as a process that governs choices. It is the process of evoking and upholding goal-directed behavior (Quick, Nelson, 2009). Motivation is the will to engage in a particular task or behavior (Kind, Lawley, 2013). It is the energy (Wagner, Hollenbeck, 2010) and force (Bratton, 2007) that a person is willing to devote to a voluntary behavior. Motivation is vital for employee performance. For instance, (Tilahun, 2020) shows motivational factors have a significant positive relationship with employee performance. (Mkwizu, 2020) assesses the role of motivation on employee performance and finds that motivation does influence the performance of employees.

As per the literature review and research gap, specific motivational factors that influence the performance of employees of SMEs are recognition, remuneration and training and development so and so on.

Employee recognition addresses two important spheres of employee’s encouragement, with one being directly recognising the good behaviour of the employee and encouraging the employee to continue with the good behaviour and on the second sphere it serves as the force that leads the observers to perform as good as the person being recognised (Rasheed et al., 2015). The recognition of the employee is the positive sensation that occurs once the employee has received gratification from the work produced successfully with improved quality (Alshmemri et al., 2017).

Mabaso, Dlamini (2017) also allude that for the organisations to motivate the employees for the greater performance, they must understand the relationship between the financial and non-financial rewards. (Mendes et al., 2017) Remuneration systems may have desired influence on the behaviour of the employee and sometimes it may lead to undesired behaviour. It may also influence the development of the organization future capabilities. Reward system can lead to attractive behaviour for a firm as people with skills could be attracted by a good reward system to join and stay with the company (Shields et al., 2015). Remunerations like salaries are not aimed at only at meeting the employee’s basic needs, but they also assist the employees into a better serving of the company with innovative behaviours and attitudes (Wang et al., 2018).

Barringer, Jones, Neubaum (2005) compared rapid-growth and slow growth firms and found that rapid growth firms depend heavily on the abilities and efforts of their employees to maintain their growth-oriented strategies. The fast-growth firms used training programs to achieve their objectives and emphasize employee development to a significantly greater extent than their slow growth counter parts. Therefore, training and employee development practices are more common in rapid growth firms than slow growth ones.

According to (Mathis, Jackson, 2001), the success or failure of an organization in achieving the goal will be largely determined by the success of individuals in carrying out the task that they were adopting, because people are the implementers of activities to achieve the objectives

of the organization. One of the company goals is to increase employee performance that will lead to improvement of company performance. The high performance will increase company productivity, reduce employee turnover rate, as well as confirming the company management style. Conversely, the low employee performance can reduce the quality and productivity of work, increase employee turnover, and decline the corporate earnings.

In Ethiopia SMEs are generally categorized in the industrial sector that includes manufacturing, construction and mining sub sectors, and the service sector includes retail trade, transport, hotel and tourism, information technology and repairs. The lack of appropriate policy, development strategy, and sector oriented support agencies restrain the development and expansion of SMEs. Study by Eshetu and Mammo stated that “Ethiopia has failed to benefit from the phenomenal growth in the SMEs sector,” This emerges from the fact that the sector lacks appropriate policy, development strategy and support services. Particularly, these enterprises are known with the fact that their performance fluctuates from year to year. This might have been attributed to the demotivation of their employees due to various factors.

Therefore, this study tries to examine what motivational factors affect the employee job performance of SMEs in Addis Ababa. Particularly among the many motivational factors that affect job performance, it focuses on only those major factors that are prevalent at SMEs. To do so, an explanatory research design and a quantitative research approach is followed where a sample size of 91 respondents are chosen to gather the data by using self-administered questionnaires which in turn is chosen as best data gathering instrument. This is because of its convenience to the researcher as well as its credibility for such quantitative data analysis. Accordingly, the study employed both a descriptive and inferential (such as correlation, regression, and ANOVA) analysis are employed in order to testify the hypotheses that: Recognition [RC] has no significant effect on Job Performance [JP], Remuneration [RM] has no significant effect on Job Performance [JP], Training and Development [TD] has no significant effect on Job Performance [JP] against their alternative hypothesis.

2. Methods

2.1. Research Design

The quality of any research project is enhanced by employing a sound research design. Therefore, it is found to be important to choose appropriate research design to respond the research questions sufficiently. An explanatory research design coupled with a quantitative research approach helped the researcher to critically assess the practice and perceptions about motivational factors as well as their impact on job performance. In brief, using the quantitative method, the Motivational factors affecting job performance is assessed briefly. In particular,

its practice, perceptions about motivational factors. Where both descriptive techniques of data analysis as well as the inferential analysis technique are applied such as the correlation and the regression analysis.

2.2. Research Approach

The research is conducted up on small and medium size enterprises that are found in Addis Ababa. A sizeable population in a highly economical way which most often used but limited to questionnaire in data collection. That is why questionnaire is used as a major data collection tool and employed in this research. In this study, a quantitative research approaches are dully considered.

2.3. Sampling Design

Target Population

In selecting sample, three factors determine the size of an adequate sample includes: nature of population, types of sampling design and degree of precision desired. Using a sample that is too large is a waste of resources while using a sample that is to small means getting results that are likely to be lacking in validity. In light of this, ninety three small and medium size enterprises are selected.

The researcher assume failure and success value of 0.5, 95 percent confident interval ($Z^2 = 1.96$), and tolerable error is set at 7 percent and determine a sample size as 93.

The researcher used a probabilistic sampling technique which is useful to explain, predict and generalize to the whole population. The technique of sampling used in this study is a stratified sampling with systematic sampling under each stratum. Using this technique the researcher first determines the representative sample. Next to that, the total population stratified as SMEs as per the regulation and proportionate method is applied to facilitate sample size from each stratum. Assuming the population being measured, the sample size for this study is ninety three.

Therefore, in order to collect quantitative data for the study, a total of ninety three questionnaires (that are constructed based on the 5-point Likert Scale) are printed and distributed for the purpose of data analysis. Among the total 93 self-administered questionnaires distributed to the respondents, the majority of them i.e. 91 of them are properly filled and returned to the researcher

2.4. Model Specification

The following multiple regression models are used to identify the major determinant factors of motivational factors that affect job performance at small and medium size enterprises in Addis Ababa and all the required statistical as well as diagnosis test results are conducted and shown in the Result section:

$$JP = \beta_0 + \beta_1 RC + \beta_2 RM + \beta_3 TD + e_i \quad (1)$$

where:

JP = Job Performance (Dependent variable of the study).

β_0 = constant or intercept.

RC = Recognition (an independent Variable).

BM = Remuneration (an independent Variable).

TD = Training and Development (an independent Variable).

where: β_0 , β_1 , β_2 and β_3 are coefficients and e_i is an error factor.

2.5. Hypothesis

The following hypotheses are stated for each of the independent variables against the dependent variable.

Null Hypothesis (Ho): Recognition [RC] has no significant effect on Job Performance [JP].

Alternate Hypothesis (Ha): Recognition [RC] has significant effect on Job Performance [JP].

Null Hypothesis (Ho): Remuneration [RM] has no significant effect on Job Performance [JP].

Alternate Hypothesis (Ha): Remuneration [RM] has significant effect on Job Performance [JP].

Null Hypothesis (Ho): Training and Development [TD] has no significant effect on Job Performance [JP].

Alternate Hypothesis (Ha): Training and Development [TD] has significant effect on Job Performance [JP].

3. Results

In order to get the required research finding, the researcher used the most commonly known software package known as Statistical Package for Social Science (SPSS) Version 21 that has helped the researcher to carry out all the necessary statistical analysis whereby the final the results are displayed by using tables and charts.

3.1. Results of the Descriptive Statistics

Accordingly, out of the total 93 Self-administered questionnaires distributed to the respondents, the majority of them i.e. 91 of them are properly filled and returned to the researcher. With this figure it can be said that the response rate is approximately 97.84%. The gender distribution of the respondents who are involved in this study is shown so that 36 or 39.6% of them are female respondents while the remaining 55 or 60.4% of them are male respondents.

The occupation distribution of the respondents to understand the type of job they are engaged in and thereby know those motivational factors that motivate them in influencing them on their job performance. Accordingly, the majority of the respondents that is 55 or 60.4% of them are employees of the organization, followed by the owner (21 or 23.1%) and shareholders (15 or 16.5%). The educational background of the respondents shows that 31(34.1%), 26(28.6%), 18(19.8%), and 16(17.6%) of them are undergraduate, certificate, diploma, and degree holders respectively. Except the non-shareholders who gave a response to show their answer for their job category (61 of them or 32.97% missing in this case), it is shown that 27 or 29.7% of them belong to the middle management category or group. 21 or 23.1% of them belong to the management group while the remaining 13 or 14.3% of them are in the supervisory staff category. The work experience of the respondents shows that 52.7 % of the respondents have a work experience for 5 years and more, while 15.4% of them have 3 years of work experience. The remaining 17.6% and 14.3% of them have 2 years and 4 years of job experience.

Results on the Survey of the perception of the employees about Motivational Factors

Table 1.

Response for Recognition related factors

S.N	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Q1.	8	8.8	16	17.6	0	0	48	52.7	19	20.9	91	100
Q2.	0	0	6	6.6	2	2.2	50	54.9	33	36.5	91	100
Q3.	2	2.2	2	2.2	0	0	54	59.3	33	36.3	91	100
Q4.	4	4.4	5	5.5	2	2.2	55	60.4	25	27.5	91	100
Q5.	21	23.1	23	25.3	35	38.5	4	4.4	8	8.8	91	100
Q6.	20	22	27	29.7	29	31.9	9	9.9	6	6.6	91	100
Q7.	2	2.2	10	11.0	34	37.4	39	42.9	6	6.6	91	100
Q8.	4	4.4	10	11.0	29	31.9	34	37.4	14	15.4	91	100
Q9.	4	4.4	9	9.9	27	29.7	37	40.7	14	15.4	91	100
Q10.	19	20.9	29	31.9	27	29.7	9	9.9	7	7.7	91	100

Where: Q1. The criteria for the recognition of programs have been clearly explained, Q2. Employees give importance to moral incentives (appreciation, respect, etc) as well as physical incentives, Q3. Success of the employees should be always appreciated, Q4. I feel like my work is always recognized by the company, Q5. I am not aware of the procedures for nominating an employee for an award, Q6. It doesn't take much time and effort to nominate employees for an award, Q7. The recipients of the employee awards are adequately publicized, Q8. I am aware of the gift awards associated with the program, Q9. I can select an award, if recognized, that will have value to me and Q10. Employee(s) of the month awards should be issued.

Source: SPSS Result (2023) (Researcher's Own computation).

According to Candi (et al., 2013), a growing recognition of the opportunities of innovation is through experience staging. Mahazril et al. (2012) concluded that rewards and recognition and communication may motivate them to work. In table 3.1 above, 52.7% and 20.9% of the respondents gave agree and strongly agreed response for the question item which says, "The criteria for the recognition of programs have been clearly explained". Similarly, 54.9% and 36.5% as well as 59.3% and 36.3% of them responded with agreed and strongly

agreed response towards the question items: “Employees give importance to moral incentives (appreciation, respect, etc.) as well as physical incentives” and “Success of the employees should be appreciated at all times” respectively. Regarding the item “I feel like my work is always recognized by the company” and “I am not aware of the procedures for nominating an employee for an award” very large proportion of them i.e. 60.4% and 27.5% and only few of them i.e., 4.4% and 8.1% of agreed and strongly agreed respectively. However, extremely very low number of the respondents (12 or 13.2%) positively responded towards “It doesn’t take much time and effort to nominate employees for an award” while the remaining 88 or 86.8% of the respondents are either neutral or disagree with this statement.

While 37.4% of them are not willing to say agreed or not agreed, 42.9% and 6.6% of them completely agreed that the recipients of the employee awards are adequately publicized by their respective organizations.

Only few of them (4.4% and 11.0%) disagreed with the fact that “I am aware of the gift awards associated with the program”. The rest do agree with it. And 40.7% and 15.4% of them also said that they can select an award, if recognized, that will have value to them. However, 20.9 % and 31.9% of them strongly disagreed and disagreed respectively with the fact that employee(s) of the month awards should be issued and very meagre of them agree with it (9.9% and 7.7%).

According to Mahazril et al. (2012) recognition enhances the level of productivity and performance at job whether it is a first time performance or a repeated action at the job in a progressive way and ultimately reinforces the behavior of employee. Hence, the finding of this study also goes with this finding of Mahazril et al.

Table 2.

Response for Remuneration factors

S. N	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Q11.	55	60.4	12	13.2	4	4.4	13	14.3	7	7.7	91	100
Q12.	16	17.6	44	48.4	4	4.4	27	29.7	0	0	91	100
Q13.	16	17.6	53	58.2	2	2.2	16	17.6	4	4.4	91	100
Q14.	16	17.6	42	46.2	6	6.6	27	29.7	0	0	91	100
Q15.	54	59.3	15	16.5	6	6.6	11	12.1	5	5.5	91	100

Where: Q11. I am satisfied with my salary, Q12. I earn the same as the people doing similar jobs, Q13. I earn the same as the people who have same qualification, Q14. My salary structure is perfect, and Q15. Salary increases are decided on the fair basis.

Source: SPSS Result (2023) (Researcher’s Own computation).

As summarized by Park (2010), monetary incentive acts as a stimulus for greater action and inculcates zeal and enthusiasm toward work, it helps an employee in recognition of achievement. Table 3.2 above portrays question items pertaining to remuneration factors and the response of the respondents. Accordingly, 60.4% and 7.7% of the respondents gave a strongly disagreed and disagreed response for the question item “I am satisfied with my salary” while 17.6% and 48.4% of them gave a strongly disagreed and agreed response for the

question item “I earn the same as the people doing similar jobs”. Regarding the qualification of the respondents again 17.6% and 58.2% of them replied saying they strongly disagree and disagree respectively with the fact that “I earn the same as the people who have same qualification”. More than half of them i.e., 58 or 63.8 % of them disagree with the question item that “My salary structure is perfect”. At last, but not the least, about 54 (59.3%) and 5 (5.5%) of them strongly disagree and disagree with the fact that salary increases are decided on the fair basis.

Likewise, Beretti et al. (2013) discussed that monetary incentives used to build a positive environment and maintain a job interest, which is consistent among the 17 employee and offer a spur or zeal in the employees for better performance. For reason, remuneration motivate employees and enhance commitment in work performance, and psychologically satisfy a person and leads to job satisfaction, and shape the behavior or outlook of subordinate toward work in the organization.

Table 3.
Response for Training and Development factors

S. N	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Q16.	8	8.8	44	48.4	5	5.5	24	26.4	10	11	91	100
Q17.	9	9.9	50	54.9	2	2.2	30	33	0	0	91	100
Q18.	13	14.3	53	58.2	1	1.1	21	23.1	3	3.3	91	100
Q19.	16	17.6	37	40.7	3	3.3	35	38.5	0	0	91	100
Q20.	6	6.6	55	60.4	7	7.7	13	14.3	10	11	91	100

Where: Q16. Your enterprise provides you appropriate training program relating to your job., Q17. As an employee you enjoy training to acquire and improve your performance in your job, Q18. You become more confident and feel motivated because of the organizational training, Q19. As an employee, I undertake courses and programs whenever there is technical change, Q20. You think organizational training is very effective.

Source: SPSS Result (2023) (Researcher’s Own computation).

Training refers to “the systematic accretion of skills, command, concepts or mindset leads to improve performance” (Lazazzara, Bombelli, 2011). Baldwin et al. (1991) indicates that individuals with higher pre-training motivation on the basis of their willingness to attend training have greater learning outcomes as compared to individuals heaving lower pre-training motivation. Responses for training and development, which is one factor that affects job performance, is assessed in Table 3 above. The result depicts that 48.4 % and 8.8% of the respondents disagreed and strongly disagreed with the statement that “Your enterprise provides you appropriate training program relating to your job”. However, 9 (9.9%) and 50 (54.9%) of them gave a strongly disagree and disagree response to the item “As an employee you enjoy training to acquire and improve your performance in your job”. Likewise, only few of them (i.e., 23.3% and 3.3% of them) gave an agreed and strongly agreed response for “You become more confident and feel motivated because of the organizational training” while majority of them (i.e., 14.3% and 58.2%) disagree with it. Of course, many of them (35 or 38.5%) believe that as an employee, they undertake courses and programs whenever there is technical change

and more than half of them (i.e. 53 or 58.3 %) don't. Nevertheless, majority of them (60.4% and 6.6%) of them have a common consensus that organizational training is not very effective in the enterprises.

Commeiras et al. (2013) point out that traineeship continues to improve performance of employee. In business context training basically refers to action of teaching employees and providing proper knowledge and skills to make themselves job fit as well as organization fit. Training teaches employees how to work and enhance their skills, hence motivate them to achieve the common goal of organization as well as of employee. In the today's competitive world, every organization wants to achieve competitive edge over their competitors and be impossible to achieve without employee involvement, which forces management to motivate their employees by different means. This is what is observed and found at Small and Medium Sized enterprises of Addis Ababa.

Table 4.
Response for Job performance

S. N	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Q21.	6	6.6	15	16.5	0	0	51	56	19	20.9	91	100
Q22.	0	0	5	5.5	1	1.1	55	60.4	30	33	91	100
Q23.	3	3.3	2	2.2	0	0	54	59.3	32	35.2	91	100
Q24.	22	24.2	59	64.8	1	1.1	5	5.5	4	4.4	91	100
Q25.	21	23.1	24	26.4	36	39.6	4	4.4	6	6.6	91	100

Where: Q21. You are capable of handling your assignments without much supervision, Q22. You are very passionate about your work, Q23. You could manage change in your job very well whenever the situation demands, Q24. You are very comfortable with job flexibility, Q25. You actively participate in group discussions and work meetings.

Source: SPSS Result (2023) (Researcher's Own computation).

The performance of employees is a concern for any organization because it determines whether the organization meets its targets and goals. "Various resources are necessary for an organization to succeed and meet its targets, and this includes the human resource or employees" (Shanks, 2012). However, skilled and talented employees may not achieve the desired results if they lack motivation and therefore, "motivation is also considered an important value which is vital in the achievement of the organization's goals" (Osei, 2011).

In table 4 above, the respondents are asked questioned related to job performance and their responses are recorded so that to the first question item which says, "You are capable of handling your assignments without much supervision", close to 86.9% of them gave a positive reply while 23.1% of them don't. In a similar fashion, they are asked whether they are very passionate about their work or not and majority of them (i.e., 88 or 93.4%) of them replied yes they do and the rest are either neutral (1 or 1.1%) or don't (5 or 5.5%). By the same virtue, most of them comply with the statement, "You could manage change in your job very well whenever the situation demands" whose proportion is around 86 or 94.5%. And at the end, nearly 24.2% and 64.8 % of the respondents strongly disagree and disagree respectively with

the question item of “You are very comfortable with job flexibility” and only a meagre number of them (i.e. 10 or 11%) gave positive reply to the question item “You actively participate in group discussions and work meetings” while the remaining respondents (i.e. 45 or 49.5%) disagree with this statement and 36 or 39.6% of them are neutral.

3.2. Result on the inferential Analysis

In order to show the individual as well as joint impact of the independent variables (motivational factors) on the dependent variable (job performance) a multiple regression analysis is conducted in which the Ordinary Least Square (OLS) method is used to estimate the coefficients of the model. According to classical multiple linear regression theory, a model is said to give economically intuitive result if it is free of serial correlation, multi linearity & normality problems which are known as Basic OLS Assumptions. Based on this the researcher conducted a test of serial correlation (Autocorrelation) test, Multi linearity test & Normality Test for the Model and the results are discussed hereunder. A Durbin Watson Statistic (D.W) is conducted in order to check for the serial correlation or autocorrelation and found with the D.W value of 1.98 which is close to 2. This indicates that the study model is free from serial correlation problem. Similarly, Multicollinearity test is checked by a system called variance inflation factor (VIF) with an VIF value of 1.039, 3.956, and 3.887 which is less than 10, indicating the absence of multi co linearity problem in the model. Finally the normality of the residuals is well proofed by a bell-shaped symmetric distribution shown by a histogram.

After estimation using OLS Method, the following multiple regression result was obtained:

$$JP = 1.655 + 0.592 RC + 0.753 RM + 0.163 TD \quad (2)$$

Table 5.
OLS Regression Result for all Explanatory Variables

Variables	Coefficients (Beta)	t -value	sig.value
(Constant) beta	1.655	5.923	0.000
RC	0.592	7.628	0.000
RM	0.753	2.937	0.006
TD	0.163	3.864	0.012

Source: (SPSS output).

The beta value of Recognition [RC] is 0.592, for Remuneration [RM] is 0.753 and Training and Development [TD] is 0.658 which show a strongest contribution (in same direction) of all the three independent variables on Job performance [JB]. This is attested by a very low sig.value which is less than 0.05 and t-ratio of greater than 2 in absolute terms.

Table 6.
Model Summary of Linear Regression for all Independent or Explanatory Variables

Model	R	R ²	Adjusted R ²	F	Sig.
1	0.741	0.611	0.601	20.258	0.000

Source: (SPSS output).

The above table shows the results of regression model. An F value of 20.258 with sig. Value of 0.000 confirms that the model is a good model. The model was used to check the effects of independent variables on the dependent variable. The value of R is 0.741, and this shows the association of independent variables with dependent variable. The value shows that independent variables are 74.1 percent correlated to dependent variable. The value of R^2 is 0.611 which shows the effect of independent variables on the dependent variable. The results show that 61.1 percent of variation in Job performance [JB] at the Small and Medium Scale enterprises of Addis Ababa, Ethiopia is due to the three independent variables: Remuneration, Recognition, and training and development.

ANOVA, or Analysis of Variance, is a test used to determine differences between research results from three or more unrelated samples or groups while A chi-square test is a statistical test used to compare observed results with expected results.

One way ANOVA and Chi-square test are used to check whether job performance of the small and medium size enterprises that are found in Addis Ababa are affected by personal profile of the respondents or not. That is, whether job performance varies between the two gender groups or not, among employees with different occupation or not, among employees with different educational background or not, among employees with different job categories or not, and among workers with different years of work experience or not. Accordingly, using the ANOVA test, except the variable occupation (with a sig.value of 0.000) the other variables are insignificant at 5% level of significance.

Similarly, using the Pearson Chi-square test, except occupation (with a sig.value of 0.001) the other variables are insignificant at 5% level of significance.

Correlation analysis, also known as bivariate, is primarily concerned with finding out whether a relationship exists between variables and then determining the magnitude and action of that relationship. A correlation analysis that is used to show how the independent variables (Remuneration, Recognition, and training and development) are related with the dependent variable (job performance) is made. Accordingly the Pearson Correlation coefficient with the corresponding sig.value is presented where all the independent variables are found to have a positive and strong correlation with the dependent variable. The sig.value of each coefficient also confirms that they are statistically significant with sig. (p-value) less than 0.05.

4. Discussions

Motivation is the key in effective business management. One of the secrets of successful business managers is to know the art and science of arousing and sustaining the motivation level of their workers in order to accomplish the business organization's goals and objectives.

Most traditional performance concepts assume that an outside task or goal is given, and that this goal or task is simply taken over. Performance is then measured in terms of how far the employee actually has achieved the goal or the task as expected. Interestingly, passive concepts are also used for describing employees' reactions to work place changes. Currently, organizations are going through a multitude of changes because of rapid technological development, a dynamic environment, different organizational ideas, and a changing job concept (Frese, Fay, 2001).

Therefore, in this study a brief investigation of the impact of motivation on job performance is made in terms of identifying those major motivational factors that affect job performance of the small and medium size Enterprises that are found in Addis Ababa Ethiopia.

According to Candi et al. (2013), a growing recognition of the opportunities of innovation is through experience staging. Mahazril et al. (2012) concluded that rewards and recognition and communication may motivate them to work. In the descriptive statistics result, it is found out that most of the small and medium sizes Enterprises that are found in Addis Ababa Ethiopia have clearly explained criteria for the recognition of their programs, their employees give value to moral incentives (appreciation, respect, etc.) as well as physical incentives, and their success is usually appreciated by their employers. Therefore, most of them feel like their work is always recognized by the company. Except a few of them, most of them aware of the procedures for nominating an employee for an award in their enterprise. However, the employees are unaware of the gift awards associated with the program and don't believe in the issuance of the awards of the employee(s) of the month awards. Recognition enhances the level of productivity and performance at job whether it is a first time performance or a repeated action at the job in a progressive way and ultimately reinforces the behavior of employee. Accordingly, from the study finding it can be seen that recognition of employees can either directly or indirectly affects the job performance of the employees of the small and medium size Enterprises that are found in Addis Ababa Ethiopia. This finding can also be reinforced by the research findings of other scholars. A study by Mahazril et al. (2012) shows that organizations had the duty to appreciate the employee from time to time and offer other form of benefits such as payment, which will help in employee motivation. Likewise, Kingira and Mescib (2010) define appreciation as the abstract of immaterial incentives; "employees giving immaterial incentives (appreciation, respect etc.) as much as materiel incentives with working department" shows employees do not agree with this behavioral statement. With this result, it can be stated that employees being employed in different parts can take their different opinions at different levels. Among the variable of responsibility and being appreciated, it is understood that "success of employers always be appreciated with education". The more effective quality and practicality of education employees had, the more contribution they will have to businesses.

In a study by (Park, 2010), monetary incentive acts as a stimulus for greater action and inculcates zeal and enthusiasm toward work, it helps an employee in recognition of achievement. Likewise Beretti et al. (2013) discussed that monetary incentives used to build

a positive environment and maintain a job interest, which is consistent among the 17 employee and offer a spur or zeal in the employees for better performance. In this study, it is found out that the employees are not satisfied with their current salary and are not earning the same as those who are working a similar job like them. Similarly, they believe that the organization is not paying them the same as that of other people who have the same qualification. Therefore, it can be said that the salary structure of most of the small and medium size enterprises is not perfect and salary increment is not made on a fair basis. According to Park (2010), monetary incentive motivate employees and enhance commitment in work performance, and psychologically satisfy a person and leads to job satisfaction, and shape the behavior or outlook of subordinate toward work in the organization. Therefore, in this study, it is shown that the performance of the employees of the small and medium sized enterprises of Addis Ababa is affected by the low remunerations they receive from their employers.

Training refers to “the systematic accretion of skills, command, concepts or mindset leads to improve performance” (Lazazzara, Bombelli, 2011). Baldwin et al. (1991) indicates that individuals with higher pre-training motivation on the basis of their willingness to attend training have greater learning outcomes as compared to individuals heaving lower pre-training motivation. With regard to the training that is given to employees of the small and medium size enterprises it is found ineffective from different perspectives. In the first place, even if these enterprises plan to provides appropriate training program to the employees, in most cases, the training given to them is found unrelated to their job. This is because they don’t enjoy the training to acquire and improve their performance in their job. Also, the training doesn’t help them to be more confident and feel motivated and the employees couldn’t undertake courses and programs whenever there is technical change. Commeiras et al. (2013) point out that traineeship helps to promote the growth of organizations. In business context, training basically refers to action of teaching employees and providing proper knowledge and skills to make themselves job fit as well as organization fit. Training teaches employees how to work and enhance their skills, hence motivate them to achieve the common goal of organization as well as of employee. As a result, the low level of training provided to the employees of small and medium sized enterprises of Addis Ababa has dwindled their productivity and their overall performance.

No one works for free, nor should they. Employees want to earn reasonable salary and payment, and employees desire their workers to feel that is what they are getting. They need to be recognized on their job. Better education and training are also factors that motivate employees to perform well on their job (Houran. J). The inferential analysis conducted in this study reveals that Job performance [JB] at the Small and Medium Scale enterprises of Addis Ababa, Ethiopia is highly determined by three important motivational factors such as Remuneration, Recognition, and training and development. For instance, the R^2 (Coefficient of determination) value of 0.611 indicates that that 61.1 percent of variation in Job performance

[JB] at the Small and Medium Scale enterprises of Addis Ababa, Ethiopia is due to the three independent variables: Remuneration, Recognition, and training and development.

The ANOVA finding together with the Chi-square test result depicts that there is no difference in job performance between the two gender groups, and among the different job categories of the employees. Hence, it can be inferred that in addition to the three motivation factors such as recognition, remuneration, and training and development, one of the personal backgrounds of the respondents (i.e., Occupation type of the employees) is found as a determinant factor of job performance at the small and medium size enterprises that are found in Addis Ababa.

5. Summary

In conclusion, even though the researcher faces some limitations in getting secondary sources of information in the form of such as annual reports from the Small and Medium sized enterprises of Addis Ababa, the study is conducted with the most reliable primary sources of information that was gathered using self-administered questionnaires for the period 2023. The researcher believes that such a detailed explanatory research design base study has not been conducted in the country even though some have tried to do so using a descriptive design method. Also, the variables considered in the study are critically evaluated and examined whether they are theoretically plausible or not by reviewing the available literature. However, since the researcher has focused only on three major motivational factors that may influence job performance can be cited as the weakness of the study; unless and otherwise the methodology employed is sound enough in addressing the stipulated objectives of the study.

The Small and medium size Enterprises that are found in Addis Ababa Ethiopia have a clearly explained their criteria for the recognition of their programs, and their employees give value to moral incentives (appreciation, respect, etc.) as well as physical incentives. In addition to these, in these enterprises success of the employees is usually appreciated by their employers. As a result, the workers feel like their work is always recognized by their employer. This goes with the finding of Mahazril et al. (2012) who concluded that rewards and recognition and communication may motivate employees to work more. Recognition enhances the level of productivity and performance at job whether it is a first time performance or a repeated action at the job in a progressive way and ultimately reinforces the behavior of employee.

The employees are also aware of the procedures for nominating an employee for an award in these enterprises and believe that the recipients of the employee awards are adequately publicized by their respective organizations. However, the employees are unaware of the gift awards associated with the program and don't believe in the issuance of the awards of the employee(s) of the month awards.

Nevertheless, the employees are not well satisfied with their current salary. Also, they ascertain that they are not earning the same as those who are working a similar job like them, and they believe that the organization is not paying them the same as that of other people who have the same qualification. Therefore, it can be concluded that the salary structure of most of the small and medium size enterprises is not perfect and salary increment is not made on a fair basis. As a result, they get demotivated on their job and this finding goes with the research finding of Park (2010): monetary incentive motivate employees and enhance commitment in work performance, and psychologically satisfy a person and leads to job satisfaction, and shape the behavior or outlook of subordinate toward work in the organization.

From the point of view of providing training to their employees, the small and medium size enterprises that are found in Addis Ababa are not effective from different perspectives. In the first place, even if these enterprises plan to provides appropriate training program to the employees, according to the respondents most of the training given to them is found unrelated to their job. Also, they don't enjoy the training to acquire and improve their performance in their job and the training doesn't help them to be more confident and feel motivated. Therefore, the employees couldn't undertake courses and programs whenever there is technical change. This is a finding that was clearly reflected in its opposite way with the research finding of (Commeiras, 2013) who concluded that Training teaches employees how to work and enhance their skills, hence motivate them to achieve the common goal of organization as well as of employee

In general, from the above findings, it can be concluded that even if most of the employees can handle their assignments without much supervision, very passionate about their work and able to manage change in their job very well whenever the situation demands, still they can't find any job flexibility in their organization and couldn't be comfortable with it. By the same virtue, they couldn't actively participate in group discussions and work meetings. This may be due to the lack of those motivational factors such as lack of recognition, less payment and remuneration and lack of well-organized training and development.

The regression and correlation analysis conducted in this study has confirmed that Job performance [JB] at the Small and Medium Scale enterprises of Addis Ababa, Ethiopia is mainly associated with and affected by the motivational factor known as Remuneration followed by Recognition, and training and development.

Finally, the researcher recommends the following points in order to enhance the job performance of the employees of Small and Medium Scale enterprises of Addis Ababa in general and to increase the productivity and profitability of the enterprises. The enterprises should be able to identify the training needs of the employees first and then provide a well-organized and target full training to the employees, the enterprises should pay a more reasonable payment and offer different incentives to its employees, the remuneration system of the enterprises should be fair and transparent, Employees should get the required recognition from their employees, the salary structure of the enterprises and the salary increment system should

be revisited by incorporating educational qualification as well as work experience of the employees and the management of the enterprises should make the working environment more comfortable and flexible to motivate the employees and thereby enhance the job performance.

At last, but not the least, the researcher believes that the study will help examine the practical experience of motivational modalities implemented by Small and Medium Enterprises, as it will guide the individual owners of SMEs through the practical knowledge of how overall SMEs motivate their employees, and in turn help them equip with the motivating practice from the experiences of other same Enterprises. Secondly, it will be an input for City Government of Addis Ababa, Job Creation and Enterprises Development Bureau to strategize their activities in regards with SMEs of Addis Ababa. Thirdly, this study is significant in helping policy makers in crafting appropriate policy by relating with the outcome of this study. Fourthly, the study will be an input to other researches in understanding how small and Medium Enterprises in Addis Ababa would motivate employees. Lastly, it will be a practical knowledge for the researcher, apart from theoretical knowledge known so far.

References

1. Alshmemri, M., Shahwan-Akl, L., Maude, P. (2017). Herzberg's Two-Factor Theory. *Life Science Journal*, 14(5), pp. 12-16.
2. Armstrong, M., Baron, A. (2006). *Performance Management: A Strategic and Integrated Approach to Achieve Success*. Mumbai: Jaico Publishing House.
3. Barringer, B.R., Jones, F.F., Neubaum, D.O. (2005). A Quantitative Content Analysis of the Characteristics of Rapid-Growth Firms and Their Founders. *Journal of Business Venturing*, 20, pp. 663-687.
4. Bratton, J., Callinan, M., Forshaw, C., Sawchuk, P. (2007). *Work and Organizational Behavior: Understanding the Workplace*. London: Palgrave Macmillan.
5. Eshetu, B., Mammo, M. (2009). Promoting Micro, Small and Medium Enterprises (MSMEs) for Sustainable Rural Livelihood. *Development, Innovation and International Political Economy Research (DIIPER) Series, Working Paper, No. 11*. Aalborg University.
6. Mabaso, C.M., Dlamini, B.I. (2017). Impact of Compensation and Benefits on Job Satisfaction. *Research Journal of Business Management*, 11(2), pp. 80-90.
7. Mathis, R.L., Jackson, J.H. (2001). *Human Resource Management (9th ed.)*. Ohio: South-Western College Publishing.
8. Mendes, A., Lunkes, R.J., Flach, L., Kruger, S.D. (2017). The Influence of Remuneration on the Behaviour of Hospital Employees in Brazil. *Contaduría y Administración*, 62(1), pp. 207-221.

9. Mkwizu, G.F. (2020). *The Role of Motivation on Employees' Performance: The Case of the University of Dodoma (UDOM)*. Doctoral Dissertation. Mzumbe University.
10. Osei, M. (2011). *The Effect of Motivation on Employee Performance in Ghana Education Service: A Case Study of Angel Educational Complex*. Unpublished MBA Thesis. Institute of Distance Learning, Kwame Nkrumah University of Science and Technology.
11. Quick, J.C., Nelson, D.L. (2009). *Principles of Organizational Behavior: Realities and Challenges (6th ed.)*. South-Western: CENGAGE Learning.
12. Rasheed, A., Khan, S.U.R., Rasheed, M.F., Munir, Y. (2015). The Impact of Feedback Orientation and the Effect of Satisfaction with Feedback on In-Role Job Performance. *Human Resource Development Quarterly*, 26(1), pp. 31-51.
13. Shields, J., Brown, M., Kaine, S., Dolle-Samuel, C., North-Samardzic, A., McLean, P., Johns, R., O'Leary, P., Robinson, J., Plimmer, G. (2015). *Managing Employee Performance & Reward: Concepts, Practices, Strategies*. Cambridge: Cambridge University Press.
14. Tilahun, G. (2020). *The Effect of Motivation on Employees' Performance in Public Sector: The Case of Menzmama Midir Worda Offices*. Amhara Region, North Shoa Zone, Central Ethiopia.
15. Vroom, V.H. (1964). *Work and Motivation*. New York: John Wiley & Sons, Inc.
16. Wagner, J.A., Hollenbeck, J.R. (2010). *Organizational Behavior: Securing Competitive Advantage*. New York/London: Routledge.
17. Wang, P., Lu, Z., Sun, J. (2018). Influential Effects of Intrinsic-Extrinsic Incentive Factors on Management Performance in New Energy Enterprises. *International Journal of Environmental Research and Public Health*, 15(2), p. 292.
18. Wilson, F.M. (2010). *Organizational Behavior and Work: A Critical Introduction (3rd ed.)*. Oxford: Oxford University Press.

PROJECT FINANCING PRACTICES: A CASE STUDY OF SELECTED SMALL AND MEDIUM SIZE ENTERPRISES IN ADDIS ABABA, ETHIOPIA

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Purpose: The main objective of the research is to evaluate the project financing practice of some selected small and medium-sized businesses (SMEs) of Addis Ababa. As recommendations, the researcher suggests that the SMEs should receive support from the government in the form of tax exemptions, expanded alternative financing sources and assistance in obtaining the equipment and raw materials they need.

Design/methodology/approach: In order to do this, a self-administered questionnaire is utilized to collect primary data from a sample of 177 respondents out of the total population of 1870. An explanatory research design is applied. Only 165 of the 177 questionnaires that are sent are returned to the researcher where each of the items has been evaluated for internal consistency or reliability. Both descriptive and inferential statistics such as Multiple Linear regression (using the ordinary least squares method) and correlation analysis are applied in which the data is analyzed using SPSS Version 21.

Findings: The project financing trend indicates that local credit and savings associations are the main source of funding for the SMEs, although this tendency is currently seen to be waning over time. The finding also pinpoints that the top three project financing determinants at SMEs are the firm's age, the cost of borrowing and the need for collateral.

Research limitations/implications: The main challenges were lack of proper documentation of the operating SMEs in Addis Ababa. And the other challenge was to convince respondents that it was purely for research purpose as most commonly firms are afraid of sudden business assessment by the government followed by tax levy.

Originality/value: The study offers new insights into the challenges SMEs face in obtaining project financing, highlighting issues such as weak business performance, limited raw materials, and declining reliance on local credit and savings institutions.

Keywords: Project Financing, Cost of Borrowing, Small and Medium Size Business Enterprises.

Category of the paper: Research paper.

1. Introduction

The concept of project finance is very simple, as it involves a capital investment on the merits of the asset's returns, but despite the simplicity of the concept, there is no definite definition agreed upon by the financial community. Project Financing is generally used to refer to a non-recourse or limited recourse financing structure in which debt, equity, and credit enhancement are combined for construction and operation or the refinancing of a particular facility in a capital intensive industry in which lenders base credit appraisals on the projected revenues from the operation of the facility, rather than the general assets or the credit of the sponsor of the facility, and rely on the assets of the facility, including any revenue producing contracts and other cash flow generated by the facility, as collateral for the debt (Hoffman, 2001).

Project finance is the structured financing of a specific economic entity - the SPV, or special purpose vehicle, also known as the project company - created by sponsors using equity or mezzanine debt and for which the lender considers cash flows as being the primary source of loan reimbursement, whereas assets represent only collateral (Gatti, 2013). The term Project Finance was particularly developed by bankers to refer to a particular method of mobilizing corporate finance. Projects that use this technique are highly leveraged and financed by lenders with limited recourse to the sponsor(s). Broadly, lenders finance a large corporate undertaking through one of two different ways: (a) a traditional loan backed by the full faith and credit of corporate balance sheet; or b) a limited recourse loan. Under the former, the lending decision is based on the prospects of the project to be built and also the general credit standing of the corporate borrower, i.e., its sponsor(s). Even if the project is not generating as much cash flow as originally anticipated, the lenders can expect to get paid if the cash flows from the various other commercial activities of the corporate entity remain robust.

Since these pioneering theoretical developments, a number of scholars have examined the particular nature of SMEs to examine how their innate characteristics may influence their ability to obtain credit (and the cost thereof). This has also led to theoretical development concerning the capital structure of small firms which we will outline below: namely the growth cycle theory and the pecking order hypothesis. Essentially, a number of critical factors are theorized to hinder the ability of SMEs to obtain credit from their preferred funding source. Small firms are different from big firms and these features have significant ramifications for their ability to obtain finance.

Plus, there are important differences between SMEs and this heterogeneity affects the ability to raise finance. Prior literature suggests that SMEs find it both difficult and expensive to raise outside capital from banks and other investors (Berger, Udell, 2006). Informational opacity is a key feature of start-ups and SMEs. Small firms do not have audited financial statements or publicly visible contracts with staff and suppliers.

According to (Finnerty, 1996), “the raising of funds to finance an economically separable capital investment project in which the providers of the funds look primarily to the cash flow from the project as the source of funds to service their loans and provide the return on their equity invested in the project”. According to (Nevitt, Fabozzi 2000) “A financing of a particular economic unit in which a lender is satisfied to look initially to the cash flow and earnings of that economic unit as the source of funds from which a loan will be repaid and to the assets of the economic unit as collateral for the loan”. According to (Pacelle et al., 2001) “It is a term that typically refers to money lent to build power plants or oil refineries”. According to (Esty, Sesia, 2005) “It involves the creation of a legally independent project company financed with equity and non-recourse debt for the purpose of financing a single purpose capital asset, usually with a limited life.” In general, it may be inferred that project finance is the financing of long term infrastructure and industrial projects based upon a complex financial structure.

The future of project financing looks bright as the world economy has improved and developing economies increasingly understand the importance of project finance in augmenting their economic development. Project Financing is also necessary to create an economic environment that enables firms to grow and prosper. McMahon (2001) found that enterprise size significantly linked to better business performance. Larger enterprises were found to have a higher level of success. SMEs in developing countries, however, face significant barriers to finance. Financial constraints are higher in developing countries in general, and specifically in Ethiopia but SMEs are particularly constrained by gaps in the financial system such as high administrative costs, high collateral requirements and lack of experience within financial intermediaries. Enterprises face financing constraints around the world, both in developed and developing markets (Ayyagari, 2007; Beck et al., 2005). Increased financing of projects for SMEs can improve economic conditions in developing countries by fostering innovation, macro-economic resilience, and GDP growth.

Using a quantitative method, the Project financing practices is assessed briefly. In particular, its practice, problems encountered, perceptions about project financing as well as determinant factors of project financing are examined using the quantitative research method where both descriptive techniques of data analysis as well as the inferential analysis technique are applied such as the correlation and the regression analysis. A hypothesis for the determinants of project financing is also made and tested for six independent variables (Age of the firm, Business skill of the firm, Cost of Borrowing, Collateral Requirement, Availability of Finance, and Past Financing Practice) that are assumed to affect project financing. At the end, the research finding is expected to be used as a guidance for the individual owners of SMEs through the practical knowledge of how overall SMEs finance their projects. It will also be used as an input for City Government of Addis Ababa, Job Creation and Enterprises Development Bureau to strategize their activities in regards with SMEs of Addis Ababa and learn the demand side of financing practices. Finally, the study is significant in

helping policy makers in crafting appropriate policy in addition to helping other researches in understanding how Small and Medium Enterprises in Addis Ababa finance their projects.

In light of the above targets, the researcher has made detailed study of the financing practice of SMEs by systematic selection of Addis Ababa's ten Kifle-Ketemas.

2. Methods

2.1. Research Design and Approach

The appropriate research design and approach followed in this study are explanatory and quantitative respectively. This is due to the nature of the study itself and with the intention to address the objective of the study i.e. The assessment and evaluation of the Project financing practices: a case study of selected small and medium size enterprises in Addis Ababa" where the above design and approach help the research to critically examine the practice, problems encountered, perceptions about project financing as well as determinant factors of project financing.

The technique of sampling used in this study is a stratified sampling with systematic sampling under each stratum. Assuming the population being measured, the sample size for this study is 177.

The researcher assume failure and success value of 0.5, 95 percent confident interval ($Z^2 = 1.96$), and tolerable error is set at 7 percent and determine a sample size as 177 Enterprises using scientific formula based on Kothari (2004) as follows:

$$n = \frac{Z^2 * p * q * N}{[e^2 * (N-1)] + [Z^2 * p * q]}$$

where:

N = size of population,

n = size of the sample,

p = sample proportion of successes,

q = 1 – p,

Z = standard variant for given confidence level (as per normal curve area table),

e = acceptable error (the precision).

$$n = \frac{(1.96)^2 * (0.5) * (0.5) * (1,870)}{[(0.07)^2 * (1,870-1)] + [(1.96)^2 * (0.5) * (0.5)]} = 177.$$

Therefore, assuming the population being measured, the sample size for this study is 177.

The researcher used a quantitative data collections instrument. In order to collect the quantitative data, the researcher employed both open and close-ended questionnaires. A questionnaire is used in order to measure and clearly show the perception of the respondents about project financing and its determinants. In data processing, after collection of data, the questionnaires are edited to determine the degree of response and the number of usable questionnaires. The data are coded and then entered into a computer data sheet for analysis.

However, only 165 of them properly filled and returned the questionnaire resulting in a response rate of 93.2% which is good enough to conduct the data analysis (Kothari, 2004) and the study is conducted based on a data collected, organized and analyzed for one full year (2023).

2.2. Data type, source and method of Analysis

A primary data gathered through a self-administered questionnaire is collected from 165 respondents that are chosen via the stratified sampling with systematic sampling techniques. The collected data is coded, edited and made ready for further analysis after conducting a pilot study with some selected respondents to check on the reliability of the questionnaire using Crobach's Alpha value as shown in the following table by using SPSS where it is 0.813 on average and hence it can be said that reliability is maintained based on a pilot survey data collected from 20 respondents (Saunders, Lewis, Thornhill, 2009). Then after, both descriptive and inferential (correlation and regression analysis) techniques are applied. As Kitindi et al. (2007) point out that lenders use firm's business information to assess current and future performance of the firm.

Table 1.
Reliability Test

Variable	Cronbach's Alpha	No. of items
Age of the firm [A]	0.745	3
Business skill of the firm [BS]	0.714	3
Cost of borrowing[CB]	0.761	3
Collateral requirements[CR]	0.832	3
Availability of Finance[AF]	0.800	4
Past financing practice [PFP]	0.880	2
Project Financing ability of the Firm [PFAF]	0.864	2
ean	0.813	

Source: (SPSS output).

The following Multiple Linear Regression Model is used to identify the major determinant factors of project financing at small and medium size enterprises in Addis Ababa:

$$PFAF = \beta_0 + \beta_1A + \beta_2BS + \beta_3CB + \beta_4CR + \beta_5AF + \beta_6PFP + e_i \quad (1)$$

where:

PFAF = Project Financing ability of the Firm (Dependent variable of the study),

β_0 = constant or intercept,

A = Age of the Firm (an independent Variable),

BS = Business skill of the Firm (an independent Variable),

CB = Cost of borrowing (an independent Variable),

CR = Collateral requirements (an independent Variable),

AF = Availability of Finance (an independent Variable),

PPF = Past financing practice (an independent Variable),

where: $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ and β_6 are coefficients and e_i is an error term.

3. Results

Male respondents formed majority of the target sample with a total of 158 representing 95.8% of the total sample taken, while 7 respondents were female representing 4.2%. 32.1% of the respondents were in the position of Employee/manager, 60% of the respondents were in the position of Owner/manager and the remaining 7.9 % of the respondents were shareholders. With regard to the type of business activity in which the respondents are engaged, it is shown that 153 (92.7%) of them are engaged in the manufacturing business, 6 (6%) of them are engaged in the Agricultural sector and the remaining 6 (6%) of them are engaged in the textile sector. 77% of them have 1 to 20 employees, 15.8% of them have 21 to 50 employees, 3.6% of them have 51 to 250 employees and the remaining 3.6% of them have more than 250 employees.

The researcher is also interested to know the current capital status of the enterprises and hence the result shows that 44.2%, 20.6%, 27.3%, 7.9% of them have less than birr 500,000, Between 500,000 to 1,000,000, between 1,000,001 to 5,000,000 and between 5,000,001 to 10,000,000 capital respectively. This implies that most of the small and medium size business enterprises that are found in Addis Ababa are running their business operation at a very low capital. Even none of them have more than 10,000,000 birr capital. Regarding the life span of each business enterprise 4.2%, 55.8%, 24.2% and 15.8 % of the respondents said that their organization has more than 10 years, between 5 and 10 years, between 2 and 5 years, and less than 2 years of experience respectively.

Notwithstanding with the long years of business experience, the small and medium size business enterprises of Addis Ababa are also expected to suffer from various kinds of problems. Among these problems, shortage of raw material and machine accounts for 55.8%, low business activity accounts for 8.5 %, lack of finance accounts for 3.6%. On the other hand, 32.1% of them replied that they didn't face any problem.

3.1. Descriptive Analysis

A variety of questions are posed to the respondents in order to look into the firm's overall project finance practice and related difficulties. As a result, the replies are analyzed using percentage and frequency distributions and hence it is shown that 79 (47.9%) of the respondents

said that they used internal funds and/or external financing during the past periods in their respective business enterprise while the remaining 86 (52.1%) of them didn't. That is more than half of them didn't have the experience of using internal funds and/or external financing in their financial structure. Even if they needed the finance from both sources they didn't have the access to get it. Of course, some of them asserted that they can get it either from internal or external sources.

The result also reveals that 31.6% of the respondents replied that internal financing is one way of financing the projects of small and medium size business enterprises while 11.39%, 10.12%, 27.84%, 10.12% and 8.86% of them replied respectively that bank overdraft, credit line or credit cards overdraft, subordinated loans, participation loans or similar financing instruments, others like credit and saving associations, internal financing and other loan (e.g. from a related company or shareholders), trade credit, leasing or hire-purchase or factoring and others like credit and saving associations are the other alternative ways of financing their projects.

The respondents are also asked to show up their response about whether they have applied the above alternative ways of financing in order to finance their projects or not, over the past six months. The result indicated that 16.4% of them replied "yes indeed" and 83.6% of them replied "not at all". That is, the majority of the respondents didn't apply the different alternative ways of financing (such as internal financing and other sources like credit and saving associations) over the past 6 months. However, from those 27 respondents who said that they have applied the different alternative ways of financing (such as internal financing and other sources like credit and saving associations) over the past 6 months, 14 (51.9%) of them requested the finance but it was completely rejected while 13 (48.1%) of them requested the finance and got only part of it.

In order to assess the reason behind why the respondents failed to get the requested finance, the researcher posed different possible factors to the respondents and the finding shows that 4.2%, 4.2%, 15.8%, 16.4%, 15.8% and 3.6% of them forwarded respectively the following reasons; Level of job, Job situation, loan is not given intensively, low business activity due to Covid-19, due to high interest rate, due to high criteria required and inability to repay back or settle previous loan. Out of the different possible reasons for the small and medium size business enterprises not to get the requested finance fully or partly, the major reasons include low business activity due to Covid-19 and due to high and various criteria required for the loan, and loan is not given intensively.

With regard to the availability of the finance or loan, 32.1% of them said that it has increased through time, 47.9% of them said that it has decreased through time while 4.2% of them said that it has remained stable for a long time and 15.8% of them said that they didn't used any finance at all.

But, the most known and identified limiting factors of Project financing of small and medium size business enterprises that are found in Addis Ababa are insufficient collateral or guarantee and high level of interest rates.

The study also has also examined how the respondents view project financing from a variety of angles, including the firm's age, business acumen, borrowing costs, collateral requirements, awareness of financing opportunities (financial availability), and previous financing practices on current financing. The result has shown that 47.9% and 16.4% of the respondents replied with strongly agreed and agreed response respectively that the age of the firm affects its ability to project financing. Almost half of them (51.5%) and 16.4% of them said that having business skills will influence business performance and hence project financing.

The respondents' perception about the cost of borrowing from different angles is reflected. 7.9%, 16.4%, 20.6%, 7.9% and 47.3% of them gave a strongly disagreed, disagreed, neutral, agreed and strongly agreed response respectively to the item 'Small businesses are usually charged higher interest rate by banks than large firms'. In a similar fashion, 15.2%, 19.4%, 12.7% and 52.7% of them gave a disagreed, neutral, agreed and strongly agreed response respectively to the item 'Lack of reputation and contact in the banking market make it hard to borrow money from the banks'. At last 4.2%, 52.1%, 4.2%, 3.6% and 35.8% of them gave a strongly disagreed, disagreed, neutral, agreed and strongly agreed response respectively to the item 'Lack of information and knowledge as a method or ways of financing makes to borrow hard'. The great majority of the respondents i.e. 87.9% and 4.2% of the respondents have strongly agreed and agreed respectively that inability to possess the required collateral makes project financing difficult. The same is true for those respondents who have strongly agreed and agreed with 12.7% and 59.4% response rate respectively that collateral is a mandatory requirement in project financing. Close to half of the respondents i.e. 44.2% of them are very worried about collateral in project financing. 55.8% and 32.1% of the respondents have agreed and disagreed respectively over the fact that there is available information on who is offering credit facilities. Majority of them (44.2%) disagreed that the performance of the lenders helps to get loan while only few of them 35.2% agreed upon it. 55.7% of the respondent disagree over the fact that alternative sources of finance are accessible to all SME. Most of them (60.9%) of them replied that past experience has an impact on obtaining project financing successfully.

With regard to general information on project financing by the SME, it is shown that 3.6%, 60.6%, 12.1%, 12.1%, and 11.5% of them gave a strongly disagreed, disagreed, neutral, agreed and strongly agreed response to the item 'All the financing opportunities are equally accessible'. Similarly, 3.6%, 23%, 12.7%, 16.4%, and 44.2% of them gave a strongly disagreed, disagreed, neutral, agreed and strongly agreed response to the item 'Using all the alternative sources of financing has more of good side than its bad side'. Close to 64.8% of the respondents said that past experience in financing has no direct effect on the current sources of financing while 26.7% of them said it did so. Also 37% of them said that the presence of past financing has not created an easy opportunity for the current sources of financing while 50.3% of them said it did so.

3.2. Inferential Analysis

This section presents the results of the multiple regression analysis.

$$\text{PFFA} = 2.324 + 0.754 A + 0.611\text{BS} + 0.658 \text{CB} + 0.355 \text{CR} + 0.720 \text{AF} + 0.125\text{PFP} \quad (2)$$

Table 2.
OLS Regression Result for all Explanatory Variables

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	2.324	.385		6.037	.025
Age	.754	.057	.627	3.180	.000
Business skill	.611	.043	.216	2.560	.001
Cost of borrowing	.658	.094	.209	3.933	.010
Collateral requirements	.355	.098	.388	3.788	.012
Availability of finance	.720	.057	.627	6.892	.000
Past financing experience	.125	.043	.216	2.501	.045

a. Dependent Variable: project financing ability of the firm.

Source: SPSS Result.

In addition to the individual statistical significance (shown by the t- value and sig. values) of each independent variable in affecting the dependent variable, the value of R² is 0.810 which shows the effect of independent variables on the dependent variable is too large. That is 81 percent of variation in Project Financing ability of the Firm [PFAF] is caused by the six independent variables (age of the firm [A], Business skill of the firm [BS], Cost of borrowing [CB], Collateral requirements [CR], Availability of Finance [AF] and Past financing practice [PFP]).

To demonstrate the relationship between the independent and dependent variables, a correlation analysis is performed and the result has shown that all the independent variables are found having a positive and strong correlation with the dependent variable. That is among the six independent variables, the three major ones that are highly associated with Project Financing ability of the Firm [PFAF] are Age of the firm [A], Cost of borrowing [CB], Collateral requirements [CR]. The result is depicted here under.

Table 3.
Correlation Result

Independent Variables	Dependent variable: Project Financing ability of the Firm [PFAF]	
Age of the firm [A]	Pearson Corr.	0.816
	Sig.	0.000
Business skill of the firm [BS]	Pearson Corr.	0.674
	Sig.	0.001
Cost of borrowing[CB]	Pearson Corr.	0.752
	Sig.	0.002
Collateral requirements[CR]	Pearson Corr.	0.811
	Sig.	0.001

Cont. table 3.

Availability of Finance[AF]	Pearson Corr.	0.667
	Sig.	0.000
Past financing practice [PFP]	Pearson Corr.	0.621
	Sig.	0.000

Source: (SPSS output).

4. Discussions

Despite a wealth of study on SMEs, a review of the literature reveals a gap in the body of knowledge about the particular subject of SMEs' project funding. The supply side of financing instruments is the main topic of most studies. However, the demand side of SMEs' project financing practices is the focus of my research, which will be valuable because I have explained the current state of affairs for SMEs in practice.

Three main areas are highlighted in my research: SMEs' financing practices, factors influencing SMEs' project financing and challenges SMEs face when financing their projects. Furthermore, comparable studies have concentrated on certain industries, such as manufacturing or a particular category of SMEs; however, this research is wide in its approach and there is a knowledge vacuum because not much research has been done on SMEs in the Addis Ababa area. In general, the characteristics of SMEs affect their financial decisions and behavior and ultimately the firm's performance and growth.

From the research finding it was found out that the age of the firm has an effect on project financing. Similarly, it is found that business skill of the firm has an effect on its project financing. According to the study, the cost of borrowing explained in terms of high rate of interest that banks charge and lack of reputation affects the project financing of SME adversely. The research finding revealed that collateral as a mandatory requirement for project financing has become a serious issue and determinant factor of project financing for most of the Small and Medium Enterprises. It is revealed that that availability of finance has a great impact on project financing of Small and Medium Enterprises. For instance, availability of information on who is offering credit facilities and past experience has an impact on obtaining project financing successfully. In its general sense, even if past experience in financing has no direct effect on the current sources of project financing, it may have an indirect effect on project financing. For instance, past project financing has created an opportunity for the SME to have an easy access to the current sources of financing.

5. Summary

From the study result, it is concluded that shortage of raw material and machine, low level of business activity, and lack of finance, are the major problems that small and medium size business enterprises of Addis Ababa are suffering from. The trend of project financing shows that the major source of financing are local credit and saving associations and this trend is currently found declining through time.

Finally, the study result clearly depicted that Project Financing ability of the Firm [PFAF] of the small and medium size business enterprises is determined by factors such as age of the firm [A], Business skill of the firm [BS], Cost of borrowing [CB], Collateral requirements [CR], Availability of Finance [AF] and Past financing practice [PFP]). Among these six factors, the top three determinant factors of project financing are Age of the firm [A], Cost of borrowing [CB], and Collateral requirements [CR].

Although the critical study on project financing methods in Ethiopian small- and medium sized businesses (SMEs) in Addis Ababa offers insightful information, it should be noted that there are certain drawbacks and shortcomings. The 165 SME respondents in the study may not be a representative sample of all Addis Ababa's SME community, which restricts the findings' potential to be applied broadly. The study's dependence on self-administered surveys could have led to response bias since participants might not have comprehended the questions or might have given socially acceptable replies. The supply side of project financing practices, such as the role of financial institutions and governmental regulations in supporting SMEs' access to funding, may have been neglected in favor of the study's demand-side focus. The study's dependence on quantitative research techniques might have limited our knowledge of the elements influencing project finance practices and the difficulties experienced by SMEs. Because the business climate and financing methods in different places and nations may vary, the study's focus on SMEs in Addis Ababa could not be applicable to SMEs in other locations or nations.

However, the study has yielded important new insights and lessons in a number of important domains. The study provides fresh perspectives on the obstacles SMEs encounter while trying to secure project funding, especially in the context of Addis Ababa. It clarifies the particular problems associated with poor company activity, a shortage of raw materials, and a downward tendency in the use of local credit and savings institutions as funding sources. SME owners, policymakers, and financial institutions can learn a lot from the discovery of the top three project financing determinants for SMEs: the firm's age, the cost of borrowing, and the collateral requirements. Gaining insight into these factors can assist project stakeholders in identifying and removing obstacles to project funding. It suggestions also , which include the necessity for SMEs to obtain funding, diversify their commercial endeavors, and receive government assistance by making resources and financing more accessible, provide useful

guidance for decision-makers in government offices. In summary, the critical research provides fresh insights and insightful lessons about the obstacles and factors influencing project finance for small and medium-sized enterprises (SMEs) in Addis Ababa. It also has useful ramifications for future researchers, policymakers, and SME owners.

There are various reasons why it is crucial to conduct critical study on project financing practices in small and medium-sized enterprises (SMEs) in Addis Ababa, Ethiopia. With regard to Ethiopian SME financing practices, particularly in the setting of Addis Ababa, the study fills a vacuum in the literature. The study's conclusions can be used to guide the creation of programs and policies that assist SMEs and increase their access to funding. By gaining a better understanding of the obstacles and factors influencing project finance, SME owners can create plans to increase their marketability and financing availability.

Lastly, the researcher makes the following important suggestions. The small and medium size enterprises are advised to raise up their internal capital from government and non-government financial institutions. The government needs to support the small and medium size enterprises by facilitating the necessary raw material, machine and finance; through tax exception, leasing and by broadening the alternative sources of finance. The small and medium size enterprises are recommended to diversify their business activity other than the manufacturing, agricultural and textile industries; whereby creating the possibilities in the area of importance for the financiers. The government is also recommended to broaden its policy in providing the alternative sources of finance to the SME other than only saving and Credit Associations. National Bank of Ethiopia which sets the bench mark for interest rates is recommended to introduce a new policy for lending with lowering of interest rate, thereby, minimizing the cost of borrowing of the small and medium size business enterprises. Those stakeholders who are involved in project financing need to make the procedure and requirements of the collateral simple and conducive to the enterprises.

Furthermore, in addition to previous recommendations, conducting a study on supply side of project financing practice would provide a holistic project financing assessment of SMEs. This would enable us to identify any gaps or areas for improvement in the current practices and develop more effective strategies to support SMEs in their financing needs.

References

1. Ayyagari, M., Beck, T., Demirguc-Kunt, A. (2007). Small and Medium Enterprises across the Globe. *Small Business Economics*, 29(4), pp. 415-434.
2. Berger, A.N., Udell, G.F. (2006). A More Complete Conceptual Framework for SME Finance. *Journal of Banking and Finance*, 30(11), pp. 2945-2966.

3. Esty, B., Sesia Jr, A. (2005). *An Overview of Project Finance – 2004 Update*. Harvard Business School Case #205-065. Boston, MA: Harvard Business School Publishing.
4. Finnerty, J.D. (1996). *Project Financing: Asset-Based Financial Engineering*. New York, NY: John Wiley & Sons, Inc.
5. Gatti, S. (2013). *Project Finance in Theory and Practice – Designing, Structuring, and Financing Private and Public Projects*. Amsterdam: Academic Press (Advanced Finance Series).
6. Hoffman, S.L. (2001). *The Law and Business of International Project Finance (2nd ed.)*. New York: Transnational Publishers, Inc.; The Hague, The Netherlands: Kluwer Law International.
7. Kitindi, E.G., Magembe, B.A.S., Sethibe, A. (2007). Lending Decision Making and Financial Information: The Usefulness of Corporate Annual Reports to Lenders in Botswana. *International Journal of Applied Economics and Finance*, 1(2), pp. 55-60.
8. Kothari, C.R. (2004). *Research Methodology (2nd ed.)*. New Delhi: New Age International Publishers, pp. 4835/24, Ansari Road, Daryaganj. ISBN 13: 978-81-224-2488-1.
9. McMahon, R.G.P. (2001). Business Growth and Performance and the Financial Reporting Practices of Australian Manufacturing SMEs. *Journal of Small Business Management*, pp. 152-164.
10. Nevitt, P.K., Fabozzi, F.J. (2000). *Project Financing (7th ed.)*. London: Euromoney Publications.
11. Pacelle, M., Schroeder, M., Emshwiller, J. (2001). Enron Has One-Year Restructuring Target. *The Wall Street Journal*, December, 13, p. A3.
12. Saunders, M., Thornhill, A., Lewis, P. (2009). *Research Methods for Business Students (5th ed.)*. Harlow: Prentice Hall.

ARTIFICIAL INTELLIGENCE ACCEPTANCE AND IMPLEMENTATION IN MICROENTERPRISES: A CONCEPTUAL FRAMEWORK AND EVIDENCE FROM A PILOT STUDY

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Purpose: This paper proposes and preliminarily validates a process model for the acceptance and implementation of Artificial Intelligence (AI) in microenterprises. It addresses the research gap concerning how small firms, often constrained by limited resources and managerial capacity, adopt AI. The study aims to identify the stages and conditions necessary for effective and sustainable AI integration in microenterprise contexts.

Design/methodology/approach: A conceptual model of AI acceptance and implementation was developed based on a literature review, comprising seven stages: awareness and education, top management support, readiness assessment, strategy formulation, pilot testing and feedback, employee training and engagement, and continuous evaluation. To verify the model's conceptual validity, a quantitative pilot study was conducted in July 2025 among $n = 10$ white-collar employees from microenterprises in advertising, transport, tourism, and legal services. Data were collected using an online questionnaire with both Likert-scale and non-Likert questions.

Findings: Results indicate that AI adoption in microenterprises remains at an early stage. Mean scores (1.8-3.4) reveal moderate awareness but low managerial support, limited readiness, and an absence of strategic direction. Although all respondents reported using AI tools – mainly ChatGPT and other freely available applications – usage was individual and experimental rather than organisation-driven. The first two stages of the process (awareness and management support) were largely unfulfilled, constraining subsequent implementation phases.

Research limitations/implications: The pilot's small, non-random sample limits generalisability. Future research should involve larger, cross-sector samples and include qualitative methods to explore managerial aspects of AI adoption in greater depth.

Practical implications: The proposed process model serves as a diagnostic framework to guide microenterprise managers in prioritising early-stage interventions – particularly in developing awareness and managerial engagement – to ensure strategic and coordinated AI adoption.

Originality/value: This study offers one of the first empirically grounded models of AI acceptance and implementation tailored to microenterprises. It contributes to the literature on digital transformation by highlighting stage-specific challenges and underscoring the pivotal role of managerial awareness and leadership in fostering effective, sustainable AI integration.

Keywords: artificial intelligence, microenterprises, process of acceptance and implementation, pilot study.

Category of the paper: Research paper.

1. Introduction

Artificial Intelligence (AI) is broadly defined as the capability of machines to replicate intelligent human behaviour. It encompasses a spectrum of technologies designed to enable systems to perform tasks that typically require human intelligence, including learning, reasoning, problem-solving, and adaptation through experience. More specifically, AI focuses on developing algorithms and models that allow machines to process data intelligently, make autonomous decisions, and operate effectively in complex environments (Lee et al., 2019; Aji, Kumar, 2024). As technological development has accelerated, AI applications have evolved from theoretical concepts into practical tools that profoundly transform business operations across sectors.

In recent years, the integration of AI into business processes has led to significant improvements in operational efficiency and strategic innovation. Many organisations have embedded AI into their business models, with surveys suggesting that approximately 75% of companies are aligning their strategies to leverage AI capabilities (Lu, Li, 2024). AI supports automation, predictive analytics, personalised customer engagement, and enhanced decision-making processes, thereby allowing firms to streamline operations, reduce costs, and improve service quality (Aji, Kumar, 2024; Tula et al., 2024). For example, AI in e-commerce enables businesses to analyse customer preferences and behaviours, facilitating more targeted marketing strategies and enhanced customer experiences (Lari et al., 2022; Aji, Kumar, 2024).

Beyond operational gains, AI also serves as a catalyst for innovation and collaboration. It allows organisations to address challenges such as labour shortages by automating repetitive tasks and analysing large data sets without continuous human oversight (Zafar, 2024). This shift enables human workers to concentrate on higher-order tasks requiring creativity and strategic thinking. Furthermore, effective AI utilisation can reshape competitive dynamics, providing firms that integrate these technologies successfully with a distinct advantage (Alsheibani et al., 2020).

However, AI adoption introduces a range of technical, ethical, and organisational challenges. Businesses must address issues such as data privacy, algorithmic bias, and potential workforce displacement (Farayola et al., 2023; Enholm et al., 2021). Developing frameworks for responsible AI use is therefore essential to balance technological potential with ethical responsibility. Integrating human judgement alongside AI technologies can help ensure that implementation enhances decision quality while maintaining transparency and fairness (Jöhnk et al., 2020; Farayola et al., 2023). As AI becomes a cornerstone of strategic management, companies must carefully assess their readiness to adopt and integrate such systems (Jöhnk et al., 2020; Takeuchi, 2022).

The study of AI adoption in microenterprises is of particular importance. These entities represent vital drivers of economic development, especially in emerging economies, where they contribute significantly to employment and income generation. Nevertheless, microenterprises often face structural challenges, including limited access to technology and financial constraints (Ortiz-Medina, Guzmán, 2020; Singh, 2021). Integrating AI and other advanced information and communication technologies (ICTs) into their operations can enhance productivity and competitiveness, stimulate innovation, and improve responsiveness to market demands (Estébanez et al., 2022; Dávalos, 2023). Empirical evidence suggests that AI may assist microenterprises in automating tasks, managing customer relations, and optimising inventory processes (Shahid et al., 2024; Alva, 2019).

However, a significant empirical gap remains concerning how AI is adopted and implemented within this group. More research is required to understand how AI can help microenterprises overcome resource limitations and skill shortages (Liyanage et al., 2023; Dávalos, 2023). Understanding these dynamics is essential for designing supportive policies and promoting sustainable growth (Angeles et al., 2019; Inga-Ávila et al., 2023; Joni et al., 2024).

The aim of this paper is to propose and preliminarily validate a process model for the acceptance and implementation of AI in microenterprises.

The paper is structured as follows. First, the potential functional areas of management in microenterprises where AI can be applied are discussed. Second, the proposed stages of the AI acceptance and implementation process are presented, grounded in the literature review. Finally, the methodology and results of a pilot study designed to test the conceptual validity of the proposed process are reported, followed by concluding remarks.

Although numerous studies have examined AI adoption in large enterprises, research focusing on microenterprises remains scarce. This paper addresses this gap by developing and empirically testing a process model for AI acceptance and implementation specifically tailored to the characteristics and constraints of microenterprises.

To strengthen the theoretical foundation of the proposed process, the present study draws conceptually on the Technology-Organization-Environment (TOE) framework and complementary insights from technology acceptance theories such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The TOE framework (Tornatzky, Fleischer, 1990) explains organisational adoption of innovations through the interplay of technological, organisational, and environmental factors, providing a comprehensive basis for analysing how microenterprises respond to emerging technologies such as AI. Within this broader context, TAM (Davis, 1989) and UTAUT (Venkatesh et al., 2003) contribute a behavioural perspective, emphasising the cognitive mechanisms – such as perceived usefulness, ease of use, and social influence – that shape managerial and employee acceptance. Integrating these perspectives enables a multidimensional understanding of AI adoption, linking structural and contextual

determinants with individual-level attitudes and behavioural intentions. This theoretical combination aligns with the staged model proposed in this paper, which captures both organisational readiness and cognitive acceptance as key drivers of successful AI implementation in microenterprises.

Building on this theoretical foundation, the following section outlines the key functional areas of management in which AI can be applied within microenterprises, providing the contextual basis for the subsequent process model of AI acceptance and implementation.

2. AI utilisation in functional areas of management in microenterprises

Artificial Intelligence (AI) is transforming the operational framework of microenterprises across multiple functional areas of management. Its implementation enables these firms to enhance efficiency, strengthen competitiveness, and foster innovation. Existing studies identifies several functional domains in which AI can be most effectively applied within microenterprises, including financial management, human resource management, marketing and customer engagement, supply chain management, operational efficiency, and risk management.

AI can significantly improve financial management by automating processes such as bookkeeping, expense tracking, and financial forecasting. Machine learning algorithms offer insights into cash flow patterns and expenditure trends, allowing managers to make more informed financial decisions (Batista et al., 2022; Mostiero, 2022). Moreover, AI-driven tools provide real-time financial reporting, which is particularly valuable for microenterprises with limited capacity for dedicated financial oversight (Mostiero, 2022).

In microenterprises, where the owner-manager often performs multiple roles, AI can streamline human resource management by enhancing recruitment and employee supervision processes. AI tools facilitate candidate screening through résumé parsing and predictive analytics, assessing applicant suitability based on historical data (Seman et al., 2019). Additionally, AI can support employee performance evaluation by tracking productivity and providing data-based feedback, thereby encouraging a culture of continuous improvement (Seman et al., 2019).

AI has also demonstrated substantial potential in marketing and customer engagement. Through data mining and predictive analytics, AI enables microenterprises to analyse customer behaviour and preferences more effectively. These insights support the design of personalised marketing campaigns and the deployment of AI-powered chatbots, improving customer interaction and increasing conversion rates (Tosca et al., 2025). Predictive analytics further helps identify emerging consumer trends, allowing microenterprises to adjust their offerings to evolving market demands (Alves, Carvalho, 2022).

For microenterprises operating in retail or manufacturing sectors, AI can enhance supply chain management by improving demand forecasting and inventory control. AI-driven solutions facilitate automated order scheduling and real-time inventory tracking, thereby reducing holding costs and stockouts (Olanrewaju, Olanrewaju, 2020). These capabilities are particularly advantageous in rural or developing regions, where logistical challenges are common (Agustin et al., 2024).

AI contributes to operational efficiency by automating repetitive tasks and optimising workflow processes. Microenterprises can implement AI-based systems for production scheduling, resource allocation, and quality assurance (Klute-Wenig, Refflinghaus, 2020). Such applications enable more effective utilisation of scarce resources and allow for rapid organisational responses to market fluctuations (Kevill et al., 2020).

Finally, AI can play an important role in risk management by analysing historical data to predict potential threats related to financial performance, operational disruptions, or market instability. For example, AI systems can assess credit risk when applying for loans, supporting more financially sound decision-making (Nkote, Jakweyo, 2024). They can also aid in developing contingency strategies to mitigate the effects of unforeseen market changes (Bruhn et al., 2013).

The integration of AI into key managerial functions therefore presents substantial opportunities for microenterprises to improve their operations and drive sustainable growth. By leveraging AI technologies, microenterprises can strengthen financial stability, enhance operational efficiency, and innovate in customer relations and supply chain processes. Embracing AI adoption is thus essential for maintaining competitiveness and adaptability in an increasingly dynamic business environment.

Understanding these functional applications provides the necessary context for developing a structured process model of AI acceptance and implementation in microenterprises.

3. The process of acceptance and implementation of AI in microenterprises

The process of acceptance and implementation of AI in microenterprises may be conceptualised as a sequence of interrelated stages shaped by the specific managerial and organisational characteristics of these small entities. Unlike larger companies, microenterprises operate under tighter resource constraints, which makes the role of managerial attitudes and decision-making particularly significant. Figure 1 illustrates the proposed stages of the process of acceptance and implementation of AI in microenterprises, developed on the basis of the existing literature. Each stage represents a necessary condition for progression to the next, forming a cumulative and iterative process that mirrors the gradual nature of technological assimilation in small firms.

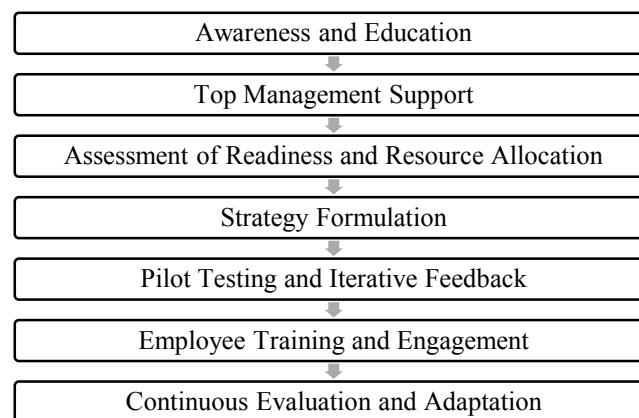


Figure 1. Stages of the process of acceptance and implementation of AI in microenterprises.

Source: own work.

The first stage involves raising awareness among managers about the potential benefits and applications of AI within their specific business context. Owner-managers must familiarise themselves with AI technologies and recognise their relevance for improving operational efficiency, customer engagement, and overall business performance (Wong, Yap, 2024). This educational phase may include participation in workshops, webinars, or online training designed to increase technological literacy and understanding of AI capabilities (Chen et al., 2020).

The next stage emphasises the importance of top management support. Research demonstrates that managerial commitment is strongly associated with successful AI implementation (Wong, Yap, 2024; Ghani et al., 2022). Owner-managers in microenterprises must actively promote AI initiatives, ensuring that they are aligned with organisational goals and effectively communicated to employees. Their leadership role extends to allocating the necessary financial and human resources and to fostering a culture that values experimentation, innovation, and learning (Rawashdeh et al., 2023).

Following this, managers should conduct a readiness assessment to evaluate their organisation's capacity for AI adoption. This includes analysing available financial resources, employee skill levels, and the state of existing IT infrastructure (Priya et al., 2022). Any gaps in these areas may be addressed through targeted training, collaboration with technology partners, or by seeking public support programmes that facilitate digital transformation in small firms (Dwivedi et al., 2021). Effective allocation of limited resources is critical to ensuring that AI implementation efforts are both feasible and sustainable (Chen et al., 2020).

Once readiness is established, microenterprises should engage in strategy formulation for AI adoption. This strategic plan should define clear objectives – such as enhancing customer service through AI chatbots or improving inventory control with predictive analytics – while identifying measurable success indicators and potential returns on investment (Jankovic, Curovic, 2023; Rawashdeh et al., 2023). Establishing such a roadmap helps ensure that AI initiatives are coherent with broader organisational priorities.

A subsequent stage involves pilot testing selected AI applications on a small scale before full implementation. This experimental phase enables managers to assess technological feasibility, collect user feedback, and refine both the tools and processes based on actual performance (Ore, Sposato, 2021). Cultivating a feedback-oriented environment is essential, as it transforms pilot testing into an iterative learning process that enhances both managerial confidence and employee engagement (Jankovic, Curovic, 2023).

Effective AI implementation also requires employee training and engagement. Managers should invest in capacity building to ensure that employees not only acquire the necessary technical competencies but also understand the practical value of AI in their daily tasks (Chen et al., 2022; Wong, Yap, 2024). Training programmes should emphasise collaboration between humans and AI systems, promoting a mindset in which technology is viewed as a complementary, rather than substitutive, element of work (Nayal et al., 2021).

Finally, AI adoption necessitates continuous evaluation and adaptation. Microenterprises must periodically assess the effectiveness of AI tools, monitor evolving market trends, and adjust their strategies in response to technological advancements (Jankovic, Curovic, 2023; Upadhyay et al., 2022). This cyclical approach ensures that AI systems remain aligned with organisational objectives and continue to deliver value over time.

In summary, the acceptance and implementation of AI in microenterprises is a multifaceted, iterative process driven by managerial awareness, commitment, and adaptability. By progressing through successive stages – awareness, managerial support, readiness assessment, strategic planning, pilot testing, training, and continuous evaluation – microenterprises can gradually integrate AI technologies into their operations. This structured pathway enables smaller firms to harness AI as a catalyst for efficiency, innovation, and sustainable growth within their unique organisational contexts.

4. Methodology of the Pilot Study

The proposed process required pilot testing to verify its conceptual validity. In particular, the pilot study aimed to determine whether all the identified stages should be included and whether their sequence accurately reflected the logic of AI acceptance and implementation in microenterprises.

To conduct the study, snowball sampling was used to recruit participants. This non-probability sampling technique began with a small group of initial respondents who subsequently referred other potential participants, thereby expanding the sample within a targeted and often hard-to-reach population. This approach was particularly suitable given the exploratory nature of the research and the specific characteristics of the target group (Chen et al., 2019). Furthermore, the method fostered trust and encouraged participation, which is especially important when the study concerns managerial and organisational practices.

The survey population comprised owners and knowledge (white-collar) employees of microenterprises. Self-employed individuals were excluded, as their operations, though formally classified as microenterprises, do not typically reflect the organisational characteristics under investigation.

The pilot study was conducted in July 2025 using an online questionnaire designed to assess the clarity and applicability of the proposed process model. The instrument contained seventeen questions presented in Table 1. One question addressed the industry in which the enterprise operated, while the remaining sixteen items referred to the stages of AI acceptance and implementation discussed earlier in the paper. The survey design aimed to verify the conceptual alignment between the theoretical process stages and practical perceptions of microenterprise employees

Table 1.
Pilot study questions

Step in AI adoption	Question	Source
Awareness and Education	How familiar are you with the concept of Artificial Intelligence (AI) and its applications in your industry? (1-5 Likert scale)	Kim et al. (2024)
	Have you participated in any training sessions related to AI in the past year? (yes/no)	Agustono et al. (2023)
	What sources do you primarily use to learn about AI technologies? (multiple-choice question)	Agustono et al. (2023)
Top Management Support	To what extent do you feel that top management supports the integration of AI within your company? (1-5 Likert scale)	Na et al. (2023)
	Has upper management allocated resources (financial, human, technological) specifically for AI implementation in your company? (yes/no/I don't know)	Horvat et al. (2023)
Assessment of Readiness and Resource Allocation	How would you rate our company's overall readiness to adopt AI technologies? (1-5 Likert scale)	Felemban et al. (2024)
	Do you believe we have the necessary technical skills among staff to implement AI? (1-5 Likert scale)	Na et al. (2022)
	What barriers do you perceive as most significant in adopting AI? (multiple-choice question)	Parameswari et al. (2024)

Cont. table 1.

Strategy Formulation	Is there a documented strategy for AI integration in your company? (yes/no/I don't know)	Botega, Silva (2020)
	How clear are the objectives and goals related to AI adoption? (1-5 Likert scale)	Wirtz et al. (2018)
Pilot Testing and Iterative Feedback	Have you used any AI applications in your work? (yes/no)	Strohm et al. (2020)
	If so, which ones? Please provide the name (short answer question)	n/a
	Is there a structured feedback mechanism for employees to share their experiences and suggestions during the pilot phase? (yes/no)	Kim et al. (2024)
Employee Training and Engagement	How engaged do you feel with the integration of AI technologies in daily tasks? (1-5 Likert scale)	Jankovic, Curovic (2023)
Continuous Evaluation and Adaptation	Is there a process in place for your company to adapt AI strategies based on performance evaluations? (yes/no/I don't know)	Paul et al. (2020)
	How open do you think your company is to making changes based on feedback about AI applications? (1-5 Likert scale)	Paesano (2021)

Source: own work.

Several questions used a five-point Likert scale, with anchors adapted to the semantic context of each construct, as follows:

- *1 = Not at all familiar – 5 = Extremely familiar* (familiarity with AI),
- *1 = Not supportive at all – 5 = Extremely supportive* (managerial support),
- *1 = Very unprepared – 5 = Very prepared* (organisational readiness),
- *1 = Strongly disagree – 5 = Strongly agree* (technical skills and engagement),
- *1 = Not clear at all – 5 = Extremely clear* (clarity of objectives),
- *1 = Not confident at all – 5 = Extremely confident* (confidence following training), and
- *1 = Not open at all – 5 = Very open* (openness to change and adaptation).

In addition to Likert-scale questions, the survey included dichotomous (*yes/no*) and multiple-choice items to gather descriptive data on AI implementation practices. This structure ensured conceptual consistency across all stages of the proposed process while maintaining response formats appropriate to each construct. All Likert items were coded so that higher values represented greater intensity of the measured attribute (e.g., stronger managerial support, higher readiness, greater familiarity).

The pilot study sample consisted of ten white-collar employees working in microenterprises. Participants were recruited through the author's professional network, meaning that the selection process was non-random. The respondents represented firms from the advertising, transport, tourism, and legal sectors, providing a sufficiently varied organisational background for assessing the general comprehensibility of the instrument.

The pilot study primarily focused on verifying whether the questions were understandable, logically structured, and appropriately aligned with the conceptual stages of the proposed process. Participant feedback confirmed that the questionnaire was clear and comprehensible, with no major ambiguities or technical issues reported.

5. Pilot research results

The results presented in Table 2, which refer to the Likert-scale questions, illustrate the respondents' perceptions of the individual stages of the proposed process of AI acceptance and implementation in microenterprises. Overall, the mean values remain within the low-to-moderate range, reflecting the early stage of AI adoption among the surveyed organisations.

Table 2.
Summary of Likert-Scale

Stage of Process	Question (summary)	Scale Anchors	Mean	SD
Awareness and Education	Familiarity with the concept of AI and its applications	1 = Not at all familiar – 5 = Extremely familiar	3.0	0.00
Top Management Support	Degree of managerial support for AI integration	1 = Not supportive at all – 5 = Extremely supportive	2.0	0.67
Readiness and Resource Allocation	Overall organisational readiness to adopt AI	1 = Very unprepared – 5 = Very prepared	2.4	0.52
	Availability of sufficient technical skills	1 = Strongly disagree – 5 = Strongly agree	2.4	0.52
Strategy Formulation	Clarity of AI-related objectives and goals	1 = Not clear at all – 5 = Extremely clear	1.8	0.42
Training and Engagement	Level of employee engagement in AI-related tasks	1 = Not engaged at all – 5 = Extremely engaged	2.0	0.67
Continuous Evaluation and Adaptation	Openness to making changes based on feedback	1 = Not open at all – 5 = Very open	3.4	0.52

Note. $n = 10$. Higher values indicate greater familiarity, support, readiness, engagement, or openness, depending on the construct measured.

Source: own work.

In the dimension of Awareness and Education, the mean score of 3.0 suggests a moderate level of familiarity with AI concepts and applications within the respondents' respective industries. By contrast, Top Management Support achieved a considerably lower mean score ($M = 2.0$), indicating that employees perceive limited institutional encouragement for AI-related initiatives.

The measures related to Organisational Readiness and Resource Allocation yielded mean scores of 2.4 for both readiness and technical skills, implying that the participating organisations are partially prepared for AI adoption but continue to face skill-based and infrastructural limitations. Similarly, Strategy Formulation recorded the lowest overall mean ($M = 1.8$), revealing an absence of clear strategic direction or formalised AI objectives.

Regarding Employee Training and Engagement, the mean score of 2.0 indicates a low-to-moderate level of involvement in AI-related activities, which corresponds with the limited formal training opportunities reported elsewhere in the survey. By contrast, the dimension of Continuous Evaluation and Adaptation yielded the highest score ($M = 3.4$), suggesting that although formal evaluation mechanisms are not yet established, employees are relatively open to feedback and change in relation to AI adoption.

Taken together, these findings confirm that the conceptual stages of the proposed process – from awareness to continuous adaptation – are empirically distinguishable and comprehensible to respondents. The low-to-moderate values also reinforce the interpretation that the participating microenterprises are at an early phase of AI acceptance and implementation, thereby supporting the conceptual soundness and practical relevance of the proposed process model for further empirical validation.

Responses to the non-Likert items complement the quantitative findings and provide additional insight into the current stage of AI acceptance and implementation in microenterprises. Among the ten respondents, four reported having participated in AI-related training within the past year, while the remaining six had not. When asked about sources of information on Artificial Intelligence, participants most frequently mentioned online courses and articles, often supplemented by peer discussions and independent exploration. These responses suggest that employees in microenterprises rely primarily on informal and self-directed learning rather than structured corporate training programmes.

Only two respondents indicated that top management had allocated financial, human, or technological resources to AI-related projects, while eight reported no such initiatives. This finding points to a generally low level of institutional support for AI development within the surveyed organisations, consistent with the early stage of digital maturity characteristic of microenterprises. When asked to identify the main barriers to AI adoption, participants most commonly cited a lack of technical expertise and resistance to change. A smaller number mentioned limited financial resources or a general reluctance toward using AI tools. These results confirm that both capability gaps and cultural factors remain central challenges for small enterprises considering AI implementation.

None of the participating organisations reported having a formal strategy for AI integration. Eight respondents explicitly answered “No” to the question about a documented strategy, while two selected “Not sure.” Similarly, no respondents confirmed the existence of key performance indicators (KPIs) to evaluate AI initiatives. This pattern indicates that while awareness of AI benefits exists, most microenterprises remain in a preliminary conceptual phase, without formalised strategic frameworks to guide adoption.

All respondents stated that they had used AI tools in their professional work. The most frequently mentioned applications included ChatGPT (eight respondents), Perplexity, Gemini, Grok, and a graphic design programme incorporating AI-based functions. Additional feedback indicated that, apart from the graphic design software, participants primarily relied on free or privately accessed versions of these tools rather than company-licensed or tailored solutions. This suggests that AI utilisation within these firms is largely individual and experimental, rather than embedded within organisational processes.

Although formal training programmes were rare, respondents expressed moderate confidence in using AI tools, indicating growing familiarity achieved through self-learning and peer exchange. This demonstrates that employees are developing practical skills in AI use,

but mainly outside structured corporate contexts. Engagement levels appeared moderate as well, suggesting that employees are becoming involved in AI-related tasks but remain outside formal implementation frameworks. No respondents confirmed the presence of a formal process for evaluating or revising AI strategies within their organisations. Nevertheless, their answers demonstrated an overall openness to feedback and change, reflecting a positive attitude toward future adaptation once more systematic procedures are introduced.

A summary of the non-Likert questions is presented in Table 3.

Table 3.
Summary of Non-Likert Questions

Section	Type of Question	Main Findings (n = 10)
Awareness and Education	Training & information sources	4 trained; main sources: online courses, articles, peer discussions
Top Management Support	Resource allocation (yes/no)	2 yes; 8 no
Readiness and Resources	Main barriers (multi-choice)	Lack of technical expertise; resistance to change
Strategy Formulation	Strategy and KPIs (yes/no)	No strategy or KPIs reported
Pilot Testing & Feedback	Use of AI tools	All use AI; main tools: ChatGPT, Gemini, Grok
Training & Engagement	Self-assessed confidence	Moderate confidence, limited formal training

Note. KPIs – key performance indicators.

Source: own work.

The results of both the Likert and non-Likert items collectively confirm that the proposed stages of AI acceptance and implementation are understandable, distinct, and empirically relevant to the realities of microenterprises. However, the findings also reveal low managerial support, limited technical readiness, and a lack of strategic frameworks, signalling that most microenterprises remain in a nascent phase of AI integration.

Despite these limitations, the generally positive attitudes toward adaptation and openness to change suggest a potential foundation for more advanced AI initiatives in the future. Consequently, the pilot study supports the validity and practical utility of the proposed process model while also identifying key areas for improvement to be explored in larger-scale, confirmatory research. Overall, the pilot findings demonstrate that AI use in microenterprises is largely decentralised and employee-driven, reflecting early experimentation rather than systematic implementation. The absence of managerial guidance and organisational frameworks prevents firms from realising the full potential of AI technologies.

6. Discussion and conclusions

This paper identifies a range of potential benefits that microenterprises can derive from the utilisation of Artificial Intelligence (AI). These benefits have been categorised according to key functional areas of management, demonstrating the potential for performance improvement through the effective adoption of AI in daily operations.

A central element of the paper is the proposed process of AI acceptance and implementation in microenterprises, supported by a detailed discussion of its individual stages derived from the literature. To verify the conceptual validity of this process, a quantitative pilot study was conducted.

The results of the pilot study provide a valuable basis for refining the proposed process to ensure its closer alignment with the specific characteristics of microenterprises. These findings provide important insights into the underlying factors shaping the early stages of AI acceptance in microenterprises and highlight the role of managerial perceptions in determining the overall success of implementation efforts.

In particular, the findings indicate that the first two stages of the process – awareness and education, as well as top management support – have not been effectively fulfilled in the surveyed firms. The finding of low managerial support for AI initiatives can be further interpreted through the lens of technology acceptance theories, particularly the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). According to these models, individuals' willingness to adopt new technologies depends largely on their perceived usefulness, ease of use, and social influence. Recent studies confirm these mechanisms: top management support has been shown to significantly enhance AI adoption through its positive effect on perceived usefulness and ease of use (Song et al., 2025), while performance expectancy and social influence have emerged as critical predictors of behavioural intention to use AI (Su et al., 2025). In microenterprises, owner-managers often perceive AI as complex, costly, or misaligned with their operational needs, which reduces perceived usefulness and increases cognitive resistance. Limited technological literacy may also lower perceived behavioural control and self-efficacy, discouraging investment and experimentation. Consequently, the observed lack of managerial support may not stem solely from financial constraints but from underlying cognitive and behavioural barriers. Addressing these perceptual and attitudinal factors through targeted education, demonstration of practical benefits, and peer learning initiatives could therefore enhance managerial readiness and accelerate AI adoption in microenterprises. This behavioural interpretation also helps explain the broader organisational pattern observed in the pilot study, where AI adoption appears largely informal and employee-driven rather than strategically coordinated.

With the exception of graphic design applications, the AI tools used by employees were not intentionally selected to meet organisational needs but rather adopted individually, often through free or private versions. This suggests that top management lacks sufficient knowledge of tailored AI solutions, which in turn limits the strategic and coordinated use of such technologies. Consequently, the absence of these initial stages constrains the effectiveness of subsequent stages, as organisational readiness, strategy formulation, and employee engagement cannot be expected to reach a high level without foundational managerial awareness and support. Strengthening managerial understanding and commitment is therefore essential for progressing from individual, experimental AI use toward structured, organisation-wide implementation in microenterprises.

Despite these limitations, the pilot study offers practical insights for improving the proposed process and demonstrates that the conceptual stages are empirically distinguishable and understandable to respondents. The study also highlights the need to strengthen the early phases of AI acceptance – particularly managerial understanding and strategic guidance – as prerequisites for successful implementation in microenterprises.

As with any exploratory research, this pilot study has certain limitations. The analysis was based on a small, non-random sample of participants, which restricts the generalisability of the results. Moreover, the study's scope was limited to preliminary verification of the survey instrument and conceptual model rather than comprehensive statistical validation.

Future research should therefore aim to test the proposed process on a larger and more diverse sample of microenterprises, ideally across different sectors and national contexts. Further studies may also incorporate qualitative approaches, such as interviews or case studies, to explore managerial attitudes, decision-making mechanisms, and organisational barriers in greater depth. Additionally, longitudinal research could assess how improvements in the early stages of AI awareness and top management support influence the success of subsequent implementation efforts.

In summary, while AI offers substantial opportunities for improving the competitiveness and efficiency of microenterprises, its successful adoption depends on the development of knowledge, leadership, and strategic alignment at the managerial level. This dynamic underscores the significant research potential within the field of management sciences, particularly in identifying the conditions, strategies, and best practices that enable microenterprises to implement AI effectively and sustainably. By addressing these gaps, future studies can contribute not only to theory-building in the field of AI adoption but also to practical frameworks supporting the digital transformation of microenterprises.

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References

1. Agustin, N., Hidalgo, D., Morante, B. (2024). Challenges in digital transformation of microenterprises in Nueva Ecija: a basis for risk management plan. *Journal of Economics Management and Trade*, 30(4), 13-26. <https://doi.org/10.9734/jemt/2024/v30i41201>
2. Agustono, D., Nugroho, R., Fianto, A. (2023). *Artificial intelligence in human resource management practices*. Kne Social Sciences. <https://doi.org/10.18502/kss.v8i9.13409>
3. Aji, S., Kumar, D. (2024). Rise of artificial intelligence in business and industry. *Journal of Informatics Education and Research*, 4(2). <https://doi.org/10.52783/jier.v4i2.850>
4. Alsheibani, S., Messom, C., Cheung, Y. (2020). *Re-thinking the competitive landscape of artificial intelligence*. Proceedings of the 53rd Hawaii International Conference on System Sciences. <https://doi.org/10.24251/hicss.2020.718>
5. Alva, E. (2019). What is a good worker? Non-cognitive skills and trade microenterprises' success. *International Journal of Organizational Analysis*, 27(4), 986-1003. <https://doi.org/10.1108/ijoa-06-2018-1449>
6. Alves, A., Carvalho, F. (2022). How dynamic managerial capabilities, entrepreneurial orientation, and operational capabilities impact microenterprises' global performance. *Sustainability*, 15(1), 14. <https://doi.org/10.3390/su15010014>
7. Angeles, I., Calara, M., Guzman, A. (2019). The mediating effect of microfinancing on access to finance and growth of microenterprises: evidence from the Philippines. *Journal of Global Entrepreneurship Research*, 9(1). <https://doi.org/10.1186/s40497-019-0150-x>
8. Batista, C., Sequeira, S., Vicente, P. (2022). Closing the gender profit gap? *Management Science*, 68(12), 8553-8567. <https://doi.org/10.1287/mnsc.2022.4579>
9. Botega, L., Silva, J. (2020). An artificial intelligence approach to support knowledge management on the selection of creativity and innovation techniques. *Journal of Knowledge Management*, 24(5), 1107-1130. <https://doi.org/10.1108/jkm-10-2019-0559>
10. Bruhn, M., Karlan, D., Schoar, A. (2013). The impact of consulting services on small and medium enterprises: evidence from a randomized trial in Mexico. *Policy Research Working Paper*. <https://doi.org/10.1596/1813-9450-6508>

11. Chen, H., Li, L., Chen, Y. (2020). Explore success factors that impact artificial intelligence adoption on telecom industry in China. *Journal of Management Analytics*, 8(1), 36-68. <https://doi.org/10.1080/23270012.2020.1852895>
12. Chen, Y., Hu, Y., Zhou, S., Yang, S. (2022). Investigating the determinants of performance of artificial intelligence adoption in hospitality industry during covid-19. *International Journal of Contemporary Hospitality Management*, 35(8), 2868-2889. <https://doi.org/10.1108/ijchm-04-2022-0433>
13. Chen, Y., Tsui, P., Lee, C., Chen, G. (2019). Can plate colour promote appetite and joy while dining? an investigative study in Chinese fine dining restaurants. *Asia Pacific Journal of Marketing and Logistics*, 32(1), 105-116. <https://doi.org/10.1108/apjml-07-2018-0247>
14. Dávalos, R. (2023). Influence of technology adoption on organizational performance: evidence from Paraguayan microenterprises. *South Florida Journal of Development*, 4(2), 696-718. <https://doi.org/10.46932/sfjdv4n2-007>
15. Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319-340.
16. Dwivedi, Y., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Williams, M. (2021). Artificial intelligence (AI): multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, 57, 101994. <https://doi.org/10.1016/j.ijinfomgt.2019.08.002>
17. Enholm, I., Papagiannidis, E., Mikalef, P., Krogstie, J. (2021). Artificial intelligence and business value: a literature review. *Information Systems Frontiers*, 24(5), 1709-1734. <https://doi.org/10.1007/s10796-021-10186-w>
18. Estébanez, R., Grande, E., Espada, M. (2022). Adoption of information technology by micro-enterprises. Evidence from the democratic republic of Congo (DRC). *European Journal of Sustainable Development*, 11(3), 167. <https://doi.org/10.14207/ejsd.2022.v11n3p167>
19. Farayola, O., Abdul, A., Irabor, B., Okeleke, E. (2023). Innovative business models driven by AI technologies: a review. *Computer Science & It Research Journal*, 4(2), 85-110. <https://doi.org/10.51594/csitrj.v4i2.608>
20. Felemban, H., Sohail, M., Ruikar, K. (2024). Exploring the readiness of organisations to adopt artificial intelligence. *Buildings*, 14(8), 2460. <https://doi.org/10.3390/buildings14082460>
21. Ghani, E., Ariffin, N., Sukmadilaga, C. (2022). Factors influencing artificial intelligence adoption in publicly listed manufacturing companies: a technology, organisation, and environment approach. *International Journal of Applied Economics Finance and Accounting*, 14(2), 108-117. <https://doi.org/10.33094/ijaefa.v14i2.667>

22. Horvat, D., Baumgartner, M., Kinkel, S., Mikalef, P. (2023). *Examining heterogeneous patterns of AI capabilities*. IFIP Advances in Information and Communication Technology. https://doi.org/10.1007/978-3-031-43666-6_42
23. Inga-Ávila, M., Churampi-Cangalaya, R., Ulloa-Ninahuamán, J., Inga-Ávila, J., Uribe-Hinostroza, M., Inga-Aliaga, M., Huamán-Pérez, F. (2023). Digital transformation and competitiveness in Peruvian small business. *International Journal of Data and Network Science*, 7(4), 1797-1804. <https://doi.org/10.5267/j.ijdns.2023.7.012>
24. Jankovic, S., Curovic, D. (2023). Strategic integration of artificial intelligence for sustainable businesses: implications for data management and human user engagement in the digital era. *Sustainability*, 15(21), 15208. <https://doi.org/10.3390/su152115208>
25. Jöhnk, J., Weißert, M., Wyrski, K. (2020). Ready or not, AI comes – an interview study of organizational AI readiness factors. *Business & Information Systems Engineering*, 63(1), 5-20. <https://doi.org/10.1007/s12599-020-00676-7>
26. Joni, I., Mokhtar, S., Talip, B., Permana, I. (2024). Smart Banjar: an ICT adoption framework to enhance people's welfare. *International Journal on Advanced Science Engineering and Information Technology*, 14(1), 107-117. <https://doi.org/10.18517/ijaseit.14.1.18466>
27. Kevill, A., Trehan, K., Harrington, S., Kars-Ünlüoğlu, S. (2020). Dynamic managerial capabilities in micro-enterprises: stability, vulnerability and the role of managerial time allocation. *International Small Business Journal Researching Entrepreneurship*, 39(6), 507-531. <https://doi.org/10.1177/0266242620970473>
28. Kim, Y., Blazquez, V., Oh, T. (2024). Determinants of generative AI system adoption and usage behavior in Korean companies: applying the UTAUT model. *Behavioral Sciences*, 14(11), 1035. <https://doi.org/10.3390/bs14111035>
29. Klute-Wenig, S., Refflinghaus, R. (2020). Quality management for microenterprises and start-ups: is the iso 9001 suitable? *International Journal of Quality and Service Sciences*, 12(1), 44-55. <https://doi.org/10.1108/ijqss-01-2018-0006>
30. Lee, J., Suh, T., Roy, D., Baucus, M. (2019). Emerging technology and business model innovation: the case of artificial intelligence. *Journal of Open Innovation Technology Market and Complexity*, 5(3), 44. <https://doi.org/10.3390/joitmc5030044>
31. Liyanage, M., Morais, S., Abeysinghe, S., Wickramasinghe, C. (2023). The impact of access to finance on firm performance: evidence from microenterprises of Sri Lanka. *International Journal of Accounting and Business Finance*, 9(2), 1-17. <https://doi.org/10.4038/ijabf.v9i2.140>
32. Lu, X., Li, Z. (2024). The application of artificial intelligence technology in the digital economy. *Advances in Economics Management and Political Sciences*, 101(1), 195-199. <https://doi.org/10.54254/2754-1169/101/20231546>

33. Mostiero, J. (2022). Working capital management practices of microenterprises in lipa city as predictors of business sustainability. *International Journal of Research Publications*, 104(1). <https://doi.org/10.47119/ijrp1001041720223596>
34. Na, S., Heo, S., Choi, W., Han, S., Kim, C. (2023). Firm size and artificial intelligence (AI)-based technology adoption: the role of corporate size in south Korean construction companies. *Buildings*, 13(4), 1066. <https://doi.org/10.3390/buildings13041066>.
35. Na, S., Heo, S., Han, S., Shin, Y., Roh, Y. (2022). Acceptance model of artificial intelligence (AI)-based technologies in construction firms: applying the technology acceptance model (tam) in combination with the technology–organisation–environment (toe) framework. *Buildings*, 12(2), 90. <https://doi.org/10.3390/buildings12020090>
36. Nayal, K., Raut, R., Priyadarshinee, P., Narkhede, B., Kazançoğlu, Y., Narwane, V. (2021). Exploring the role of artificial intelligence in managing agricultural supply chain risk to counter the impacts of the covid-19 pandemic. *The International Journal of Logistics Management*, 33(3), 744-772. <https://doi.org/10.1108/ijlm-12-2020-0493>
37. Nkote, I., Jakweyo, C. (2024). Do government support correlates enhance financial performance? rural microenterprises perspectives. *Journal of Money and Business*, 4(1), 91-106. <https://doi.org/10.1108/jmb-09-2022-0044>
38. Olanrewaju, E., Olanrewaju, O. (2020). Rural electrification and profitability among rural women - owned microenterprises in Nigeria. *Shanlax International Journal of Economics*, 8(4), 1-11. <https://doi.org/10.34293/economics.v8i4.3381>
39. Ore, O., Sposato, M. (2021). Opportunities and risks of artificial intelligence in recruitment and selection. *International Journal of Organizational Analysis*, 30(6), 1771-1782. <https://doi.org/10.1108/ijoa-07-2020-2291>
40. Ortiz-Medina, M., Guzmán, G. (2020). Information and communication technology and growth in the Dominican Republic microbusinesses. *International Business Research*, 13(9), 129. <https://doi.org/10.5539/ibr.v13n9p129>
41. Paesano, A. (2021). Artificial intelligence and creative activities inside organizational behaviour. *International Journal of Organizational Analysis*, 31(5), 1694-1723. <https://doi.org/10.1108/ijoa-09-2020-2421>
42. Parameswari, R., Patil, S., Dawasaz, A., Baig, F., Karobari, M. (2024). Unlocking the potential: investigating dental practitioners' willingness to embrace artificial intelligence in dental practice. *Cureus*. <https://doi.org/10.7759/cureus.55107>
43. Paul, S., Riaz, S., Das, S. (2020). Organizational adoption of artificial intelligence in supply chain risk management., 10-15. https://doi.org/10.1007/978-3-030-64849-7_2
44. Priya, S., Jain, V., Priya, M., Dixit, S., & Joshi, G. (2022). Modelling the factors in the adoption of artificial intelligence in Indian management institutes. *Foresight*, 25(1), 20-40. <https://doi.org/10.1108/fs-09-2021-0181>

45. Rawashdeh, A., Bakhit, M., Abaalkhail, L. (2023). Determinants of artificial intelligence adoption in SMEs: the mediating role of accounting automation. *International Journal of Data and Network Science*, 7(1), 25-34. <https://doi.org/10.5267/j.ijdns.2022.12.010>
46. Seman, N., Jusoh, N., Rashid, U., Ramin, A. (2019). An analysis of basic accounting practices of microenterprises. *International Journal of Engineering and Advanced Technology*, 8(5c), 628-637. <https://doi.org/10.35940/ijeat.e1089.0585c19>
47. Shahid, M., Salvi, E., Sajjad, M. (2024). Navigating crisis through digitalisation and its impact on firm formality: the case of microenterprises in India. *International Journal of Sociology and Social Policy*, 45(1/2), 274-291. <https://doi.org/10.1108/ijssp-08-2024-0390>
48. Singh, U. (2021). *Global trends in management, IT and governance in an e-world*. E-MIG 2019 international. <https://doi.org/10.29086/978-0-9869936-9-5/2021/aasbs07>
49. Song, Y., Qiu, X., Liu, J. (2025). The Impact of Artificial Intelligence Adoption on Organizational Decision-Making: An Empirical Study Based on the Technology Acceptance Model in Business Management. *Systems*, 13(8), 683. <https://doi.org/10.3390/systems13080683>
50. Strohm, L., Hehakaya, C., Ranschaert, E., Boon, W., Moors, E. (2020). Implementation of artificial intelligence (AI) applications in radiology: hindering and facilitating factors. *European Radiology*, 30(10), 5525-5532. <https://doi.org/10.1007/s00330-020-06946-y>
51. Su, J., Wang, Y., Liu, H., Zhang, Z., Wang, Z., Li, Z. (2025). Investigating the factors influencing users' adoption of artificial intelligence health assistants based on an extended UTAUT model. *Scientific Reports*, 15(1), 18215. <https://doi.org/10.1038/s41598-025-01897-0>
52. Takeuchi, H. (2022). Method for identifying business goals and tasks for AI service system. *Information Engineering Express*, 8(2), 1. <https://doi.org/10.52731/iee.v8.i2.712>
53. Tian, L., Zhang, Z., Long, Y., Tang, A., Deng, M., Long, X., Fang, N., Yu, X., Ruan, X., Qiu, J., Wang, X., Deng, H. (2022). Endoscopists' acceptance on the implementation of artificial intelligence in gastrointestinal endoscopy: development and case analysis of a scale. *Frontiers in Medicine*, 9. <https://doi.org/10.3389/fmed.2022.760634>
54. Tornatzky, L., Fleisher, M. (1990). *The processes of technological innovation. Issues in organization and management series*. Lexington Books.
55. Tosca, D., Martínez-Manuel, R., Notario-Priego, R., Izquierdo, K., Rivera-Rodriguez, M. (2025). *Teaching with artificial intelligence in rural communities for microenterprise development*. Intelligent Human Systems Integration (IHSI 2025): Integrating People and Intelligent Systems. <https://doi.org/10.54941/ahfe1005848>
56. Tula, S., Kess-Momoh, A., Omotoye, G., Bello, B., Daraojimba, A. (2024). AI-enabled customer experience enhancement in business. *Computer Science & IT Research Journal*, 5(2), 365-389. <https://doi.org/10.51594/csitrj.v5i2.789>
57. Upadhyay, N., Upadhyay, S., Al-Debei, M., Baabdullah, A., Dwivedi, Y. (2022). The influence of digital entrepreneurship and entrepreneurial orientation on intention of

- family businesses to adopt artificial intelligence: examining the mediating role of business innovativeness. *International Journal of Entrepreneurial Behaviour & Research*, 29(1), 80-115. <https://doi.org/10.1108/ijebr-02-2022-0154>
58. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.
59. Wirtz, B., Weyerer, J., Geyer, C. (2018). Artificial intelligence and the public sector – applications and challenges. *International Journal of Public Administration*, 42(7), 596-615. <https://doi.org/10.1080/01900692.2018.1498103>
60. Wong, J., Yap, K. (2024). Factors influencing the adoption of artificial intelligence in accounting among micro, small medium enterprises (ESMEs). *Quantum Journal of Social Sciences and Humanities*, 5(1), 16-28. <https://doi.org/10.55197/qjssh.v5i1.323>
61. Zafar, N. (2024). Adaption of artificial intelligence (AI) to enhance business and collaboration between countries, focusing on Saudi Arabia. *Journal of Accounting Business and Management (JABM)*, 32(1), 355. <https://doi.org/10.31966/jabminternational.v32i1.1475>

ARTIFICIAL INTELLIGENCE IN THE CYBER DOMAIN – HOPES AND THREATS

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Purpose: The purpose of this article is to analyze the role of artificial intelligence (AI) in the cyber domain, addressing both the benefits and risks. The paper aims to explore AI's potential in enhancing the effectiveness of cybersecurity systems and to identify challenges associated with its use in cyberspace, especially in armed conflicts, like the one in Ukraine.

Design/methodology/approach: To achieve the research objective, both theoretical and empirical methods were applied, including analysis, synthesis, deduction, induction, and scientific observation. Data from industry reports and empirical research on AI in the context of cyber threats were analyzed, providing an in-depth overview of AI's impact on cybersecurity.

Findings: The research shows that AI significantly supports cybersecurity systems, enabling rapid detection and mitigation of threats such as zero-day attacks. Simultaneously, advanced AI algorithms may pose a threat when used for cyberattacks (e.g., deepfake phishing). The findings highlight the need for legal regulations to mitigate AI-related risks in cyberspace.

Research limitations/implications: The main limitation stems from the rapid development of AI technology, which may necessitate updates to the conclusions as technology advances. Future research should focus on creating adaptive defense mechanisms and establishing regulatory frameworks for AI in cybersecurity.

Practical implications: The article suggests that AI advancements in cybersecurity systems will offer practical benefits, such as faster threat detection and neutralization and improved critical infrastructure protection. Practically, this implies a need for investment in AI and the development of appropriate security protocols.

Social implications: The use of AI in cybersecurity could enhance personal data protection and public safety. However, the article emphasizes the need for regulations to ensure AI is used responsibly, which is crucial from both social and ethical perspectives.

Originality/value: The article provides a new perspective on the use of AI in cybersecurity within the context of armed conflicts and risks associated with its misuse. It is addressed to scholars and practitioners interested in cybersecurity and technologists developing AI.

Keywords: artificial intelligence, cybersecurity, cyber threats, armed conflict, AI regulations.

Category of the paper: Research paper.

1. Introduction

The development of cybertechnology has sparked changes in almost every aspect of state functioning. Thanks to the Internet, a major factor in the global revolution, many everyday devices have received constant access to information in real time. Which has translated into the convenience of using these devices as well as the development of individuals and organizations. On the other hand, this opportunity has brought many risks related to the security of state institutions, organizations, the private sector and citizens. The modern state, more than ever, has become dependent on digital communications, and national security and economic stability have become dependent on the flow of information using technology. It should be noted that even the most advanced technology can become useless in the event of a hardware or software failure, and an increasingly common cause of these situations is the malicious actions of hackers, cyber criminals or cyber terrorists (Górka, 2021). Cyberspace, nowadays, can be defined as: public administration, social activity and our daily life, (e.g., leisure activities). Researchers define it as network, information and interface connections, present in economic and social transformations (human and cultural interactions) (Paatero, 2021). T. Szulc predicts that after 2050 the world will be a world of augmented reality, completely virtual and cyberspace, based on inventions and revolutionary advances in science and technology that are difficult to imagine today (Szulc, 2018). Cyberspace is a virtual domain, an environment artificially created by man, limited only by the capabilities of the human mind, human creativity in constructing further sub-networks, layers or elements. The dissimilarity of cyberspace from the physical domains of the operational environment, (land, sea, air and space), means that cyber weapons will be unique in many ways compared to kinetic weapons systems. In cyberspace, it is difficult to determine the perpetrator of an attack if he or she is unwilling to reveal himself or herself. Identifying the geographic source of an attack does not mean that it was carried out on behalf of the government of the country on whose territory the source was located. Moreover, pointing to a specific copy of the computer from which the attack was made does not make it possible to determine who carried it out (physically used the computer at the time of the attack) (Dymanowski, 2016). Therefore, in 2016, during the NATO Summit in Warsaw, cyber space was recognized as another domain (then the fourth) in which operational activities can be conducted. To this end, 7 commitments known as the Cyber Defense Pledge were adopted. The cyber domain is also referred to as a new and unstable man-made environment. The characteristics of cyberspace imply a change in the balance of power between the various actors in the international arena, and thus provide a good example of the diffusion of power that characterizes global politics in this century. According to J. Nye, the major powers will not be able to dominate this domain as much as the others: sea, air, etc. (Bógdał-Brzezińska, 2020; Nye, 2010). Cyberspace is under constant attack, not only during conflict, but even in

peacetime. Nowadays we constantly hear about attacks on critical infrastructure, communication systems and information space.

The development of digital technology has made artificial intelligence (AI) one of its components. The very concept of artificial intelligence emerged as early as the middle of the 20th century. Although it is widely used there is still no clear definition of the term. It is defined as “intelligence demonstrated by machines” as opposed to natural intelligence in humans and animals. The literature often distinguishes the division of artificial intelligence into two main types of AI: “strong” and “weak”. Strong is the vision of a machine with capabilities equal to humans (not yet in existence), while “weak” AI is defined as specialized algorithms based on machine learning (ML) and data engineering. The European Commission defines AI as computer software (and possibly hardware) created by humans, operating physically or digitally by collecting data, interpreting the collected structured or unstructured data, reasoning from knowledge or processing information derived from the data, and deciding on the best action to take to achieve a specific goal (Grabowski, 2022). According to the degree of capability compared to human intelligence, M. Roszczak distinguished three categories of AI. The first, referred to as narrow artificial intelligence, designed to perform specific tasks, such as speech recognition, image analysis, etc (Orłowski, 2023). It does not have a general understanding capability. The second, called “general artificial intelligence”, is a theoretical concept of a machine with human intellectual abilities, capable of consciousness and self-awareness (still in the research phase). The third type is “artificial superintelligence”, which would surpass human intellectual abilities in all areas, such as creativity and social skills. For the time being, this is only a hypothetical goal (Rojszczak, 2019). In the cyber domain, artificial intelligence, on the other hand, is seen as a modern security system. Due to the author's interests, further considerations undertaken in this article mainly focused on the use of artificial intelligence in the ongoing armed conflict (cyber domain), however, there was also reference to the civilian environment.

2. Literature Review

The development of artificial intelligence (AI) in the cyber context is of growing interest to researchers, practitioners and policymakers. The literature notes an emphasis on the duality of AI's impact: on the one hand, it offers the potential to increase efficiency and precision in cybersecurity operations, while on the other hand, it represents a source of new challenges and threats (Russell, Norvig 2020; Goodfellow et al., 2016). Research indicates that AI can effectively support security systems by automating threat identification, anomaly detection, and high-throughput data analysis, which is particularly useful in defense systems and the financial sector (Buczak et al., 2016; Oltramari et al., 2014). Machine learning and natural language

processing play a special role here, enabling faster response to attacks and minimizing potential financial and reputational losses (Vinayakumar et al., 2019). Artificial intelligence is a general-purpose technology with significant technological, social, economic and political implications (Oleksiewicz, 2020). It is being used today in the armed conflict in Ukraine to analyze intelligence, monitor Russian troop movements and optimize strategic decisions. In cybersecurity, among other things, for information warfare, where both sides of the conflict use AI technologies to defend against cyber-attacks and for propaganda operations. The use of artificial intelligence in the conflict in Ukraine, as Kowalczevska points out, is complex and multidimensional, involving both military and civilian aspects. It is used to improve the effectiveness of warfare, as well as humanitarian and information support. Both sides of the conflict effectively use it to defend against cyberattacks and to carry out offensive operations. Artificial intelligence makes it possible to quickly detect and neutralize threats in cyberspace, which is extremely important during potential attacks on critical infrastructure. In addition, its use to monitor and analyze information on social media and other digital platforms to identify attempted disinformation and manipulation of public opinion has been documented (Kowalczevska, 2021). M. Rudyk, on the other hand, describes the use of artificial intelligence during the war in Ukraine by independent journalists Bellingcat. Who used it to create various types of reports and analysis using military, political and economic information (OSINT open-source intelligence, or white intelligence based on open sources, such as Google Maps, photos, videos, web posts, etc.). The collected data was analyzed and mapped cases of damage and losses among the population in Ukraine (destruction of infrastructure, civilian casualties). The efforts of these journalists, using AI, were directed at exposing the manipulation of the Russian army's falsification of crimes (including in: Bucza, Mariupol and Kramatorsk). Journalists from The New York Times, also used AI to analyze satellite images from the US company Maxar Technologies. They made a comparison of photographs of victims murdered by Russian occupiers in Bucha and confirmed their authenticity. Journalists from "Schemes" (Radio Svoboda), used AI to analyze satellite photos from the same company (Maxar) and attempted to uncover more mass graves in occupied Mariupol and surrounding villages. AI during the armed conflict on Ukrainian territory was also used in drone technology to analyze data, plan operations and support decision-making. Analyzing data from various sources, it can be concluded that artificial intelligence processes information in a timeframe impossible for humans (Rudyk, 2024). L. Szymanski, describes the use of AI during this armed conflict to acquire and analyze intelligence (ISR) data in signal (SIGINT) and imagery (IMINT) forms, as well as in overt-source intelligence (OSINT), making it possible to select and analyze vast data resources, and in logistical operational support to predict equipment service needs (Szymanski, 2023). The U.S. Joint All Domain Command and Control (JADC2) system, with the help of AI, integrates data from multiple domains: land, air, space and cyber, and provides it to commands in the form of an integrated operational picture. In addition, AI technology has made it possible to coordinate operations under combat conditions, such as

in the “swarming” tactics of drones (Prus, 2024). However, researchers highlight the magnitude of the risks associated with inappropriate use of AI technology. For example, it is possible that advanced algorithms will be used to launch sophisticated phishing attacks or steal data in a way that fools standard defense systems (Robles, Mallinson, 2023). The literature also devotes attention to the “AI vs. AI” phenomenon, i.e. the use of artificial intelligence by both defenders and attackers, leading to a kind of “arms race” in the area of cybersecurity (Brundage et al., 2018). Parallel to technological and functional research, an ethical and legal debate is developing on the use of AI in cyberspace. According to P. I. Chen et al. the introduction of regulations covering AI can influence the reduction of the possibility of unauthorized access to data and ensure transparency of actions taken by algorithms in the context of cyber security (Chen et al., 2020).

3. Research Methodology

In preparing the article, the author used both theoretical and empirical research methods, particularly analysis, synthesis, deduction, induction, comparison, generalization, as well as scientific observation with casual observation technique. An analysis of empirical data from industry reports on artificial intelligence compiled by Human Rights Watch, Harvard University and trojanczyk.pl was conducted. What resulted was the deepening of knowledge in the area of the studied issues, as well as the identification of their interrelationships and the dependencies between them.

4. Results

The research conducted in this article indicates that AI can effectively support security systems by automating threat identification, anomaly detection and high-throughput data analysis, which is particularly useful in defense systems (modern conflict on Ukrainian territory) or in other sectors such as finance (Buczak et al., 2016; Grzywacz et al., 2021; Prus, 2024). As a definite advantage of artificial intelligence, one should mention the possibility of machine learning and natural language processing, which enable rapid response to attacks and minimize potential financial and reputational losses. Nowadays, much is being written about the use of artificial intelligence in armed conflicts and future wars, all due to the ongoing armed conflict on Ukrainian territory. Where it occurred, an opportunity to use it in combat conditions, on a real battlefield. However, it should be noted that as early as 2015, Human Rights Watch, together with Harvard University, produced a report in which they warned that there could be

a situation where machines would be able to kill on their own, without any instructions given by humans. Such major military powers as the United States, China, Israel, Russia, South Korea and the United Kingdom have been increasing funding and resources for the development of weapons systems with less and less human control over the critical functions of selecting and attacking targets. Today, more countries have already acquired weapons systems of the future, such as remotely armed (the aforementioned drones) (Orłowska, Orłowski, 2024). It is predicted that artificial intelligence could transform the production potential and GDP of the global economy. For this to happen, strategic investments are needed in developing different types of technology. Improvements in labor productivity are expected to lead to an initial increase in GDP, as companies seek to increase the productivity of their workforce through artificial intelligence technology by automating certain tasks and functions. Research published by techopedia.com indicates that 45% of total economic gains by 2030 will come from product improvements, stimulating consumer demand. This is because artificial intelligence enhances product variety, personalization, appeal and affordability. Analysts predict that the largest economic benefits from AI will accrue to China (26% GDP growth in 2030) and North America (14.5% growth in 2030), which today is equivalent to \$10.7 trillion in U.S. dollars and accounts for nearly 70% of the global economic impact. All this is due to the speed of technological progress in these countries and the financial investment in the development of this field.

Today, the application areas of AI in business mainly include: data analytics and data mining programming (data mining), image identification, emotion recognition, text analysis, forecasting, diagnosis and personalized medicine, various types of optimization from costs to advice, personalized advertising (Orłowski, 2022). Therefore, it can be said that it is primarily network automation based on artificial intelligence in the cyber domain. It represents an area of investment to detect and address vulnerabilities in security systems in a cost-effective manner in terms of the ratio of effort to cost (economic efficiency; Kuczabski, 2019). Artificial intelligence in cybersecurity has made it possible to detect and neutralize more quickly cyberattacks. Which can lead to changes in the balance of power, affect regional relations and trigger responses from other countries (Bloch, 2005).

Liudmila Climoc, a participant in the EFNI discussion, "Tomorrow Starts Today. Technological transformation - fascination or challenge?" and CEO of Orange Poland, pointed to the growing cyber threats that pose a serious challenge to businesses and institutions in Poland. She noted that 73% of companies consider cybersecurity as an IT priority, as Poland is one of the most frequently attacked countries in the world. She also stressed that artificial intelligence plays a key role in defending against these threats. Last year, Orange blocked 360,000 phishing domains, which shows the scale of the threats users face. It also noted that Poland has a lower level of cybersecurity than the European average, which requires to be increased investment and education in this area. She also stressed the importance of infrastructure development, pointing to Orange Poland's investment of PLN 2.3 billion in 2023 and a total of PLN 20 billion over the past decade. These investments enable the development

of fiber optics and 5G networks, which is key to the country's digital transformation. L. Climoc called for simplifying procedures and ensuring regulatory stability to enable further infrastructure development. She added that delays in the distribution of 5G bandwidth must be made up for Poland to compete with other EU countries and keep up with digitization.

5. Discussion

The results of the study provide insight into key aspects of the potential benefits and risks of implementing artificial intelligence (AI) in the area of cybersecurity. The effectiveness of various AI algorithms in detecting and combating cyber threats was analyzed, and risk areas associated with the use of AI technologies by cyber criminals were identified. The analysis conducted showed that algorithms based on machine learning significantly increase the effectiveness in detecting cyberattacks in real time. Deep learning-based models (e.g., neural networks) achieved higher accuracy (92%) in identifying anomalies and phishing attacks compared to traditional data analysis methods. Most notably, the detection rate of zero-day attacks increased by 30%, indicating the great usefulness of AI in managing cyber threats in a dynamically changing network environment. The analysis also pointed to the growing use cases of AI in advanced cyberattacks, such as “deepfake phishing” (Scharfman, 2024) and automated brute force attacks using reinforcement learning algorithms (Trieu, Yang, 2018). These findings suggest that AI poses a threat, especially when used to create attacks that are more convincing and harder to detect, such as voice or video fraud generated by deepfake technologies.

It was also found that the implementation of advanced AI algorithms significantly reduces the response time to attacks, which increases the level of protection of sensitive data and infrastructure (Oleksiewicz, 2020). However, the results also confirmed that the use of AI in security systems involves the risk of vulnerability to manipulation, especially in the case of attacks targeting false training data, which requires the development of new security mechanisms (Chodyński et al., 2024). The findings also point to the need to consider ethical and regulatory aspects associated with the development of AI in cyberspace. Observations from experiments suggest that AI algorithms that are not subject to transparent regulation can be used for unauthorized data acquisition and manipulation of digital content. Therefore, it is recommended that a legal framework be developed to prevent the misuse of AI in the cyber operational environment. Bad examples of the use of AI should also be mentioned, these include: traffic accidents caused by Tesla's “autopilot,” accidental layoffs of company employees after the HR computer system inadvertently terminated their employment contracts, or the case of Facebook's chatbots, where the company created artificial intelligence that could talk to each other, but soon the programmers realized that the bots had developed their own

“secret” (unintelligible) language that they use to communicate with each other. New technologies bring with them new bugs and failures that no one expected. As S. Nickel rightly pointed out, errors with AI often start at the level of coding and development of data models (Nickel, 2022) or have to do with a phenomenon called “bias”.

The great danger remains that many countries still do not have regulations on the use of artificial intelligence. Although the number of such regulations increased significantly between 2016 and 2022, there are still quite a few countries in Europe that lack any regulation in this area (Figure 1).

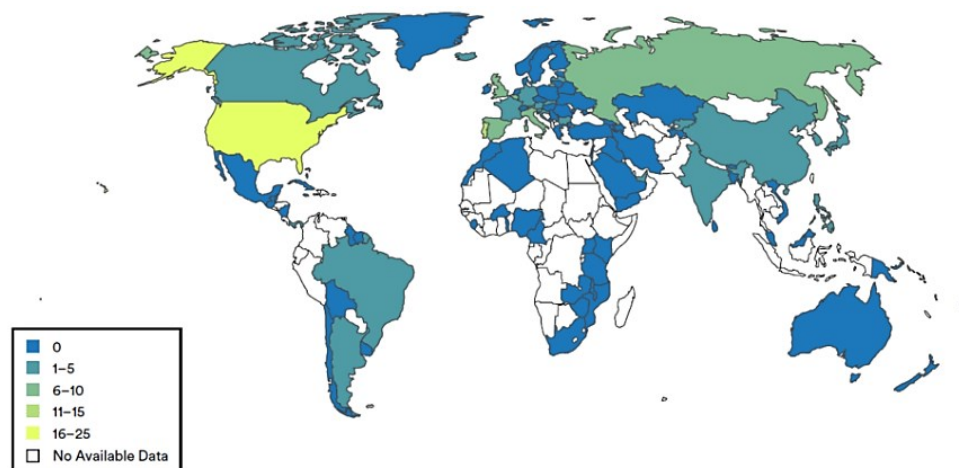


Figure 1. Number of AI-Related Bills Passed Into Law by Country, 2016-2022.

Source: NetBase Quid, 2022 | chart: 2023 AI Index Report.

According to a report on the state of artificial intelligence published by trojanczyk.pl, artificial intelligence is playing an increasingly important role in the national economy (Figure 2).

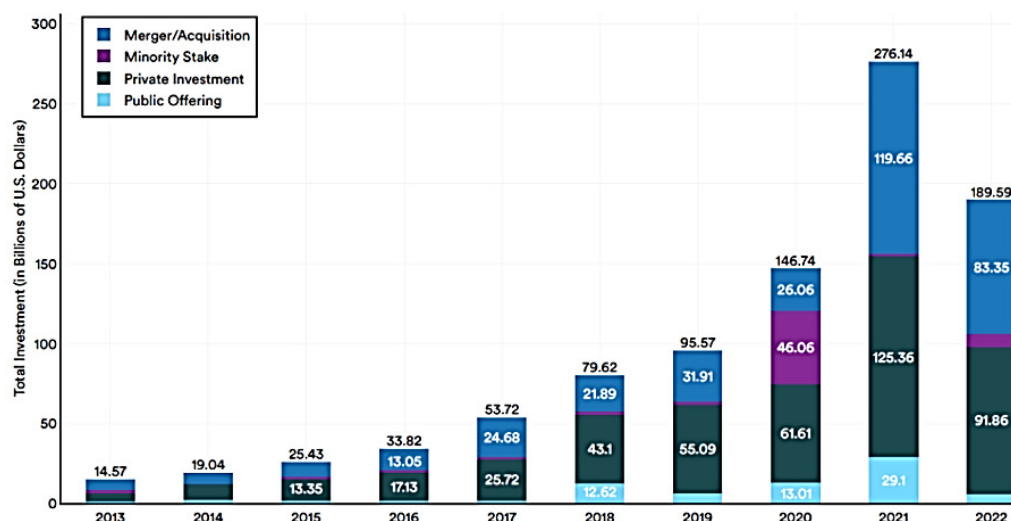


Figure 2. Global Corporate Investment in AI by Investment Activity, 2013-2022.

Source: NetBase Quid, 2022 | chart: 2023 AI Index Report.

Funding growth for AI projects grew steadily from 2013 until 2022, when there was a slight decline.

6. Conclusions

The analysis concluded that artificial intelligence (AI) plays a key role in transforming cybersecurity, offering both significant benefits and challenges. The use of advanced machine learning algorithms enables effective detection and minimization of cyber threats, allowing for faster response to attacks, especially in the context of zero-day threats and network anomalies. In addition, the author agrees with other researchers that the implementation of AI into the cybersecurity domain is a great potential in raising the level of security, especially in dynamic and complex environments. However, the concurrent use of AI by cybercriminals introduces new threats that can undermine the effectiveness of traditional security measures. Techniques such as deepfake, automated phishing attacks and manipulation of training data present challenges that require both technological development and regulatory action. Identified security gaps underscore the need for standards and regulations that could curb unauthorized use of AI and ensure transparency of algorithms used in cyberspace. In conclusion, the growing importance of AI in the cyber operational environment requires a balanced approach that takes into account both advanced technologies and ethical and legal principles. Further research should focus on developing defensive mechanisms capable of adapting in response to growing AI threats, as well as defining a legal framework that will enable the safe and responsible use of artificial intelligence in the area of cybersecurity. Accordingly, a careful and responsible approach to the development and implementation of artificial intelligence in the cyber domain is necessary.

References

1. Bloch, J.G. (2005). *Przyszła wojna pod względem technicznym, ekonomicznym i politycznym*. Warszawa: PISM, pp. 428-430.
2. *Boringoel*. Retrieved from: <https://boringowl.io/blog/jak-obronic-sie-przed-atakami-zero-day>, 25.10.2024.
3. Bógdał-Brzezińska, A. (2020). Cyberprzestrzeń i przestrzeń kosmiczna jako sfery bezpieczeństwa międzynarodowego—aspekty teoretyczne. *Wyzwania bezpieczeństwa w XXI wieku*. Oficyna Wydawnicza Politechniki Rzeszowskiej. Retrieved from: https://www.academia.edu/43702456/Cyberprzestrze%C5%84_i_przestrze%C5%84_kosmiczna_jako_sfery_bezpiecze%C5%84stwa_mi%C4%99dzynarodowego_aspekty_teoretyczne_Cyberspace_and_outer_space_as_spheres_of_international_security_theoretical_aspects_, 4.11.2024.

4. Brundage, M., Avin, S., Clark, J., Toner, H., Eckersley, P., Garfinkel, B., Amodei, D. (2018). The malicious use of artificial intelligence: Forecasting, prevention, and mitigation. *arXiv preprint arXiv:1802.07228*.
5. Buczak, A.L., Baugher, B., Guven, E., Moniz, L., Babin, S.M., Chretien, J.P. (2016). Prediction of peaks of seasonal influenza in military health-care data: Supplementary issue: Big data analytics for health. *Biomedical engineering and computational biology*, 7, BECB-S36277.
6. Chena, P.I., Tupac Panigo, D., Zorba, G. (2020). Beyond goodwin: Financialization as a structural change to explain the new Argentinian crisis. *Cuadernos de Economía*, 39(SPE80), pp. 523-539.
7. Chodyński, A., Ziarko, J., Sienkiewicz-Małyjurek, K., Bałamut, A., du Vall, M., Majorek, M., Jabłoński, A. (2024). *Bezpieczeństwo. Teoria i Praktyka, No. 1 (LIV)*. Zarządzanie kryzysowe wobec zagrożeń ekologicznych–rola organizacji komercyjnych i niekomercyjnych. Oficyna Wydawnicza AFM. <http://hdl.handle.net/11315/31284>
8. Dymanowski, K. (2016). Broń cybernetyczna jako uzbrojenie strategiczne nowej generacji, *Kwartalnik Bellona, No. 2*, pp. 178-180.
9. *Gazeta Prawna*. Retrieved from: <https://biznes.gazetaprawna.pl/artykuly/9644079,sztuczna-inteligencja-szanse-i-wazne-dylematy.html>, 25.10.2024.
10. Goodfellow, I. (2016). Nips 2016 tutorial: Generative adversarial networks. *arXiv preprint arXiv:1701.00160*.
11. Górka, M. (2021). Współczesne zagrożenia cybernetyczne na przykładzie zjawiska cyberwojny. Analiza teoretyczna. *Acta Politica Polonica, No. 1(51)*. Retrieved from: www.wnus.edu.pl/ap | DOI: 10.18276/ap.2021.51-01, pp. 5-21
12. Grabowski, T. (2022). Globalne tendencje w bezpieczeństwie. In: W. Pasierbek, B. Szlachta, A. Malewska, M. Filary-Szczepanik (eds.), *Globalizacja i współzależność* Wydawnictwo Naukowe Akademii Ignatianum, pp. 313-320.
13. Grzywacz, J., Jagodzińska-Komar, E. (2021). Rola sztucznej inteligencji w rozwoju sektora bankowego. *Nauki Ekonomiczne, No. 34*. [https://doi.org/10.19251/ne/2021.34\(2\)](https://doi.org/10.19251/ne/2021.34(2)), pp. 17-25.
14. Kowalczyńska, K. (2021). *Sztuczna inteligencja na wojnie. Perspektywa międzynarodowego prawa humanitarnego konfliktów zbrojnych*. Warszawa: Scholar, pp. 75-102.
15. Kuczabski, M. (2019). Współczesne i przyszłe zagrożenia bezpieczeństwa. Cz. 1. *Present and future threats to security. Vol. 1*. Bielawski, R., Solarz, J., Miszewski, D. (eds.). Warszawa: Wydawnictwo Akademii Sztuki Wojennej, pp. 175-196.
16. NATO. Retrieved from: https://www.nato.int/cps/en/natohq/official_texts_133177.htm, 4.11.2024.
17. Nikiel, S. (2022). *Sztuczna Inteligencja na wojnie – Autonomiczne Systemy Broni, No. 4*. <https://doi.org/10.34768/8aj8-3h79>.

18. Nye, J. (2010). *Cyber Power*. Harvard Kennedy School, Belfer Center. Retrieved from: https://www.belfercenter.org/sites/default/files/pantheon_files/files/publication/cyber-power.pdf, 4.11.2024.
19. Oleksiewicz, I. (2020). Cyberbezpieczeństwo i sztuczna inteligencja w sektorze energetycznym UE. *Rocznik Bezpieczeństwa Międzynarodowego*, vol. 14, no. 1. DOI: <https://doi.org/10.34862/rbm.2020.1.13>, pp. 222-232.
20. Oltramari, A., Cranor, L.F., Walls, R.J., McDaniel, P.D. (2014). Building an Ontology of Cyber Security. *STIDS*, pp. 54-61.
21. Orłowska, M., Orłowski, D. (2024). Wyzwania i możliwości zastosowania dronów w logistyce miejskiej. *Gospodarka Materialowa i Logistyka*, t. LXXVI nr 3, DOI 10.33226/1231-2037.2024.3.7, pp. 69-79.
22. Orłowski, D. (2023). *Supporting military unit management processes through the use of new technologies - selected examples*. Proceedings of International Scientific Conference —Defense Technologies. DefTech, pp. 381-391.
23. Orłowski, D. (2022). Wybrane aspekty zastosowania big data w zarządzaniu zasobami ludzkimi w organizacji. *Management & Quality [Zarządzanie i Jakość]*, 4(4), pp. 248-258.
24. Paatero, S. (2021). *Digiosallisuus on digitaalisen yhteiskunnan*. Helsinki. Retrieved from: <https://vm.fi/-/digiosallisuus-on-digitaalisen-yhteiskunnan-perusedellytykset>, 15.05.2022.
25. Prus, A. (2024). Uwarunkowania wykorzystania sztucznej inteligencji w przyszłej wojnie. *Cybersecurity and Law*, 12(2), 48-66. <https://doi.org/10.35467/cal/188559>, pp. 50-55.
26. Robles, P., Mallinson, D.J. (2023). Catching up with AI: Pushing toward a cohesive governance framework. *Politics & Policy*, 51(3), pp. 355-372.
27. Rojszczak, M. (2019). Prawne aspekty systemów sztucznej inteligencji - zarys problemu. In: K. Flaga-Gieruszyńska, J. Gołaczyński, D. Szostak (Eds.), *Sztuczna inteligencja, blockchain, cyberbezpieczeństwo oraz dane osobowe. Zagadnienia wybrane* (pp. 1-10).
28. Rudyk, M. (2024). Rola nowoczesnych technologii w informowaniu o wojnie w Ukrainie. *Media i Społeczeństwo*, DOI:10.5604/01.3001.0054.6508, p. 49.
29. Russell, S.J., Norvig, P. (2016). *Artificial intelligence: a modern approach*. Pearson.
30. Scharfman, J. (2024). Crypto Phishing and Spoofing Scams. In: *The Cryptocurrency and Digital Asset Fraud Casebook, Volume II: DeFi, NFTs, DAOs, Meme Coins, and Other Digital Asset Hacks* (pp. 193-219). Cham: Springer Nature Switzerland.
31. Szulc, T. (2018). Ile kosztuje bezpieczeństwo informatyczne? *Cyberbezpieczeństwo. Nowa Energia*, No. 4(64).
32. Szymański, L. (2023). *Najnowsze technologie w walce z Rosją. Ukraina sięga po AI w systemach obrony i na froncie*. Retrieved from: <https://polskieradio24.pl/arttykul/3219676,najnowsze-technologie-w-walce-z-rosja-ukraina-siega-po-ai-w-systemach-obrony-i-na-froncie>, 1.03.2024.
33. *Techopedia*. Retrieved from: <https://www.techopedia.com/pl/sztuczna-inteligencja-statystyki>, 25.10.2024.

34. Trieu, K., Yang, Y. (2018). *Artificial Intelligence-Based Password Brute Force Attacks*.
35. Vinayakumar, R., Alazab, M., Soman, K.P., Poornachandran, P., Al-Nemrat, A., Venkatraman, S. (2019). Deep learning approach for intelligent intrusion detection system. *IEEE Access*, 7, pp. 41525-41550.

DRIVERS OF ENVIRONMENTAL EFFECTIVENESS: GAP BETWEEN ORGANISATIONAL AND EXPERT PERSPECTIVES

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Purpose: The purpose of this study is to examine how economic, legal, social and organisational factors are perceived to influence environmental effectiveness in organisations, and to compare these perceptions between business practitioners and academic experts.

Design/methodology/approach: The study employed a quantitative CAWI-based approach. The sample comprised 847 organisations from 14 European countries and 35 academic experts in environmental management. Perceived influences of factors were assessed using a five-point Likert scale and analysed through descriptive statistics and one-way ANOVA, with comparisons made at the level of the four factor categories.

Findings: Organisations consistently rated economic, social, legal and organisational drivers more positively than academic experts. The largest divergence occurred in the organisational category: organisations emphasised internal objectives, reputational motives and corrective actions, while experts highlighted resource constraints, weak integration of environmental considerations and limited managerial commitment. Legal drivers received the lowest scores in both groups, yet interpreted differently—organisations associated them with procedural burdens, whereas experts viewed them as insufficiently influential. Organisations with ISO 14001 or EMAS certification reported higher ratings across all categories than those without formal environmental management systems.

Research limitations/implications: The non-identical questionnaire structures and the relatively small size of the expert sample limit the strength of direct comparison. The analysis is based on perceptual, cross-sectional data, which reflect subjective assessments rather than objective performance measures.

Practical implications: The findings suggest that formal environmental management systems, particularly EMAS, may support more proactive interpretations of external expectations. They also indicate the need for stronger exchange of knowledge and perspective between practitioners and experts to address differing evaluations of organisational capabilities and external pressures.

Social implications: The low importance assigned to legal drivers by both groups indicates limited regulatory and societal pressure to stimulate environmental improvement, pointing to the need for more coherent policy frameworks and stronger public accountability mechanisms.

Originality/value: The study provides a systematic comparison of organisational and expert perceptions of the drivers of environmental effectiveness and demonstrates how certification status shapes these interpretations. It contributes to understanding the divergence between operational and analytical viewpoints in sustainability management.

Keywords: environmental management; environmental performance; inhibitors; stimulators.

Category of the paper: Research paper.

1. Introduction

Growing pressures from climate change and environmental degradation have brought sustainability to the forefront of organisational agendas. This means that organisations are now seen as important players in addressing environmental problems rather than bystanders. To guide this change, governments and international institutions have set ambitious targets. For example, the European Green Deal commits the European Union to reduce greenhouse gas emissions by 55% by 2030 and to reach climate neutrality by 2050 (European Commission, 2019). Within this policy, organisations are expected to take responsibility for sustainable development by managing resource use, reducing pollution, and aligning business growth with environmental protection (European Environment Agency, 2019). The important issue, however, is whether these organisational actions lead to actual improvements. This brings into focus the idea of environmental effectiveness.

An organisation's environmental effectiveness can be understood as the extent to which it achieves its environmental objectives and contributes to the protection of natural resources. It goes beyond the reporting of environmental performance indicators by focusing on the actual success of actions taken to deliver tangible improvements (Matuszak-Flejszman, Paliwoda, 2022). In practice, environmental effectiveness covers reducing emissions and waste, improving energy and resource efficiency, and fostering eco-innovation in products and processes. Strengthening it is not only essential for meeting global sustainability goals but is also increasingly tied to competitiveness and long-term organisational resilience (Czyżewski et al., 2021).

Improving environmental effectiveness is a complex challenge shaped by both external and internal influences. The literature highlights four categories of factors that are particularly important: economic, legal, social, and organisational. Economic drivers include the costs and benefits of sustainability initiatives and the availability of financial incentives. Legal and regulatory frameworks establish minimum standards but also create opportunities for organisations to go beyond compliance. Social factors capture the expectations of stakeholders such as customers, employees, investors, and local communities, who put pressure on organisations to demonstrate responsibility. Finally, organisational factors refer to internal capabilities, including leadership, culture, and management systems, which determine how

effectively environmental strategies are implemented (Tung, Baird, Schoch, 2014; Paliwoda, Matuszak-Flejszman, 2024). Together, these dimensions provide a comprehensive framework for assessing the drivers and barriers of environmental effectiveness.

An emerging subject in the literature is the perceptual gap between academic experts and practitioners. Scholars often emphasise systemic barriers, such as inconsistent regulations or insufficient societal pressure, that constrain effectiveness. Practitioners, on the other hand, sometimes describe a more supportive environment, pointing to progress in regulation, stakeholder engagement, and organisational practices (Matuszak-Flejszman et al., 2019). These divergent perspectives suggest that the relative importance of different drivers may be viewed differently depending on whether one adopts a theoretical or a practical standpoint.

The purpose of this study is to examine the factors that shape environmental effectiveness and to compare how they are perceived by experts and by organisations themselves. By analysing both perspectives, the study seeks to identify areas of convergence and divergence, offering insights into how theory and practice can be better aligned. Ultimately, the paper aims to show how economic, legal, social, and organisational factors can stimulate or inhibit environmental effectiveness, and how a shared understanding of these influences can enhance the effectiveness of sustainability initiatives. The following literature review explores each category of factors in turn, building the foundation for the empirical analysis presented later in the paper.

2. Literature Review

2.1. Economic Factors and Environmental Effectiveness

A long-standing question in sustainability research is how environmental performance interacts with economic performance. Traditional views often presumed a trade-off that investing in environmental improvements adds costs and can weaken competitiveness. However, recent evidence suggests that, under many conditions, environmental and financial goals can be synergistic. For example, a meta-analysis of environmental innovation studies found that innovation efforts positively promoted both firms' environmental and financial performance (Liao, 2021). Organisations that adopt proactive sustainability strategies frequently achieve operational efficiencies and innovation gains that offset the associated costs. Prior research has shown that such activities can improve efficiency, reduce waste, resource use, and enhance competitiveness, thereby supporting profitability in the long term (Aguilera-Caracuel et al., 2021). Empirical studies further suggest that companies with strong environmental performance report higher profit margins than their less sustainable counterparts. On average, the difference is around 3-5%, primarily due to savings in energy use, streamlined

processes, and more effective management of environmental risks (Albertini, 2013). In short, “going green” is increasingly recognised not as a financial burden, but as a source of economic value.

That said, the economic incentive structure must be aligned with this win-win scenario to materialise. Market-based drivers such as consumer demand for green products or investor preference for ESG (Environmental, Social, Governance) leaders are increasingly important. Companies perceived as “ecological” attract a growing segment of socially conscious consumers, which can translate into higher sales and market share. Likewise, investors now often evaluate firms’ environmental credentials, influencing access to capital. This external economic pressure rewards environmental effectiveness by linking it to revenue growth and investment. On the cost side, the avoidance of environmental penalties and liabilities also makes a compelling economic case. For instance, firms with strong pollution controls avoid fines and remediation costs, and they can also benefit from lower borrowing costs and improved credit ratings (Bauer, Hann, 2010). Recent studies underscore that integrating environmental considerations into core business strategy yields long-term financial advantages. Companies can strengthen profitability and shareholder value by cutting waste, using energy more efficiently, and innovating sustainable products.

However, economic conditions can also constrain environmental initiatives. During economic downturns or crises, even sustainability-conscious firms might scale back green investments in favour of short-term cost-cutting. Arco-Castro et al. (2024) found that while environmental management systems and stakeholder engagement normally drive improved corporate environmental performance, these mechanisms lost effectiveness during the 2008-2009 economic crisis, as financial pressures forced firms to prioritise survival. This suggests that robust economic performance or incentives are a prerequisite for sustained environmental commitment. In summary, economic drivers can strongly motivate environmental effectiveness when the business case is positive. However, barriers such as high upfront costs or weak short-term returns may still hinder green initiatives in some contexts. Aligning sustainability with financial performance, therefore, appears crucial for organisations seeking consistent improvements in their environmental outcomes.

2.2. Legal and Regulatory Factors

The legal and regulatory environment is another considerable influence on organisational environmental effectiveness. Governments use laws, regulations, and enforcement mechanisms to compel minimum environmental standards and encourage best practices. Strong environmental regulations can catalyse substantial improvements in corporate performance, creating a level playing field that pushes all firms toward greener operations. For example, in China, the introduction of a new, stringent Environmental Protection Law proved highly effective in raising the environmental performance of heavy-polluting enterprises. Using a quasi-natural experiment, Chen et al. (2024) showed that stricter “command-and-

control” regulation reduced pollution and improved firms’ environmental performance. Their study supports the Porter Hypothesis by showing that well-designed regulation can drive innovation and efficiency rather than only add costs. The law worked by pushing firms to invest in better pollution control technologies and by increasing transparency through mandatory disclosure of emissions. The positive impact remained strong across a range of robustness tests, confirming that strict enforcement improved corporate outcomes. Similar results are seen internationally. A meta-analysis by Zhang et al. (2024) found that strong environmental regulation often stimulates green innovation, giving firms a competitive advantage while also reducing risks of legal sanctions.

On the other hand, weak or fragmented regulatory frameworks can undermine environmental effectiveness. If environmental laws are full of loopholes, or poorly enforced, companies may lack external pressure to improve. In such cases, companies that take voluntary action may be undercut by less responsible competitors, and overall progress stalls. For example, firms in emerging markets often treat strong environmental management as a way to build legitimacy with local stakeholders and gain reputation advantages (Shu et al., 2024). They often operate above and beyond the law to meet international standards, effectively self-regulating in the absence of stringent local requirements. Conversely, when regulations tighten across the board, as illustrated by the European Union’s climate policies, even lagging firms must adapt, which leads to industry-wide improvements. The European Climate Law of 2021 made the EU’s carbon-neutrality target legally binding and requires companies to plan for deep emissions cuts (European Commission, 2021).

Overall, clear and stringent environmental regulations, combined with consistent enforcement, are key legal drivers for corporate environmental effectiveness. They not only mandate baseline performance but can also stimulate innovation (companies find creative ways to meet standards efficiently) and reduce uncertainty by defining long-term rules of the game. Compliance-driven improvements have the side benefit of levelling the playing field, ensuring that proactive firms are not disadvantaged. In contrast, regulatory gaps, or inconsistent policies (for example, if different jurisdictions have conflicting rules) can act as barriers, creating confusion and uneven expectations. Both academic analyses and industry reports often call for more coherent legislation to avoid such issues. In summary, a supportive legal context, characterised by ambitious environmental standards and robust enforcement, empowers organisations to invest in sustainability with confidence, knowing that their efforts are both required and rewarded in the marketplace. Many companies now proactively integrate regulatory foresight into their strategy, recognising that anticipating future laws (such as carbon pricing or circular economy mandates) can position them ahead of competitors. The literature thus affirms that the regulatory push is a cornerstone of environmental effectiveness in organisations, driving improvements especially when voluntary measures fall short.

In the European context, recent policy frameworks such as the EU Taxonomy for Sustainable Activities (European Commission, 2020) and the Corporate Sustainability Reporting Directive (CSRD) (European Commission, 2022) are designed to strengthen the regulatory environment by linking corporate reporting, financing, and sustainability performance. These instruments aim to increase transparency and comparability across companies and to integrate environmental objectives into financial and strategic decision-making.

2.3. Social and Stakeholder Factors

Beyond formal regulation, social dynamics and stakeholder expectations exert a powerful influence on organisational environmental performance. Over the past five years, public awareness of environmental issues has grown, leading to closer scrutiny of companies' behaviour. Organisations face growing pressure from a range of stakeholders: customers demand sustainable products, investors incorporate environmental criteria into decisions, employees prefer ecologically responsible employers, and civil society (including NGOs and local communities) campaigns against corporate polluters. This social pressure can act as both a carrot and a stick. Companies with strong environmental records can build brand loyalty and reputation advantages, whereas those with poor records risk boycotts, protests, and reputational damage (Sharma, Henriques, 2005). As a result, many organisations now treat stakeholder engagement on environmental matters as an essential part of business strategy.

Empirical research confirms that stakeholder pressure is positively associated with better environmental performance. In a recent study of energy companies, firms facing higher external pressure to decarbonise were more likely to adopt ambitious carbon-reduction strategies and achieved superior CO₂ performance as a result (Seroka-Stolka, 2023). Here, stakeholders served as catalysts, pushing companies to implement cleaner technologies and cut emissions. Similarly, Arco-Castro et al. (2024) identified stakeholder engagement as a key driver of corporate environmental performance in normal economic conditions. When businesses actively engage with stakeholders' environmental concerns (for example, through dialogue, reporting, and collaborative initiatives), they tend to adopt more robust sustainability practices, leading to measurable improvements in outcomes. These findings align with the principles of stakeholder theory, which suggest that meeting the expectations of various interested parties (not just shareholders) is crucial for a firm's long-term success. One important channel of stakeholder influence is the market, where green consumerism has become a significant trend. A 2024 study by the European Central Bank found that "brown" (high-emission) companies in the Eurozone pay approximately 0.14 percentage points more in interest rates compared to greener firms (Pagano, 2024). This creates a considerable incentive for firms to strengthen their environmental performance in order to gain more favourable financing terms, while avoiding financial penalties.

In contrast, a lack of stakeholder pressure can be a barrier. If consumers are unaware or indifferent, or if investors do not factor in environmental criteria, businesses may feel less external push to change. In some sectors or regions, this societal push remains weak. For example, in industries with complex supply chains, consumers often do not notice the environmental damage, such as upstream pollution. As a result, the company responsible faces less direct pressure. Nonetheless, the broader trend is that stakeholder expectations are steadily rising. Except in the most isolated contexts, companies today operate under the watchful eye of a public that increasingly demands genuine environmental stewardship. Social factors, through reputation, consumer choice, and investor activism, are now firmly established as a pillar of environmental effectiveness. Engaging constructively with stakeholders and responding to their environmental concerns has become not only a matter of public relations but a core component of sustainable business strategy.

2.4. Organisational Factors and Internal Capabilities

The final set of factors shaping environmental effectiveness lies within the organisations themselves. Even with favourable economic incentives, strict laws, and social pressure, actual performance ultimately depends on internal management decisions, resources, and capabilities. Organisational factors include a company's leadership commitment to sustainability, its culture and values, the skills and awareness of employees, the structures, and systems in place (such as environmental management systems), and the integration of environmental objectives into everyday operations and strategy. Recent research emphasises that companies with strong internal sustainability capabilities tend to outperform others in environmental metrics. In other words, how a business organises for environmental responsibility makes a critical difference.

One crucial organisational driver is the implementation of formal Environmental Management Systems (EMS) and standards (e.g. ISO 14001). An EMS provides a structured framework for continually monitoring and improving environmental performance within a company. Arco-Castro et al. (2024) found that adoption of an EMS is a significant positive predictor of corporate environmental performance. Organisations that had these systems in place consistently achieved better outcomes than those that did not. Another internal driver is governance and oversight. Companies with dedicated sustainability committees or clear board-level responsibility for environmental issues often have superior performance. In this regard, corporate governance diversity has been highlighted in recent studies: the presence of women on boards has a measurable positive effect on environmental performance, as diverse leadership may bring greater attention to sustainability and stakeholder concerns (Arco-Castro et al., 2024). Interestingly, Arco-Castro et al. noted that this positive effect of board gender diversity persisted even during economic crises, suggesting that strong governance can anchor a firm's environmental commitment in turbulent times.

Beyond systems and governance structures, organisational culture and human capital are key. A recent study by Al Basheer and Javad (2024) underscores the importance of instilling environmental values and knowledge within the business. Their survey of managers in the UAE found that environmental ethics and training within an organisation significantly improve its environmental performance and even confer competitive advantage. In practical terms, companies that invest in educating employees about sustainability, enforce ethical standards regarding environmental impact, and empower staff with skills to innovate in eco-friendly ways see better outcomes. These firms not only comply with regulations more easily but often exceed them, driven by an internal ethos of responsibility. The findings “underscore the strategic significance of embracing environmental initiatives within corporate policies” and highlight the need for ongoing capacity-building (e.g. training programs) to embed sustainability into daily operations (Al Basheer, Javad, 2024). In essence, when environmental responsibility becomes part of “how we do things” in an organisation, supported by top management and echoed through all levels, performance improvements follow naturally.

Conversely, internal weaknesses can hold back environmental progress. A common barrier is a lack of leadership support: when executives treat sustainability as non-core, initiatives are often underfunded or sidelined. Organisational silos also create problems. For instance, when EHS activities are not linked to core business units or communication is poor. Some firms further fall into a “greenwashing” culture, promoting sustainability externally while making little real change, often because incentives remain tied to short-term financial results. This gap between talk and action is largely cultural. Recent studies show that organisations which align their structures, incentives, and culture with environmental goals achieve stronger employee engagement in sustainability (Peng et al., 2024).

In summary, organisational factors act as the engine (or brakes) behind environmental effectiveness. Companies that build strong internal frameworks such as leadership commitment, formal management systems, staff engagement and training, and a culture of continual improvement are far better equipped to respond to economic, legal, and social drivers of sustainability. They turn external pressures into proactive strategies and are often innovators in their industries. Meanwhile, firms lacking these internal capabilities may struggle to meet even basic compliance, let alone voluntary excellence, regardless of outside pressure.

2.5. Synthesis of Factors and Research Gap

Drawing on the above literature, it is obvious that environmental effectiveness in organisations is multifaceted, shaped by an interplay of economic incentives, regulatory context, stakeholder influences, and internal management capabilities. These factors do not operate in isolation; rather, they often reinforce one another. For example, a strong legal requirement can catalyse organisational improvements (by forcing adoption of an EMS), or active stakeholder pressure can highlight economic opportunities (such as new green markets) to top management. High-performing businesses typically manage to align all four

domains in support of their environmental goals. However, the literature also highlights tensions and disparities between the perspectives of different actors. Academic experts tend to focus on systemic issues (like policy gaps or market failures) and warn of barriers, whereas many businesses practitioners report that they experience a supportive environment for sustainability, citing progressive regulations or consumer interest as enablers. This divergence in viewpoint suggests a need for closer examination.

This study seeks to connect expert insights with practitioners' experiences of the economic, legal, social, and organisational drivers of environmental effectiveness. By comparing these perspectives, it examines where gaps or misalignments occur. Do companies overstate their progress, or do academics underestimate firms' adaptive measures? Addressing such questions helps refine theory and offers practitioners valuable external perspectives. The literature shows that improving environmental effectiveness requires an integrated approach across multiple dimensions. Building on this foundation, the analysis explores how these factors are perceived and balanced in practice, with the aim of aligning organisational strategies more effectively with today's environmental challenges.

3. Methods

3.1. Research Design

This study used a quantitative research design to explore the factors that influence environmental effectiveness in organisations. The analysis compared two groups: business practitioners (organisations) and academic experts. The framework followed four categories of factors commonly discussed in the literature: economic, legal, social, and organisational (Paliwoda & Matuszak-Flejszman, 2024). This structure enabled a systematic evaluation of the perceived role of these factors as either inhibitors or stimulators of environmental effectiveness.

3.2. Data Collection

Data were collected using a Computer-Assisted Web Interviewing (CAWI) survey conducted in 2023. Two separate questionnaires were used:

- **organisational survey:** sent to over 800 business representatives from 14 European countries, including Austria, Cyprus, the Czech Republic, Denmark, France, Germany, Hungary, Italy, the Netherlands, Poland, Portugal, Slovakia, Spain, and Sweden. The sample covered firms from different sectors;
- **expert survey:** completed by over 30 academic researchers and specialists in environmental management and sustainability.

Both surveys applied a five-point Likert-type scale to measure the perceived influence of different factors on organisational environmental effectiveness, where 1 = definitely inhibits and 5 = definitely stimulates. Respondents could also choose “no opinion”; these responses were excluded from the analysis to ensure that results reflected only substantive evaluations.

3.3. Sample Characteristics

The organisational dataset included 847 valid responses. Companies were divided into three groups:

- 397 organisations without a management system,
- 144 organisations with ISO 14001,
- 306 organisations with EMAS.

The expert dataset included 35 valid responses. All participants had recognised expertise in sustainability and environmental management.

Comparing these two perspectives allowed the study to capture both practical, experience-based views and theoretical expert assessments. In addition, the organisational dataset enabled a distinction between companies with environmental management systems (ISO 14001 or EMAS) and those without, highlighting how formal certification may shape perceptions of key drivers.

3.4. Data Processing

Survey data were exported to Microsoft Excel. For each category (economic, legal, social, organisational), average scores were calculated separately for organisations and for experts. In the case of organisations, separate averages were also calculated for firms with and without ISO 14001/EMAS. Records with “no opinion” were excluded automatically.

3.5. Statistical Analysis

The analysis combined descriptive statistics (averages and standard deviations) with statistical tests. To check if differences between groups were significant, a one-way analysis of variance (ANOVA) was applied. This was used especially to test whether organisations with ISO 14001 or EMAS rated factors differently than organisations without such systems. Since the expert and organisational surveys did not use identical questions, results were compared at the category level (economic, legal, social, organisational).

4. Results

4.1. Organisations Survey Results

The organisational survey revealed clear differences across the four categories of drivers - economic, social, legal, and organisational. Among these, organisational and social factors received the highest average ratings, indicating that both internal practices and external expectations are seen as key to environmental effectiveness. Economic drivers were rated at a moderate level, while legal drivers received the lowest scores (Figure 1).

In addition to the average category scores, individual questions provide more detail about organisational perceptions. The highest ratings were given to the desire to improve the organisation's image, well-established and implemented environmental objectives, and effective corrective and improvement action, all scoring above 4.1 on average. By contrast, the lowest ratings concerned legal aspects such as ignorance of legal requirements relating to EIA and the complex legal regime relating to EIA, both averaging below 2.7.

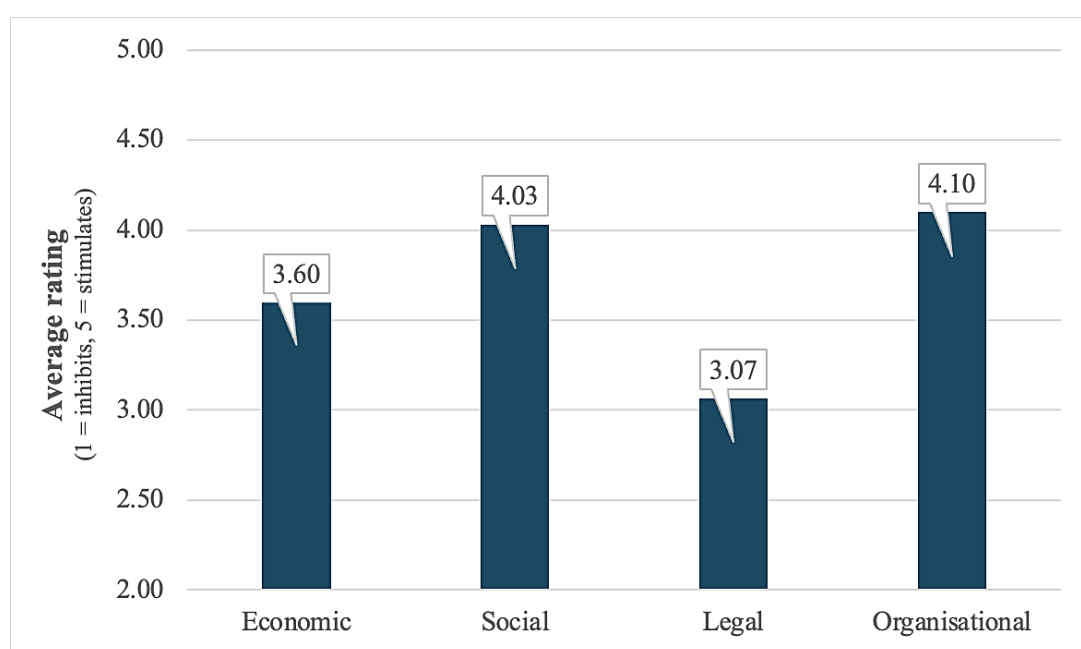


Figure 1. Organisations' average ratings of economic, social, legal, and organisational drivers.

Source: Own study.

The results also varied depending on whether organisations had an environmental management system (EMS). On average, businesses with a formal EMS reported higher influence scores across all categories compared to firms without any EMS (Figure 2). Within this group, EMAS-certified companies gave the highest ratings for economic, social, legal, and organisational drivers, followed by ISO 14001-certified companies. In contrast, non-certified firms reported the lowest ratings. These between-group differences were statistically significant for each category (all $p < 0.001$; see Table 1). Figure 2 illustrates this pattern: for every factor

category, EMAS organisations rated drivers as more stimulating, followed by ISO 14001 certified companies, and then firms without certification.

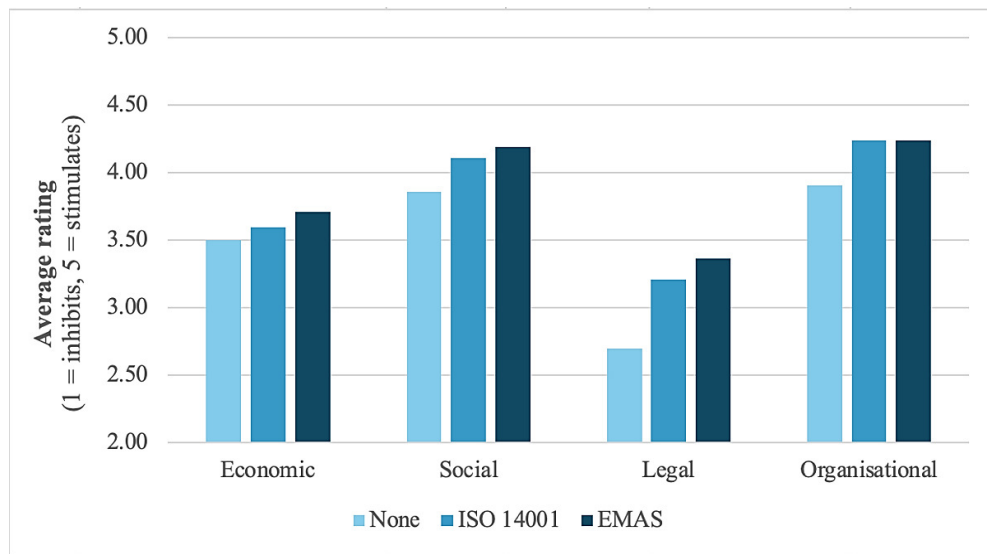


Figure 2. Average ratings of economic, social, legal, and organisational drivers by EMS status.

Source: Own study.

Table 1.

Average ratings of environmental effectiveness drivers by EMS status with ANOVA results

Category	Mean - none	Mean – ISO 14001	Mean - EMAS	F	p-value
Economic	3.50	3.60	3.71	8.60	0.0002
Social	3.86	4.11	4.19	27.50	< 0.0001
Legal	2.70	3.21	3.36	64.50	< 0.0001
Organisational	3.91	4.24	4.24	34.24	< 0.0001

Source: Own study.

The impact of EMS differed across categories. The largest contrast was observed for legal factors: EMAS organisations rated them at 3.36 on average, compared with only 2.70 among firms without certification. This category also created the strongest statistical difference ($F \approx 64.5$, $p < 0.001$). Social and organisational factors also revealed clear differences. Both ISO 14001 and EMAS adopters rated them at around 4.1, while non-certified firms gave slightly lower values (~ 3.9). These gaps were statistically significant (social: $F \approx 27.5$; organisational: $F \approx 34.2$; $p < 0.001$). For economic drivers, the difference was less evident: organisations without certification rated them at about 3.5, compared with slightly higher values among ISO 14001 and EMAS firms (3.6–3.7; $F \approx 8.6$, $p = 0.0002$).

4.2. Experts Survey Results

The expert survey gathered insights from 35 environmental sustainability researchers regarding the same four categories of influence. The experts' ratings revealed a distinct emphasis compared with practitioners. They considered the social driver to be the most influential, with a mean score of about 3.48 on the 5-point scale (Figure 3). Economic factors

were rated almost as highly (~3.42), which indicates that experts see both societal expectations and financial pressures as key drivers of environmental effectiveness.

By contrast, organisational factors received a slightly lower ratings (~3.23) from the experts. Legal influences were assigned the lowest importance, with an average rating of only 2.56. This low score suggests that the expert panel views regulatory compliance as the least effective driver of environmental performance among the four categories. Overall, the experts' responses were moderate across all dimensions, reflecting a balanced view in which social and economic factors were seen as slightly more influential.

When looking more closely at individual questions, experts rated highest those factors connected with organisational strategy and market conditions. They valued well-established environmental objectives, a pro-environmental mission and strategy, and market requirements, all averaging above 4.5. In contrast, the lowest scores were associated with organisational shortcomings such as lack of resources, weak integration of environmental aspects into business processes, and uncommitted management teams, each scoring below 1.7.

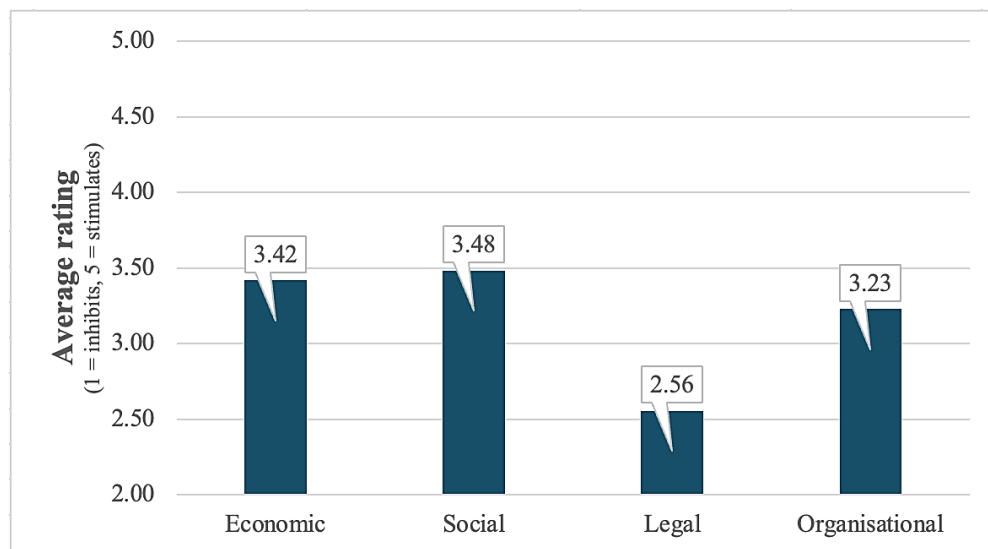


Figure 3. Experts' average ratings of economic, social, legal, and organisational drivers.

Source: Own study.

4.3. Comparison of Organisational and Expert Perspectives

Comparing the two surveys shows that organisations reported higher influence scores than experts across all four categories (Figures 4 and 5). The gap was particularly visible for organisational drivers as companies gave them an average score of about 4.10, while experts rated them lower at 3.12. Social drivers followed a similar pattern, with organisations scoring them at 4.03 compared to 3.36 from experts. Economic and legal drivers revealed smaller gaps. Organisations rated economic drivers at about 3.60, compared with 3.30 from experts. Legal drivers received the lowest scores in both surveys, with organisations at 3.07 and experts at 2.50.

The ranking of drivers revealed both similarities and differences between the two groups. Experts placed social drivers first, while organisations ranked them second. Organisational drivers were most important for companies but only third for experts. Economic drivers held a middle position in both surveys, whereas legal drivers consistently came last. Figure 4 illustrates these patterns, showing higher overall ratings among organisations and the widest gap in the organisational category.

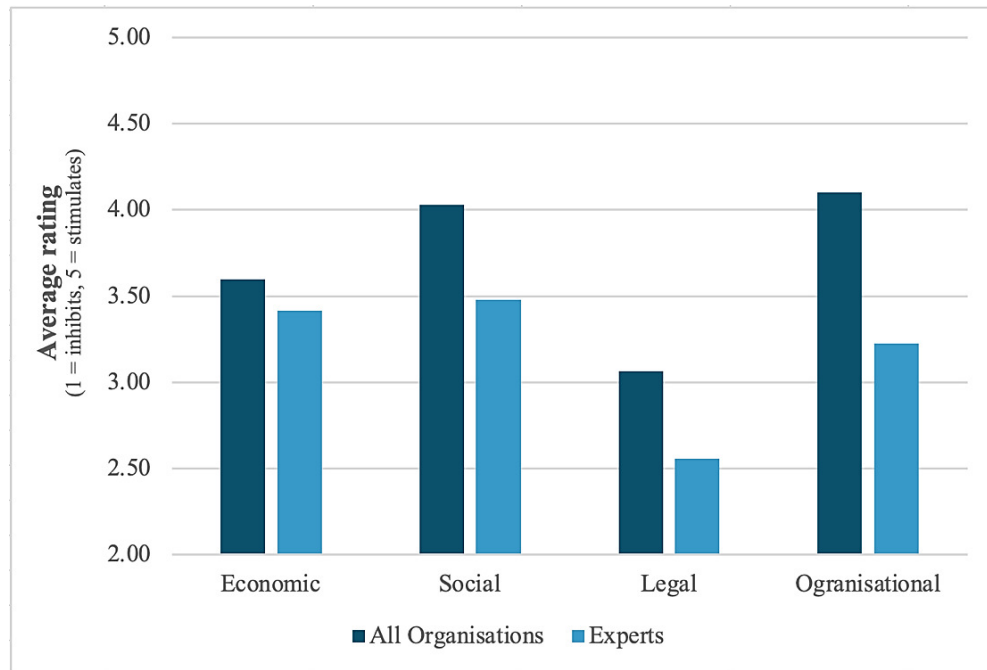


Figure 4. Comparison of organisations' and experts' ratings across four driver categories.

Source: Own study.

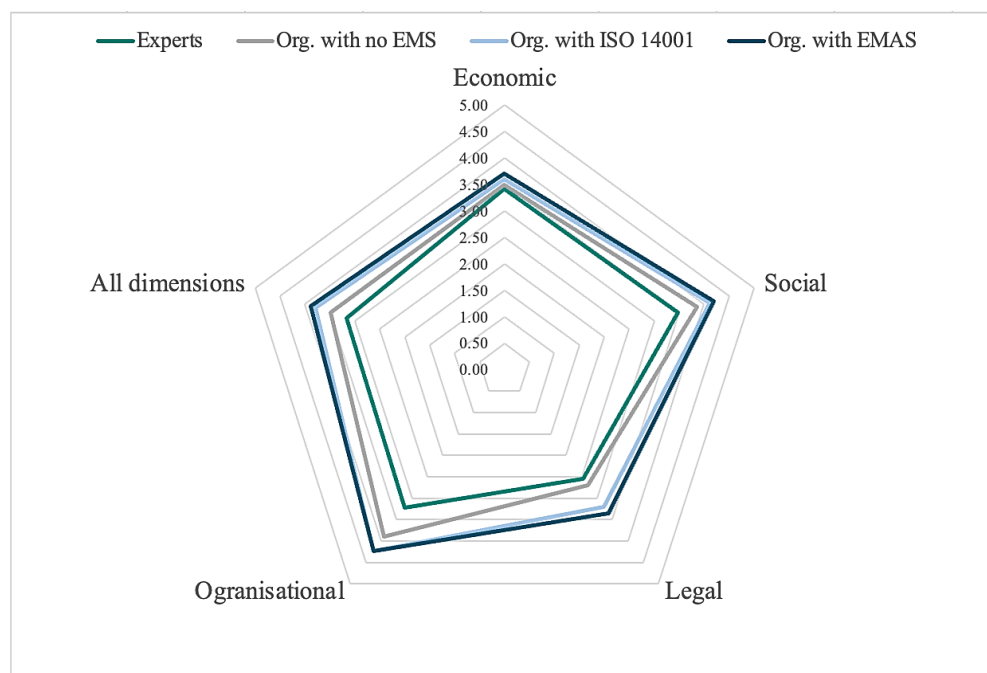


Figure 5. Comparison of Environmental Drivers Across Organisations and Experts.

Source: Own study.

5. Discussion

The results reveal a difference between organisational and expert perspectives on the drivers of environmental effectiveness. Organisations tended to rate all categories more optimistically, indicating that the current economic, social, regulatory, and organisational context stimulates environmental effectiveness. Experts, by contrast, assigned consistently lower scores, reflecting a more cautious view of how strongly these factors contribute. This pattern corresponds with what has been described in the literature as a “theory-practice gap” (Matuszak-Flejszman et al., 2019), where the same conditions are perceived as enabling by practitioners but as less convincing or insufficient when assessed by experts.

The strongest difference was observed in the organisational category. Companies placed great emphasis on their own capacities, with the desire to improve the organisation’s image, well-established environmental objectives, and corrective actions rated among the most important drivers. This indicates that firms regard internal procedures and reputational motives as the main stimulators of environmental performance. Experts also valued organisational factors but were far more sceptical. Their lowest ratings were linked to lack of resources, weak integration of environmental aspects into business processes, and uncommitted management teams. This suggests that experts see internal practices as unevenly implemented and therefore less reliable in explaining environmental effectiveness. The divergence reflects two vantage points, companies highlighting what they successfully apply, and experts focusing on the weaknesses that are still widespread across organisations (Tung, Baird, Schoch, 2014).

Both groups placed legal drivers at the bottom of their rankings. Organisations gave low scores to items such as ignorance of legal requirements and the complexity of the EIA system. This shows that companies perceive regulations more as formal obstacles than as real stimulators of environmental progress. Experts also rated legal factors lowest, suggesting that regulations are currently too weak to act as strong incentives. Thus, while both groups agree that legal conditions do not strongly drive effectiveness, their emphasis differs. Organisations focus on burdens and complexity, while experts stress insufficiency and lack of impact. This finding may also reflect the current transition phase in the European regulatory landscape. New policy instruments such as the EU Taxonomy and the Corporate Sustainability Reporting Directive (CSRD) are still in early stages of implementation, and their full impact on corporate environmental behaviour has yet to materialise (European Commission, 2020, 2022).

In the social category, both groups recognised the importance of external expectations, though again with different emphases. Organisations rated the desire to improve image as the single most important factor overall, underlining how reputational concerns and stakeholder pressures stimulate their environmental efforts. Experts, meanwhile, also ranked social drivers highest among the four categories but did not place reputational motives at the very top. Instead, they emphasised more structural elements such as market requirements and pro-environmental

mission and strategy. This reflects a subtle distinction that companies interpret social influence directly in terms of reputation and immediate stakeholder demands, while experts see its value mainly when it is embedded in broader strategic commitments. In both cases, however, the findings support the view that social expectations play a central role in shaping organisational behaviour (Sharma, Henriques, 2005).

Economic factors produced the smallest gap. Organisations gave moderate scores overall, with relatively higher ratings for awareness of the monetary benefits of environmental performance, while noting lower influence for high utility costs or environmental charges. This suggests that they perceive economic benefits primarily when they are clearly visible and linked to efficiency gains, whereas cost burdens are not considered stimulators. Experts, on the other hand, rated market and industry requirements very highly, placing them alongside the most supportive drivers overall. This indicates that they regard economic forces as a strong lever, especially when market expectations align with environmental objectives. The difference therefore lies in orientation: managers emphasise tangible operational benefits, while experts highlight systemic economic signals, consistent with prior findings that financial structures shape long-term effectiveness (Aguilera-Caracuel et al., 2021).

A further pattern within the organisational results confirmed that businesses with ISO 14001 or EMAS certifications consistently rated all drivers more positively than those without. The effect was most visible in the legal domain, where certified companies saw regulations as generally more supportive. This supports earlier studies showing that formal management systems help firms not only to implement environmental measures but also to perceive external requirements as opportunities rather than constraints (Arco-Castro et al., 2024). These results suggest that formal environmental management systems, especially EMAS, may encourage organisations to interpret regulatory and market expectations as opportunities rather than constraints. The mechanisms associated with EMAS — including stronger transparency, external validation and continual improvement — could help explain why EMAS organisations perceive all categories of drivers as more supportive.

6. Limitations

This study has several limitations that should be acknowledged. First, although both surveys were based on the same four categories of factors, the questionnaires for organisations and experts were not identical. Each was adapted to its target group, which means that some items do not match one-to-one. As a result, the comparison between the two groups was carried out at the level of broad categories rather than individual questions. This was necessary to keep the analysis consistent, but it also means that some of the differences observed may be due to the design of the questionnaires rather than real differences in perceptions.

Secondly, there is a considerable imbalance between the two datasets. The organisational survey was completed by 847 firms across 14 European countries, while the expert survey involved only 35 respondents. This smaller expert group limits the strength of statistical analysis and may not fully represent the diversity of opinions within the wider expert community. In addition, the experts were less geographically diverse than the organisations which may have reduced the variety of perspectives captured on that side.

Furthermore, as with any survey-based research, the results reflect the views and perceptions of the respondents rather than objective measures of environmental effectiveness. Answers may have been influenced by personal judgement or by social desirability bias. For instance, companies could have been inclined to present themselves as more environmentally active than they actually are, and experts might have aligned their answers with prevailing expectations in the field. Although the surveys were anonymous, such bias cannot be fully excluded.

Finally, the study is based on cross-sectional data, collected at a single point in time. This means it captures perceptions as they stood during the survey period, but does not show how these views might change over time or in response to new regulations, policies, or market conditions. Participation was also voluntary, which may have led to self-selection bias if individuals or firms with a strong interest in environmental issues were more likely to take part.

Taken together, these limitations mean that while the study provides useful insights into how organisations and experts perceive drivers of environmental effectiveness, the findings should be read with some caution. They highlight patterns and contrasts in perceptions, but they cannot be taken as definitive evidence of actual effectiveness or as representative of all possible contexts.

Finally, the conceptual framework applied in this study does not include a structural or path analysis of interactions among the four categories of drivers. Such an approach could provide deeper insight into causal relationships between organisational capacity, social pressure, and legal or economic stimuli. However, it would require a different methodological design and data structure, which was beyond the scope of this research. This limitation is acknowledged as an important direction for future studies.

7. Conclusion

This study compared how organisations and experts perceive the drivers of environmental effectiveness, focusing on economic, legal, social, and organisational factors. The findings revealed clear differences between these groups. Organisations tended to view most drivers as supportive, while experts assessed them more cautiously. The strongest divergence was observed in the organisational category, where companies emphasised objectives, corrective

actions, and reputational motives, whereas experts underlined resource shortages and weak integration. Legal drivers were consistently rated lowest by both groups, though interpreted differently. Social and economic drivers were seen as more important, but again with different emphases. Organisations pointed to reputation, customer expectations, and efficiency gains, while experts highlighted strategic orientation and market requirements.

These outcomes align closely with the literature reviewed earlier. Previous studies have shown that economic incentives can encourage sustainability, though their impact remains uneven. Regulations are effective only when strong and coherent. Stakeholder expectations often act as powerful drivers of change. Internal capacities are also critical, but they are applied inconsistently across organisations.

Overall, the comparison demonstrates that both perspectives capture valid aspects of reality. Practitioners see progress in their internal practices and immediate context, while experts emphasise the structural limitations that continue to hold back broader effectiveness. Organisations with ISO 14001 or EMAS viewed the drivers of environmental effectiveness more positively, showing how formal systems can shape the way organisations perceive and respond to external demands. Together, these findings reinforce the view from the literature that improving environmental effectiveness requires alignment across internal capacities, regulatory frameworks, stakeholder pressure, and economic incentives. At the same time, the study shows that bridging the gap between organisational experience and expert critique remains essential for achieving lasting progress in sustainability.

Acknowledgements

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References

1. Aguilera-Caracuel J., Duque-Grisales, E. (2021). Environmental, social and governance (ESG) scores and financial performance of multilatinas: Moderating effects of geographic diversification and financial slack. *Journal of Business Ethics*, 168(2), pp. 315-334. <https://doi.org/10.1007/s10551-019-04177-w>
2. Al Basheer, S., Javad, S. (2024). The role of environmental ethics and training in enhancing performance and competitive advantage. *Advances in Environmental Innovation*, 1(2), Article 200. <https://doi.org/10.69725/aneva.v1i2.200>

3. Albertini, E. (2013). Does environmental management improve financial performance? A meta-analytical review. *Organization & Environment*, 26(4), pp. 431-457. <https://doi.org/10.1177/1086026613510301>
4. Arco-Castro, M.L., Lopez-Perez, M.V., Alonso-Conde, A.B., Rojo-Suárez, J. (2024). Determinants of corporate environmental performance and the moderating effect of economic crises. *Baltic Journal of Management*, 19(6), pp. 39-59. <https://doi.org/10.1108/BJM-06-2023-0233>
5. Bauer, R., Hann, D. (2010). Corporate environmental management and credit risk. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.1660470>
6. Chen, X., Liu, H., Liu, S. (2024). Environmental regulation and environmental performance of enterprises: Quasi-natural experiment of the new environmental protection law. *International Studies of Economics*, 19, pp. 406-430. <https://doi.org/10.1002/ise3.77>
7. Czyżewski, B., Matuszczak, A., Grzelak, A., Guth, M., Majchrzak, A. (2021). Environmental sustainable value in agriculture revisited: How does Common Agricultural Policy contribute to eco-efficiency? *Sustainability Science*, 16(1), pp. 137-152. <https://doi.org/10.1007/s11625-020-00834-6>
8. European Commission (2019). *The European Green Deal (COM(2019) 640 final)*. Brussels: European Commission. Retrieved from: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640>
9. European Commission (2020). Regulation (EU) 2020/852 (EU Taxonomy Regulation): Establishing a framework to facilitate sustainable investment. *Official Journal of the European Union*, L198, pp. 13-43. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R0852>
10. European Commission (2021). Regulation (EU) 2021/1119 (European Climate Law): Establishing the framework for achieving climate neutrality. *Official Journal of the European Union*, L243, pp. 1-17.
11. European Commission (2022). Directive (EU) 2022/2464 (Corporate Sustainability Reporting Directive – CSRD): Amending Regulations (EU) No 537/2014 and Directives 2004/109/EC, 2006/43/EC and 2013/34/EU. *Official Journal of the European Union*, L322, pp. 15-64. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022L2464>
12. European Environment Agency (2019). *Drivers of change of relevance for Europe's environment and sustainability (EEA Report No. 25/2019)*. Copenhagen: EEA. <https://www.eea.europa.eu/publications/drivers-of-change>
13. Liao, Z., Liu, P., Liu, S. (2021). A meta-analysis of environmental innovation and firm performance. *Journal of Environmental Planning and Management*, 64(11), pp. 2047-2065. <https://doi.org/10.1080/09640568.2020.1855129>
14. Matuszak-Flejszman, A., Paliwoda, B. (2022). Effectiveness and benefits of the Eco-Management and Audit Scheme: Evidence from Polish organisations. *Energies*, 15(2), 434. <https://doi.org/10.3390/en15020434>

15. Matuszak-Flejszman, A., Szyszka, B., Jóhannsdóttir, L. (2019). Effectiveness of EMAS: A case study of Polish organisations registered under EMAS. *Environmental Impact Assessment Review*, 74, pp. 86-94. <https://doi.org/10.1016/j.eiar.2018.09.005>
16. Pagano, M., & Eurosystem Research Team (2024, August). 'Brown' companies already pay higher interest rates, ECB study finds. *Financial Times*. <https://www.ft.com/content/c2408062-68c4-4a50-af9a-29099e95dda1>, 02.10.2025
17. Paliwoda, B., Matuszak-Flejszman, A. (2024). The impact of environmental indicators on consumer purchase decisions for food products. *Sustainability*, 16(5), 1834. <https://doi.org/10.3390/su16051834>
18. Peng, M.-Y.-P., Zhang, L., Lee, M.-H., Hsu, F.-Y., Xu, Y., He, Y. (2024). The relationship between strategic human resource management, green innovation and environmental performance: A moderated-mediation model. *Humanities and Social Sciences Communications*, 11, Article 239. <https://doi.org/10.1057/s41599-024-02754-7>
19. Seroka-Stolka, O. (2023). Enhancing environmental sustainability: Stakeholder pressure and corporate CO₂ -related performance - An examination of the mediating and moderating effects of corporate decarbonization strategies. *Sustainability*, 15(19), 14257. <https://doi.org/10.3390/su151914257>
20. Sharma, S., Henriques, I. (2005). Stakeholder influences on sustainability practices in the Canadian forest products industry. *Strategic Management Journal*, 26(2), pp. 159-180. <https://doi.org/10.1002/smj.439>
21. Shu, C., Zhao, J., Yao, Q., Zhou, K.Z. (2024). Green innovation and export performance in emerging market firms: A legitimacy-based view. *Management and Organization Review*, 20(1), pp. 85-110. <https://doi.org/10.1017/mor.2023.40>
22. Tung, A., Baird, K., Schoch, H. (2014). The relationship between organisational factors and the effectiveness of environmental management. *Journal of Environmental Management*, 144, pp. 186-196. <https://doi.org/10.1016/j.jenvman.2014.05.025>
23. Zhang, W., Wang, X., Li, Y. (2024). Revisiting the Porter hypothesis: A multi-country meta-analysis of the relationship between environmental regulation and green innovation. *Humanities and Social Sciences Communications*, 11, 232, <https://doi.org/10.1057/s41599-024-02671-9>

INVENTORY MANAGEMENT OF FMCG PRODUCTS WITH A SHORT SHELF LIFE – SYSTEMATIC LITERATURE REVIEW

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Purpose: The aim of this study is to examine the current state of research on inventory management models for fast-moving finished goods with limited shelf life through a systematic literature review.

Design/methodology/approach: The study was conducted through a systematic literature review and bibliometric analysis using the Prisma standard and VOSViewer tools. Five different keyword searches were conducted in the Scopus, Web of Science, and EBESCOhost Web databases. Key trends, leading authors, institutions, and research topics were identified, and the main areas of interest in this field were determined. Based on a narrative literature review of the most important publications, the characteristics, and key challenges for the FMCG sector around inventory management in the production-warehouse-customer chain were also presented.

Findings: The study identified a research gap in the application of a multidimensional approach to the inventory management of fast-moving finished goods with a short shelf life, considering the production-warehouse-customer supply chain. A lack of research was noted in terms of simultaneously considering key criteria such as minimizing production costs associated with decreasing batch sizes and the consequent rise in setup costs, reducing storage costs and losses related to product expiration, and maximizing product availability for customers.

Research limitations/implications: The scope of the study was restricted to identifying and analyzing comprehensive inventory management models discussed in the literature that consider both high product availability and limited shelf life. Future research will aim to develop a model for managing fast-moving finished goods in FMCG manufacturing companies to maximize product availability, minimize storage costs and losses from product expiration, and reduce production start-up costs for inventory replenishment.

Practical implications: At this stage, practical implications cannot yet be determined.

Originality/value: The originality of the article lies in examining the occurrence of inventory management models from production to distribution in the literature that consider short shelf life and high product availability. Further research developing such a model will be valuable for FMCG enterprises aiming to maintain high availability of short shelf life products.

Keywords: Fast Moving Consumer Goods, inventory management, product availability, short shelf life.

Category of the paper: Literature review.

1. Introduction

The fast-moving consumer goods (FMCG) market is characterized by intense competition, dynamic growth, and high customer expectations. The FMCG sector includes, in particular, everyday products, such as food, chemicals, cosmetics, pet food, and pharmaceuticals. Entities operating in the FMCG sector compete for customers primarily by offering products tailored to their expectations (Kabus, 2022). Today's consumers can choose from a wide range of products from different suppliers, so they pay attention not only to the high quality of the products offered, but also to order fulfillment time, reliability, and constant availability of products. In this context, failure to fulfill an order in full has significant consequences for the company. Customers whose needs have not been met often choose substitute products from other suppliers. For the company, this means not only a direct financial loss, but also a negative impact on the brand's reputation, which in the long term can translate into a weakening of its market position. In the FMCG sector, customer loyalty is very often determined by shopping experiences, so even temporary shortages in the product range can translate into a weakening of the company's market position in the long term.

Manufacturing companies in the FMCG sector usually have production lines dedicated to specific product groups. The production process involves long line changeover times due to technical and hygienic requirements. In addition, production cycles are highly variable depending on batch size, and a minimum batch size is specified for each product group to ensure the profitability of production due to changeovers.

In the case of FMCG enterprises, production planning requires freezing the plan for a fixed period to ensure the availability of materials. At the same time, warehouse stock levels must be adjusted to the intensity of demand due to the short shelf life of the products.

Inventory management models tailored to different situations have been developed for over 50 years. An analysis of inventory management models and the above challenges has identified **a research problem**, namely the inventory management of fast-moving finished goods with a short shelf life, to ensure high product availability while minimizing the costs associated with creating and maintaining inventory at the appropriate level and minimizing losses associated with the disposal of expired products or those with a very short shelf life.

The subject of finished goods inventory management is discussed in literature in various aspects. More often, the subject of analysis is the warehouse-customer relationship, and less often the production-warehouse and production-warehouse-customer relationships.

In the **warehouse-customer relationship**, effective inventory control systems are sought to reduce inventory levels and avoid customer order shortages. One such system is the VMI service (Harrison et al., 2019). Cooperation within the supply chain has been strongly supported by both researchers and consultants since the mid-1990s through concepts such as Vendor Managed Inventory (VMI), Collaborative Forecasting Planning and Replenishment

(CPFR), and Continuous Replenishment (CR) (Holweg et al., 2005). The policy of inventory management through the VMI system is often considered a win-win solution: the supplier can better coordinate deliveries to customers based on observed inventory levels at the customer's site rather than on replenishment orders from customers; in turn, the customer does not have to devote its resources to inventory management (Coelho, Cordeau, Laporte, 2012). Enforcing a VMI policy effectively is not easy, as the supplier must deal with a complex problem consisting of its own decisions regarding vehicle routes and decisions regarding customer inventory (Raa, Aghezzaf, 2009). This integrated problem is known as IRP (Inventory Routing Problem) and refers to the coordination of inventory management and vehicle routing (Jemai et al., 2013). In the traditional Vehicle Routing Problem (VRP) model, the supplier strives to fulfill customer orders to minimize the total cost of distribution - to plan routes accordingly. In contrast, in IRP, orders are determined by the supplier based on input data regarding customer demand. Furthermore, in IRP, the supplier seeks to manage customer inventory in such a way that they do not experience stockouts, whereas traditional VRP does not consider this aspect. The presence of an inventory component in IRP adds a time dimension to the associated routing problem. The VRP system is used for short-term problems, and IRP for medium-term problems. The IRP system assumes an unlimited shelf life for products, as it does not allow for the decline in shelf life to be considered – this is one of the main challenges of using IRP in the logistics of FMCG companies.

From a **production-warehouse perspective**, suitable models for production management in the FMCG sector are sought that will ensure production flexibility in relation to variable demand, as a different approach from the classic one, focused on minimizing planned production costs. Various approaches to solving the integrated problem of batch size and scheduling and minimizing changeover costs are reviewed and compared (Lueb, 2014).

When analyzing the **production-warehouse-customer relationship**, there is a clear problem of a widening gap between inventory management theory and practice and the latest developments aimed at bridging this gap. The need for a central information system that enables supply chain members to exchange information in real time in order to minimize inventory is emphasized (Kumar, Mishra, George, 2013). The growing demand for a make-to-availability production management model is also highlighted, which performs better than a make-to-stock model due to the minimization of inventory creation costs, storage costs, and customer demand fulfillment costs (Ciechańska, Szwed, 2020).

The aim of this article is to examine the current state of work on inventory management models for fast-moving finished goods with a short shelf life. On this basis, key trends, leading authors, institutions, and research topics have been identified, and the main areas of interest in this field have been determined.

This article consists of five parts. The Introduction presents the characteristics and current key challenges for the FMCG sector in the area of inventory management in warehouse-customer, production-warehouse, and production-customer-warehouse relationships,

and identifies the research problem. The Methodology section describes the literature analysis method used, namely a systematic literature review based on the Prisma standard. The Results section presents the results of a systematic literature review for five different keyword searches in the Scopus, Web of Science, and EBESCOhost Web databases. The Discussion section is devoted to a detailed analysis of the publications from the most advanced search. Using a narrative review of the most important areas related to inventory management, the literature was examined for comprehensive inventory management models from production to distribution that take into account the particular importance of product availability and freshness in the FMCG industry, while at the same time focusing on minimizing storage and production costs. The final section, Conclusions, summarizes the systematic review of the literature in the area of inventory management for FMCG products with a short shelf life and identifies a research gap and an outline for further research.

2. Methods

Currently, there are many publications in the field of inventory management in the FMCG industry. For this reason, it was necessary to take a systematic approach to the analysis and evaluation of publications, focusing on quantitative methods of data analysis. The literature review was conducted using the bibliometric analysis method, which involves the use of mathematical and statistical models (Mora, Bolici, Deakin, 2017). Recommendations from the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) standard, which is key to systematic literature review, were also used. The guidelines for this standard were developed by a consortium of methodologists, journal editors, and authors of systematic reviews to address the problem of incomplete and unsatisfactory reporting in systematic literature reviews (Moher et al., 2007).

A systematic literature review should include planning, analysis, and summarizing the results. The authors suggest looking at the number of articles over the years, the journals with the most publications in a given subject area, the number of citations, the authors with the most publications, or the countries of publication, and then observing trends based on that. VOSViewer is a useful tool here for analyzing links between publications, keywords, and trends (Niñerola et al., 2019). The authors additionally add criteria related to the language of publication or type of publication in order to select the most important ones, including only English-language and full-text peer-reviewed articles, avoiding conference materials, or publications with anonymous authors (Lim et al., 2021). The literature review scheme, based on the PRISMA standard, is presented in Figure 1.

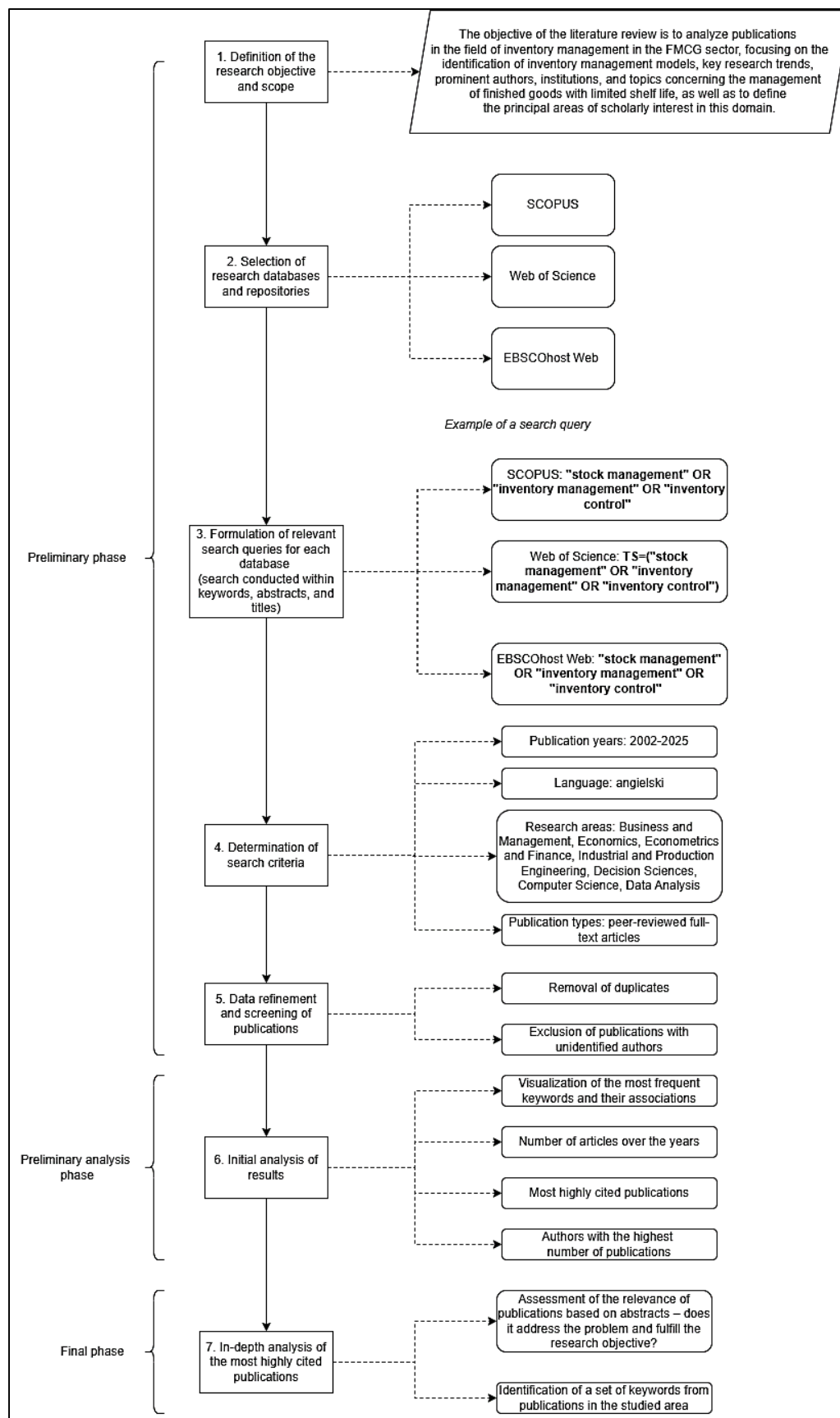


Figure 1. Subsequent stages of literature analysis.

Source: own study based on: (Zhao, Strotmann, 2015; Ertz, Leblanc-Proulx, 2018; Szum, 2021; Michałowska, Majchrzak, 2024; Czakon, 2021).

A systematic literature review consists of seven main stages. First, the objective and scope of the study are defined. In this case, the objective is to review publications in the field of inventory management in the FMCG industry, examine inventory management models, and identify key trends, leading authors, institutions, and research topics in the management of finished goods with a short shelf life, and to define the main areas of interest in this field. Next, databases are selected, and appropriate queries are defined for each database – in this case, Scopus, Web of Science, and EBESCOhost Web. The main bibliographic and abstract databases, Scopus and Web of Science, were selected due to their high quality, popularity in the scientific community, and the interdisciplinary nature of the articles. EBESCOhost Web, on the other hand, is a good complement to Scopus and Web of Science and offers high-quality interdisciplinary articles and full-text access to selected items. EBESCOhost Web is supplemented by, among others, full-text databases (Academic Search Complete, Business Source Complete, Health Source - Consumer Edition & Nursing/Academic Edition, MasterFILE Premier, Newspaper Source, Regional Business News), comprehensive data from international repositories, and bibliographic and abstract databases (Agricola, ERIC, GreenFILE, LISTA, MEDLINE). Since 2002, the databases analyzed show an upward trend in the number of articles in the field of inventory management. For each database, appropriately defined search criteria should be selected. In the example described, these are the years 2002-2025, items in English, fields of science: Business and Management, Economics, Econometrics and Finance, Industry and Manufacturing Engineering, Decision Making, Computer Science, Data Analysis, as well as publication type as full-text peer-reviewed items.

After completing steps 1–4, the downloaded databases are cleaned of records that do not qualify for the review, duplicates, and items with unknown authors. Once these steps have been completed, a preliminary analysis of the results can be performed, i.e.:

- Visualize the most common keywords and connections, e.g., using VOSViewer.
- Present the number of publications over the years in a graph.
- Present the countries, disciplines, and journals with the highest number of publications and, if necessary, analyze trends in this area over the years.

On this basis, literature analysis can proceed to the final stage, which is a detailed analysis of the results of the publications with the highest number of citations. For these publications, determine their usefulness based on the abstracts and identify a set of keywords from the publications in the area under study.

3. Results

Five different searches were conducted in the Scopus, Web of Science (WoS), and EBESCOhost Web databases and analyzed. The results are presented in Table 1. The number of articles analyzed was determined after cleaning the databases of duplicates, items not eligible for review, and items with unknown authors. The first search was conducted using the keywords stock management, inventory management, and inventory control, while the fifth search included: stock management, inventory management, inventory control, Fast Moving Consumer Goods, FMCG, product availability, stock levels, out of stock, overstock, shelf life, freshness, model, strategy, framework, review, literature review, systematic review.

Table 1.

Five subsequent article search queries in the databases

Item	Databases		
	Scopus	WoS	EBESCOhost Web
Query no 1	"stock management" OR "inventory management" OR "inventory control"	TS=("stock management" OR "inventory management" OR "inventory control")	"stock management" OR "inventory management" OR "inventory control"
All publications	73 741	12 464	54 849
Full-text peer-reviewed articles	50 969	9 024	36 348
Query no 2	"FMCG" OR "fast moving consumer goods"	TS=("FMCG" OR "Fast Moving Consumer Goods")	"FMCG" OR "fast moving consumer goods"
All publications	11 953	1 494	25 749
Full-text peer-reviewed articles	9 577	1 147	4 505
Query no 3	"product availability" OR "stock levels" OR "out of stock" OR "overstock"	TS=("product availability" OR "stock levels" OR "out of stock" OR "overstock")	"product availability" OR "stock levels" OR "out of stock" OR "overstock"
All publications	10 714	2 311	10 928
Full-text peer-reviewed articles	8 212	1 796	5 383

Cont. table 1.

Query no 4	("stock management" OR "inventory management" OR "inventory control") AND ("product availability" OR "stock levels" OR "out of stock" OR "overstock") AND ("shelf life" OR "freshness") AND ("review" OR "literature review" OR "systematic review")	TS=("stock management" OR "inventory management" OR "inventory control") AND ("product availability" OR "stock level*" OR "out of stock" OR "overstock") AND ("shelf life" OR freshness) AND ("literature review" OR "systematic review" OR review)	("stock management" OR "inventory management" OR "inventory control") AND ("product availability" OR "stock levels" OR "out of stock" OR "overstock") AND ("shelf life" OR "freshness") AND ("review" OR "literature review" OR "systematic review")
All publications	391	4	3
Full-text peer-reviewed articles	330	4	3
Query no 5	("stock management" OR "inventory management" OR "inventory control") AND ("FMCG" OR "fast moving consumer goods") AND ("product availability" OR "stock levels" OR "out of stock" OR "overstock" OR "shelf life" OR "freshness") AND ("model" OR "strategy" OR "framework") AND ("review" OR "literature review" OR "systematic review")	TS=("stock management" OR "inventory management" OR "inventory control") AND TS=("FMCG" OR "fast moving consumer goods") AND TS=("product availability" OR "stock levels" OR "out of stock" OR "overstock" OR "shelf life" OR "freshness") AND TS=("model" OR "strategy" OR "framework") AND TS=("review" OR "literature review" OR "systematic review")	("stock management" OR "inventory management" OR "inventory control") AND ("FMCG" OR "fast moving consumer goods") AND ("product availability" OR "stock levels" OR "out of stock" OR "overstock" OR "shelf life" OR "freshness") AND ("model" OR "strategy" OR "framework") AND ("review" OR "literature review" OR "systematic review")
All publications	219	0	1
Full-text peer-reviewed articles	169	0	1

Source: own study.

Almost all publications identified in the fifth search were included in the Scopus database (219), therefore detailed analyses for the fifth search using VOSViewer were performed for the Scopus database. Figure 2 shows the number of all publications by year in Scopus.

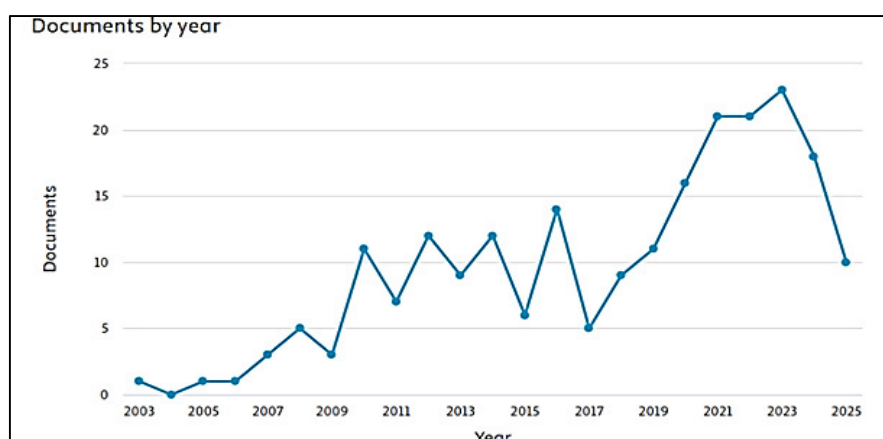


Figure 2. Number of publications in 2002-2025 in the Scopus database – fifth search.

Source: analysis tool from Scopus.

Since 2002, the Scopus database has shown an increase in the popularity of topics related to product availability and freshness for the FMCG industry, with the highest growth rate observed since 2017, although the number of articles each year is relatively small. In 2025, there are fewer publications due to the ongoing publication period, but a larger number of publications can be expected here (as of April 2025, there are already 10 publications in this area). An analysis was also conducted to determine which authors published the most material about product availability. Figure 3 shows the authors with the highest number of publications in the Scopus database.

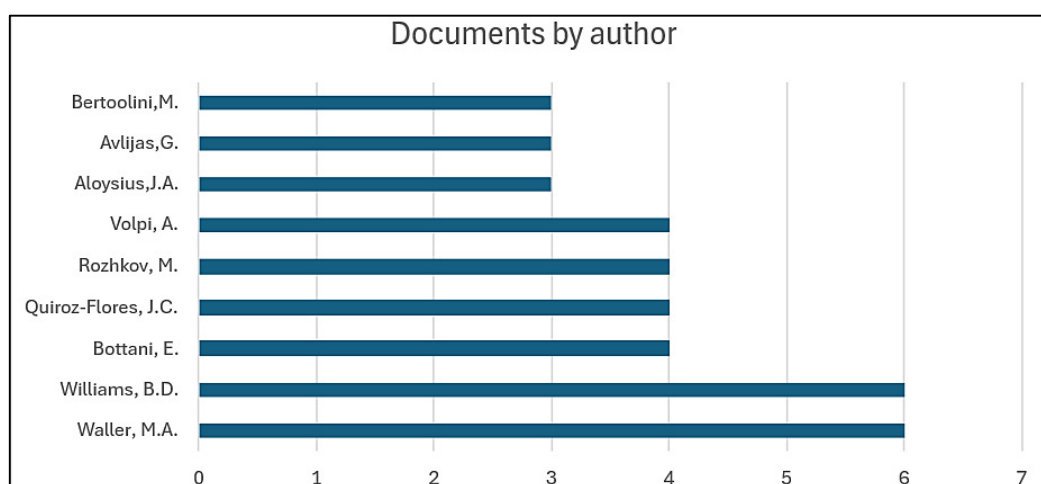


Figure 3. The most productive authors in the years 2002-2025 in the Scopus database – fifth search.

Source: own work based on the analysis tool from Scopus.

In the Scopus database, the most active authors published an average of three to six articles in the field of inventory management in the FMCG industry, considering inventory levels, product availability, and expiration dates. Figure 4 shows the share of publication types in the Scopus database.

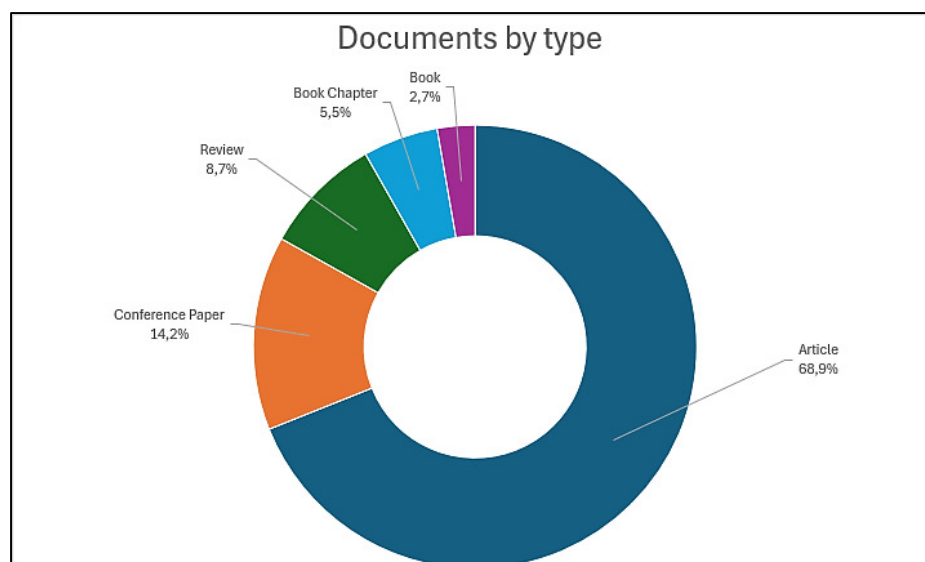


Figure 4. Share of publication types in 2002-2025 in the Scopus database – fifth search.

Source: own study based on the analysis tool from Scopus.

Most of the publications are journal articles. The second largest share is held by conference proceedings, followed by reviews and book chapters.

Another analysis of the results from the Scopus database concerns the countries of publication and the scientific fields in which the articles were published. The results are presented in Figures 5 and 6.

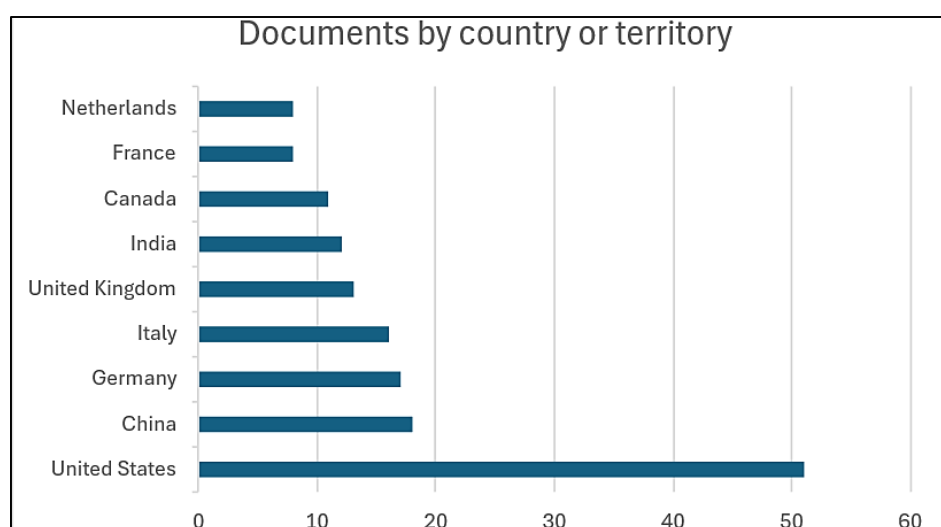


Figure 5. Countries of publication in 2002-2025 in the Scopus database – fifth search.

Source: own study based on the analysis tool from Scopus.

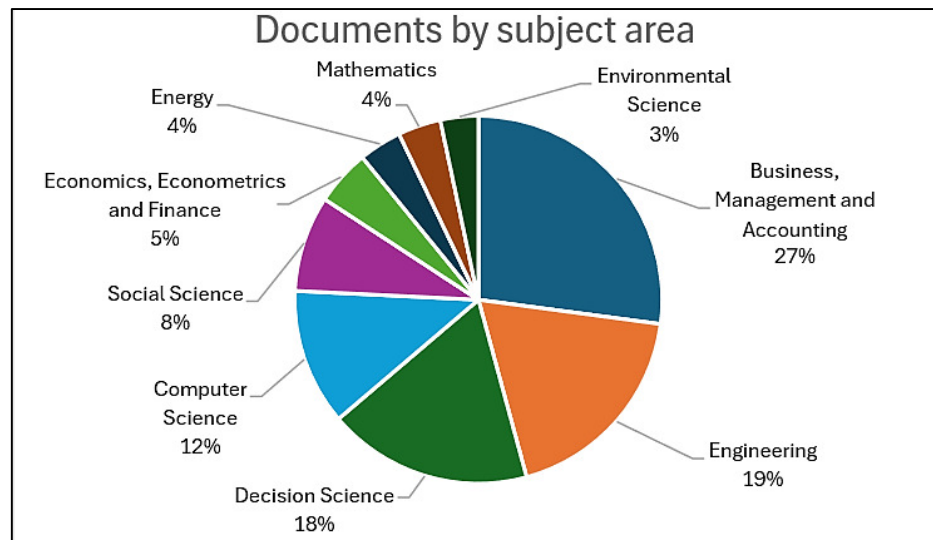


Figure 6. Fields of science in 2002-2025 in the Scopus database – fifth search.

Source: own study based on the analysis tool from Scopus.

In the Scopus database, most publications originated in the United States, China, Germany, and Italy. The most popular areas of publication are Business and Management, Engineering, Decision Sciences, and Computer Sciences, followed by Social Sciences.

The final area of analysis for the fifth search is the journals in which the scientific materials were published. The results of the analysis for the Scopus database are presented in Figure 7.

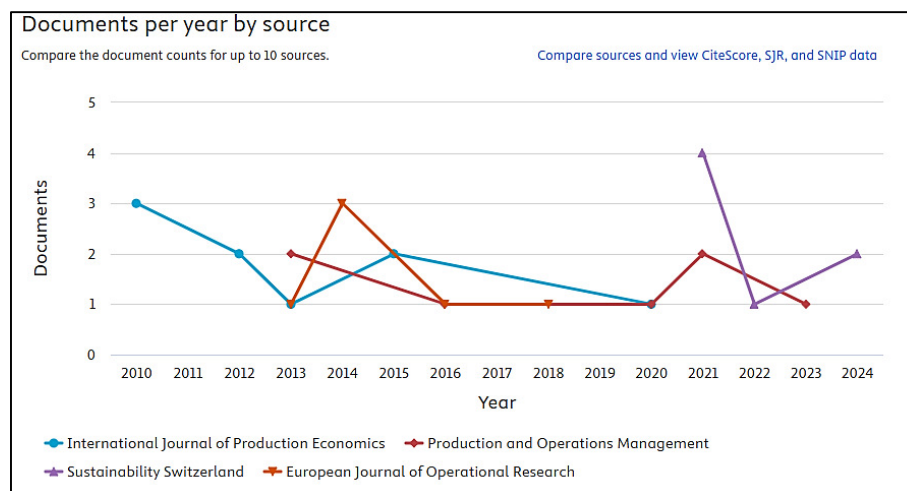


Figure 7. Journals with the highest number of publications between 2002 and 2025 in the Scopus database – fifth search.

Source: own study based on the analysis tool from Scopus.

In the Scopus database, the journal with the highest number of publications, which amounts to only 9 publications, is the International Journal of Production Economics, followed by journals with 7 publications, namely Production and Operations Management, Sustainability Switzerland, and then the European Journal of Operational Research with 6 publications. The remaining journals have fewer than five publications. In this case, it is difficult to talk about trends due to the small number of publications.

For the most advanced search, an analysis of the most frequently occurring keywords was also performed using the VOSViewer tool, as shown in Figure 8.

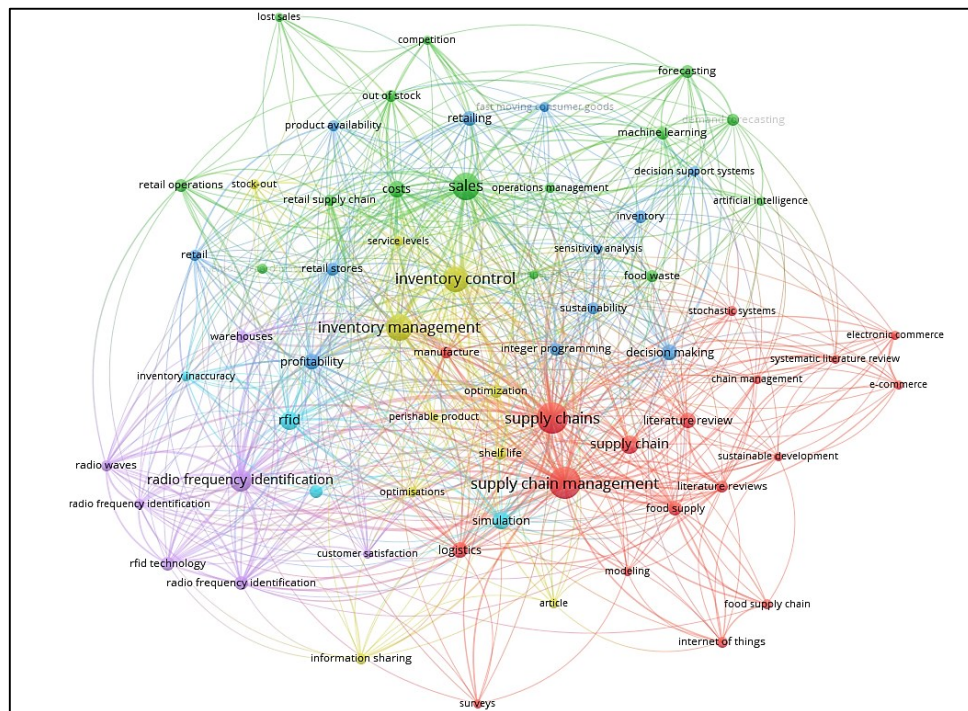


Figure 8. Most common keywords in the Scopus database – fifth search.

Source: own study based on the analysis tool from Scopus.

The most frequently occurring keywords are inventory control and inventory management, which directly correspond to the query, but there is also a noticeable frequency of keywords outside the query, including sales, supply chains, and supply chain management. The most popular keywords from the analyzed items are directly related to the topic of finished goods inventory management from production to distribution.

4. Discussion

The last and most advanced search was used to examine the occurrence of inventory management models in the literature that consider the importance of product availability and freshness in inventory management for the FMCG industry. Positions in this area were sought to properly identify the research gap and analyze the models found in the literature in this area. The results confirm that the topic of inventory management, in conjunction with product availability and freshness for the FMCG industry, has not been thoroughly analyzed, and no models have been found in the literature that comprehensively address inventory management in the FMCG industry from production to distribution, taking into account high availability and adequate product freshness, while minimizing storage and production costs.

The only articles that were related to the problem being solved to a limited extent were found in the Scopus database (a total of 219 items), which were subjected to further analysis.

During the study of the current state of work on inventory management models for fast-moving finished goods with a short shelf life, different approaches and strategies for inventory management were found depending on the industry sector and part of the supply chain to ensure high product availability. Further analysis revealed that authors often also identified critical areas that affect the availability of products for sale.

Over the past decade, research on finished goods inventory management has increasingly focused on digital technologies, lean methodologies, and advanced optimization techniques, including financial ones. Many literature sources indicate that predictive analytics, artificial intelligence, and machine learning improve demand forecasting and cost control.

Table 2 presents the key trends and issues identified in finished goods inventory management over the last 10 years.

Table 2.

Key trends and challenges in inventory management over the last 10 years.

Publication	Identified key trends	Related challenges	Potential benefits of applying trends	Sector
França et al., 2018	Lean tools (Kanban, value stream mapping, Heijunka)	Losses, inefficiency	Reduction of inventory and lead times	Furniture
Alvarez-Placencia et al., 2020	ABC analysis, min-max system, lean pull during COVID-19	Low product availability, pandemic	Improving service levels	Large industrial
Simić et al., 2019	Inventory optimization algorithms	Balancing demand fulfillment and costs	A model that minimizes inventory and costs	Automotive
Yeshwanth, Bhavana, 2022	ABC analysis, Just-In-Time, Kanban, automation	Disruptions in the supply of raw materials and throughout the supply chain	Increase in inventory turnover	Electronics
Lemke, 2015	Economic order quantity, Kanban, Vendor Managed Inventory (VMI), process integration	Lack of a universal strategy, poorly adapted performance measurement indicators	Proposal for alternative measures to improve efficiency	Manufacturing in the United States
Anisere-Hameed, Dare, 2021	Just-In-Time, process review	Frozen capital, risk of financial illiquidity	Improving profitability	Food and beverages
Adegbola et al., 2024	Integration of artificial intelligence, machine learning, and predictive analytics	Data quality, technology integration, ethical issues	Cost reduction, improved forecasting	Total production
Avilés-Sacoto et al., 2019	Industry 4.0, technology-based operations	Technology, data, cultural barriers, product life cycle reduction, flexible manufacturing to meet customer needs	Action plan for small and medium-sized enterprises to overcome barriers related to technology, data, and flexible production	Small and medium-sized enterprises, total production

Source: own study.

Based on the above summary, there is a visible trend in the use of lean tools such as Kanban, Value Stream Mapping, and Just-In-Time to increase operational efficiency. At the same time, the authors highlight various challenges in the area of finished goods inventory management. The problems are related to data quality, difficulty in integrating technology, and resource constraints. There are also challenges related to balancing demand fulfillment with costs, waste

and inefficiency, low availability of finished goods for sale, lack of a universal strategy, high inventory maintenance costs, and disruptions in raw material supplies and the entire supply chain. The main areas of research are inventory reduction, order fulfillment time reduction, cost reduction, service level improvement, and inventory turnover improvement.

In the context of the FMCG sector, the identified trends are particularly significant due to short product life cycles, high demand variability, and the necessity to maintain a high level of finished goods availability. Research findings indicate that lean tools and methods such as Kanban, Just-In-Time, and ABC/XYZ analysis can be effectively adapted within this sector, provided that they are complemented by solutions that enhance flexibility and responsiveness across the supply chain. Furthermore, evidence from other industries (e.g., automotive, electronics, heavy industry) highlights the importance of data integration, process automation, and the application of predictive methods, which can be partially transferred to FMCG to improve demand forecasting and reduce losses associated with short product shelf life. In the FMCG sector, however, dynamic adjustment of operational strategies is of paramount importance—combining lean principles with modern digital tools and predictive inventory planning. This approach simultaneously enables cost efficiency improvements and maintains high product availability, representing one of the main challenges for manufacturing enterprises in this sector.

As part of a systematic review of the literature, inventory management strategies, their impact on product availability, and key success factors were also examined. Table 3 presents the results for representative items in this area.

Table 3.

The impact of inventory management strategies on product availability

Publication	Supply chain scope	Main inventory management strategy	Key metrics	Key success factors
Boone et al., 2013	Spare parts inventory management in military/defense	Strategic alignment of inventory management	Continuity, resilience	Integration of several strategies, streamlining of the process
Hetzel, 1993	Manufacturing and distribution in production (films)	Lot size optimization, safety stock placement	Cycle time, inventory reduction, cost savings	Forecast accuracy, coordination at various stages of the supply chain
Alvarez-Placencia et al., 2020	Manufacturing and distribution of industrial products	ABC analysis, Min-max inventory control method, Lean Pull Replenishment	Service level, inventory costs, delivery time	Integration of several strategies, streamlining of the process
Blomgren, Eriksson, 2016	Sales, purchasing, logistics in distribution	ABC analysis, cost-based inventory management	tied-up capital, turn-over rate	Integration of several strategies, streamlining of the process
Lundberg, Tranchell, 2017a	Distribution and inventory control in mining and construction	Product segmentation, differentiated inventory management	Not mentioned	Differentiated strategies based on product characteristics

Cont. table 3.

Keene et al., 2006	Manufacturing and distribution of construction equipment	Six Sigma, inventory optimization at various stages of the supply chain	Order fulfillment time, product availability, total inventory in the supply chain	Forecast accuracy, coordination at various stages of the supply chain
Lundberg, Tranchell, 2017b	Distribution and inventory control in mining and constructions	Product segmentation based on sales volume, inventory life cycle stages, cost size, and frequency	Not mentioned	Diversified strategies based on product characteristics
Polak, 2014	Manufacturing and distribution in retail sales	Optimizing inventory at different stages of the supply chain	Safety margin, service level	Forecast accuracy, coordination at various stages of the supply chain
Montiel Pineda, Caballero-Morales, 2023	Manufacturing (air conditioning)	ABC classification, periodic inventory review, continuous inventory review models	Costs, level of service	Simulation-based validation
Lemke, 2015	Manufacturing operations	Various strategies: Economic Order Quantity (EOQ), kanban, Vendor Managed Inventory (VMI), process integration	Inventory efficiency	Tailoring strategies to specific applications – tailor-made strategies

Source: own study.

Many items used a variety of strategies and diverse key indicators, pointing to a comprehensive approach to inventory management across different sectors and areas of the supply chain. Indicators related to product availability include customer service levels, order fulfillment times, and safety stock. Inventory management strategies that integrate multiple approaches have a measurable impact on product availability at the manufacturing and distribution stages. Research documents that strategies balancing demand forecasting, information sharing, and process integration not only reduce overall inventory and cycles but also improve order fulfillment times and reduce product availability volatility. Within the FMCG industry, these findings underscore the critical importance of strategies that enable rapid responses to demand variability and short product life cycles. Approaches that integrate production planning, distribution, and inventory management—based on continuous monitoring of stock levels and information sharing across the supply chain—prove particularly significant. Although many strategies discussed in the literature were developed for other industries (e.g., automotive, heavy industry, or aerospace), some of them—especially those concerning flow coordination, finished goods segmentation, or the application of ABC/XYZ methods—can be effectively transferred to the FMCG sector when adapted to its specific characteristics, namely short shelf life, high inventory turnover, and stringent product availability requirements. From this perspective, flexible strategies combining production, warehousing, and distribution form the foundation for maintaining high product availability in the dynamic FMCG environment.

The literature review also identified key factors influencing product availability in the supply chain for selected publications from the bibliometric analysis. The results are presented in Table 4.

Table 4.
Critical areas for product availability in the FMCG industry

Publication	Research area	Supply chain areas covered	Key conclusions
Chauhan et al., 2023	Logistics distribution efficiency in the FMCG sector	Transport and warehousing	Optimizing transport and storage efficiency has a positive impact on logistics distribution efficiency.
Ali et al., 2020	The bullwhip effect in the case of multiple products for a supply chain consisting of multiple links	Retailer, Distributor	Centralized information exchange reduces the bullwhip effect, improves supply chain efficiency, and product availability.
Jepherson et al., 2021	Logistics management systems for manufacturers in the FMCG industry	Order management, inventory management, transportation, information flow, warehousing, packaging	Logistics management systems have a positive impact on supply chain efficiency.
Anwar et al., 2023	Logistics efficiency in the FMCG industry	Logistics activities (transport, warehouse operations and storage, product availability)	Transportation, warehouse operations, storage, and product availability significantly impact logistics efficiency.
Mbhele, 2013	Central distribution system in the retail food industry	Distribution centers and replenishment of stocks in retail stores	The Central Distribution System improves product availability through integrated information exchange.
Njuguna, Ndolo, 2021	Logistics management systems for manufacturers in the FMCG industry	Warehousing and inventory management	Inventory and warehouse management systems significantly impact supply chain efficiency.
Bala, Kumar, 2011	Supply chain performance attributes in the FMCG industry	Procurement, production, logistics, customer service	SCOR (Supply Chain Operations Reference) a model tailored to the FMCG industry, focusing on quality, safety, and supplier reliability.
Shakur et al., 2024	Challenges associated with the implementation of Industry 4.0 in the FMCG sector	Manufacturing, physical distribution, wholesale and retail sales	Investments, technological infrastructure, and value chain structure are key challenges for the implementation of Industry 4.0.
Neboh, Mbhele, 2021	Supply chain resilience in the FMCG retail industry	Retail stage, focus on the transport network	Technology, economic indicators, and transport networks influence supply chain resilience.
Singh, 2013	Implementation of Vendor Management Inventory in the FMCG industry	Inventory management between supplier and customer (buyer)	VMI optimizes product availability and reduces inventory-related costs.

Source: own study.

Many studies suggest that the integration of information exchange systems may be a critical factor influencing availability in the supply chain in the FMCG sector. The authors highlight various aspects and their impact on supply chain performance, including centralized information exchange, central distribution systems in the supply chain, digitization, technological advances, and the challenges associated with the implementation of Industry 4.0.

The review of articles also shows that effective inventory and warehouse management are critical factors affecting product availability in the FMCG supply chain. The authors highlight areas such as VMI, warehouse and inventory management systems, storage efficiency, comprehensive logistics management, as well as warehousing and warehouse operations. The authors also point out the need to focus on optimizing logistics and distribution, including in the areas of transport management, transport networks, lead time management, and distribution network efficiency. The analyzed publications highlight several performance indicators that affect the availability and overall efficiency of the supply chain: bullwhip effect, logistics performance, SCOR model attributes, product availability, supply chain resilience, operational efficiency, and inventory costs. The aggregate results of these studies indicate interrelationships between factors affecting supply chain performance. Improvements in one area lead to cascading benefits and enhanced performance in other indicators across the entire supply chain. This complexity is particularly evident in the FMCG industry, where achieving better performance requires the simultaneous consideration of multiple indicators and factors. In the FMCG industry, the above findings confirm that product availability is the result of an integrated approach to managing the entire supply chain, encompassing both logistical and informational processes. Solutions based on digitalization and data flow automation—such as central distribution systems, the Supply Chain Operations Reference (SCOR) standard, Vendor Managed Inventory (VMI), or the implementation of Industry 4.0 technologies—play a critical role, as they enable faster responses to demand fluctuations and reduce replenishment lead times.

Analyzing the results presented in Tables 2, 3, and 4, it is evident that in recent years, both new trends in inventory management and the associated strategies and critical factors affecting product availability have become increasingly apparent. The approaches identified in the literature—from lean tools and optimization methods, through inventory management strategies, to the integration of logistical processes—highlight the growing need for a comprehensive, integrated approach to supply chain management.

5. Conclusions

Through systematic literature review and bibliometric analysis, as well as selection based on abstracts and analysis of full publications of selected articles, a research gap was identified, namely the need for a multifaceted approach to managing fast-moving finished goods with a short shelf life, considering the three main elements of the production-warehouse-customer supply chain. In the framework of further research, the development of a conceptual model has been proposed to describe and illustrate the relationships among these three areas. The model aims to provide an understanding of the mechanisms through which production decisions

(e.g., changeover frequency, batch size) affect warehouse inventory levels and, subsequently, product availability for customers. The interrelationships among these areas serve as a foundation for the development of a future simulation model.

The available literature lacks research that simultaneously considers key criteria such as:

1. In the area of production – minimization of production costs due to reduced batch sizes and the resulting increase in setup costs.
2. In the area of warehousing – minimization of storage costs and losses associated with product expiration.
3. On the customer side – maximization of product availability for customers.

The analysis of the relationships among these areas indicates that decisions in one domain directly affect the others. More frequent production changeovers increase operational costs but simultaneously shorten lead times and reduce inventory costs as well as the risk of product obsolescence. In turn, higher warehouse inventory levels enhance product availability but also lead to increased inventory maintenance costs and potential losses (e.g., disposal of expired products, price reductions for products with lower than acceptable freshness). Additionally, a prolonged production plan freeze allows for better resource utilization and raw material delivery planning, yet it limits the flexibility to respond to sudden market demand changes, potentially causing temporary product shortages. On the other hand, high production flexibility, and thus excessively frequent plan modifications, may overload production lines and increase the number of changeovers. Producing excessively large batches reduces unit production costs but increases inventory levels and the risk of product obsolescence, whereas overly small batches generate excessive changeovers and higher production costs. Frequent market demand fluctuations and sales seasonality impact both production planning and inventory levels. An increase in demand necessitates more frequent production runs, raising changeover costs but improving product availability and customer service levels. Conversely, a decrease in demand results in excessive inventory, increasing storage costs and the risk of product value loss. For these reasons, accurate demand forecasting and information integration across the entire supply chain are crucial. Decisions made in one area (production–warehouse–market) can simultaneously improve cost and operational efficiency in one area while negatively affecting it in another. Understanding these interdependencies is essential for developing a model that enables optimization of the balance among costs, product availability, and customer service levels in the FMCG sector.

The literature review also revealed an absence of simulation modeling applications as a tool for examining a multidimensional approach to managing inventories of fast-moving finished goods with a short shelf life. The future simulation model will therefore incorporate dependent and independent variables across three areas: production (e.g., changeover costs, batch size, resource utilization), warehousing (e.g., inventory holding costs, risk of product obsolescence, lead times), and market (e.g., demand, seasonality, order fulfillment timeliness). The model's

objective function will be defined as minimizing total supply chain costs while simultaneously maximizing product availability for customers.

The aim of further research is to develop an inventory management model for fast-moving finished goods in manufacturing enterprises within the FMCG sector, focused on:

- maximization of product availability for customers,
- minimization of storage costs and losses caused by product expiration,
- minimization of production start-up (line changeover) costs for inventory replenishment.

The proposed model will enable the identification of trade-offs among production flexibility, warehousing efficiency, and product availability. It will provide insights into how changes in parameters within one area (e.g., reducing production batch size) affect the other two areas, both in terms of costs and customer service levels. Constraints that should be considered in the model:

- freezing of the production schedule to ensure material availability (inability to immediately start production of a batch of products),
- minimum production order size due to changeover costs,
- product shelf life (losses related to price reductions or disposal of expired products).

Each of the above constraints affects other elements of the supply chain—for example, a long production plan freeze limits the flexibility to respond to variable demand, while a minimum production batch size determines inventory levels in the warehouse and, consequently, product availability.

The originality of the model to be developed in further research lies in its comprehensive approach to the production–warehouse–market chain, considering the constraints arising from the characteristics of FMCG sector enterprises, and focusing on minimizing production changeover and storage costs while maximizing product availability for customers.

References

1. Adegbola, A., Adegbola, M., Amajuoyi, P., Benjamin, L., Adeusi, K. (2024). Advanced financial modeling techniques for reducing inventory costs: A review of strategies and their effectiveness in manufacturing. *Finance & Accounting Research Journal*, 6(6), pp. 801-824, doi: <https://doi.org/10.51594/farj.v6i6.1180>
2. Ali, R., Khalid, R., Qaiser, S. (2020). A Discrete Event Simulation Analysis of the Bullwhip Effect in a Multi-Product and Multi-Echelon Supply Chain of Fast Moving Consumer Goods. *Pakistan Journal of Statistics and Operation Research*, 16(3), pp. 561-576, doi: <https://doi.org/10.18187/pjsor.v16i3.3088>

3. Alvarez-Placencia, I., Sánchez-Partida, D., Cano-Olivos, P., Flores, J.L. (2020). Inventory Management Practices during COVID 19 Pandemic to Maintain Liquidity Increasing Customer Service level in an Industrial Products Company in Mexico. *Advances in Science, Technology and Engineering Systems Journal*, 5(6), pp. 613-626, doi: <https://doi.org/10.25046/aj050675>
4. Anisere-Hameed, R.A., Dare, T. (2021). The Impact Of Inventory Management On The Profitability Of Manufacturing Companies In Nigeria. *International Journal of Innovative Research and Advanced Studies*, Vol. 8, Iss. 1, pp. 9-15. Retrieved from: https://www.ijiras.com/2021/Vol_8-Issue_1/paper_2.pdf, 17.08.2025.
5. Anwar, U.A.A., Wirayudha, A., Suwarsi, S., Anuar, A., Mohamed, B. (2023). Logistics performance for practice in the fmcg industry through a supply chain management approach. *Jurnal Ilmiah Manajemen Bisnis Dan Inovasi Universitas Sam Ratulangi*, 10(2), pp. 1386-1394, doi: <https://doi.org/10.35794/jmbi.v10i2.49546>
6. Avilés-Sacoto, S.V., Avilés-González, J.F., Garcia-Reyes, H., Bermeo-Samaniego, M.C., Cañizares-Jaramillo, A.K., Izquierdo-Flores, S.N. (2019) A glance of i4.0 at supply chain and inventory management. *International Journal of Industrial Engineering: Theory, Applications and Practice*, 26(4), pp. 486-506, doi: <https://doi.org/10.23055/ijietap.2019.26.4.5175>
7. Bala, M., Kumar, D. (2011). Supply chain performance attributes for the fast moving consumer goods industry. *Journal of Transport and Supply Chain Management*, 5(1), pp. 23-28, doi: <https://doi.org/10.4102/jtscm.v5i1.19>
8. Blomgren, O., Eriksson, S. (2016). *Improving Demand Planning and Inventory Management - A Supply Chain Evaluation from a Distributor's Perspective*. Gothenburg: Chalmers Univeristy Of Technology, Department of Technology Management and Economics.
9. Boone, C., Craighead, C., Nair, A. (2013). Implementation of a System Approach for Enhanced Supply Chain Continuity and Resiliency: A Longitudinal Study. *Journal of Business Logistics*, 34(3), pp. 220-232, doi: <https://doi.org/10.1111/jbl.12021>
10. Chauhan, P., Bangwal, D., Kumar, R. (2023). Managing the Logistics Distribution Performance Using Digitalization in the FMCG Sector. *Vision: The Journal of Business Perspective*, 27(1), pp. 1-10, doi: <https://doi.org/10.1177/09722629221143261>
11. Ciechańska, O., Szwed, C. (2020). Characteristics and study of make-to-stock and make-to-availability production strategy using simulation modelling. *Management and Production Engineering Review*, 11(4), pp. 68-80, doi: <https://doi.org/10.24425/mper.2020.136121>
12. Coelho, L.C., Cordeau, J.-F., Laporte, G. (2012). The inventory-routing problem with transshipment. *Computers & Operations Research*, 39(11), pp. 2537-2548, doi: <https://doi.org/10.1016/j.cor.2011.12.020>

13. Czakon, W. (2015). *Podstawy Metodologii Badań w naukach o zarządzaniu*. Warszawa: Wolters Kluwer SA, pp. 119-136.
14. Ertz, M., Leblanc-Proulx, S. (2018). Sustainability in the collaborative economy: A bibliometric analysis reveals emerging interest. *Journal of Cleaner Production*, 196(20), pp. 1073-1085, doi: <https://doi.org/10.1016/j.jclepro.2018.06.095>
15. França, S., Dias, D., Freitag, A., Quelhas, O., Meirino, M. (2019). Lean Manufacturing Application Analysis in the Inventory Management of a Furniture Industry. In: J. Reis, S. Pinelas, N. Melão (eds), *Industrial Engineering and Operations Management, I* (pp. 207-219). Cham: Springer.
16. Harrison, A., Skipworth, H., van Hoek, R.I., Aitken, J. (2019). *Logistics management and strategy: competing through the supply chain*. UK: Pearson, pp. 242-254.
17. Holweg, M., Disney, S., Holmström, J., Småros, J. (2005). Supply Chain Collaboration: Making Sense of the Strategy Continuum. *European Management Journal*, 23(2), pp. 170-181, doi: <https://doi.org/10.1016/j.emj.2005.02.008>
18. Jemai, Z., Rekik, Y., Kalaï, R. (2013). Inventory routing problems in a context of vendor-managed inventory system with consignment stock and transshipment. *Production Planning & Control*, 24(8-9), pp. 671-683, doi: <https://doi.org/10.1080/09537287.2012.666844>.
19. Jepherson, M., Ngugi, P., Moronge, M. (2021). Logistics management systems and performance of fast-moving consumer goods manufacturers in Nairobi, Kenya. *International Journal of Supply Chain Management*, 6(1), pp. 29-63, doi: <https://doi.org/10.47604/ijscm.1232>
20. Kabus, J. (2022). Managing the distribution process with an example of the FMCG market. *Scientific Papers of Silesian University of Technology. Organization and Management Series*, 160, pp. 275-286, doi: <http://dx.doi.org/10.29119/1641-3466.2022.160.18>
21. Keene, S., Alberti, D., Henby, G., Brohinsky, A., Tayur, S. (2006). Caterpillar's Building Construction Products Division Improves and Stabilizes Product Availability. *Interfaces*, 36(4), pp. 283-295, doi: <https://doi.org/10.1287/inte.1060.0208>
22. Kumar, N., Mishra A., George, S. (2013). Gaps between inventory management theory and practice: a critical examination of emerging trends from the FMCG industry. *International Journal of Logistics Economics and Globalisation*, 5(1), pp. 1-14, doi: <https://doi.org/10.1504/IJLEG.2013.054427>
23. Lemke, S.W. (2015). *Inventory Optimization in Manufacturing Organizations*. Minneapolis: Walden University, School of Management.
24. Lim, Z.S., Wong, R.R., Wong, C.-Y., Zulkharnain, A., Shaharuddin, N.A., Ahmad, S.A. (2021). Bibliometric Analysis of Research on Diesel Pollution in Antarctica and A Review on Remediation Techniques. *Applied Sciences*, 11(3), pp. 1-13, doi: <https://doi.org/10.3390/app11031123>

25. Lueb, M. (2014). *Modeling Production Sequences in the Fast Moving Consumer Goods Industry*. Berlin: Technische Universität Berlin, Wirtschaft und Management.
26. Mauléon Lundberg, J., Beckvid Tranchell, J. (2017). *Forming a Strategy for Distribution Inventory Management*. Lund: Lunds Universitet, Department of Industrial Management and Logistics.
27. Michałowska, I., Majchrzak, J. (2024). Systemic Approach in the Study of the Current State of Knowledge in the Field of University Management. *Annales Universitatis Mariae Curie-Skłodowska sectio H Oeconomia*, 58(4), pp. 149-169, doi: <https://doi.org/10.17951/h.2024.58.4.149-169>.
28. Moher, D., Tetzlaff, J., Tricco, AC., Sampson, M., Altman, DG. (2007). Epidemiology and Reporting Characteristics of Systematic Reviews. *PLOS Medicine*, 4(3), pp. 1-9, doi: <https://doi.org/10.1371/journal.pmed.0040078>
29. Montiel Pineda, M. del C., Caballero-Morales, S. (2023). A comparison of inventory strategies for a manufacturer within the air conditioning industry. *Journal of Engineering Research and Reports*, 25(3), pp. 13-25, doi: <https://doi.org/10.9734/jerr/2023/v25i3888>
30. Mora, L., Deakin, M., Bolici, R. (2017). The First Two Decades of Smart-City Research: A Bibliometric Analysis. *Journal of Urban Technology*, 24(2), pp. 3-27, doi: <http://dx.doi.org/10.1080/10630732.2017.1285123>
31. Neboh, N., Mbhele, T. (2020). Supply Chain resilience and design in retail supermarkets. *Journal of Contemporary Management*, 17(2), pp. 51-73, doi: <https://doi.org/10.35683/jcm19086.64>
32. Neboh, N., Mbhele, T. (2021). Supply chain design dimensions for supply chain resilience in the South African fast-moving consumer goods retail industry. *Africa Journal of Management*, 7(5), pp. 1-24, doi: <https://doi.org/10.1080/23322373.2021.1930742>
33. Niñerola, A., Sánchez-Rebull, M-V., Hernandez, A. (2019). Tourism Research on Sustainability: A Bibliometric Analysis. *Sustainability*, 11(5), pp. 2-27, doi: <https://doi.org/10.3390/su11051377>
34. Njuguna, L.W., Ndolo, J. (2021). Influence of logistics management systems on supply chain performance of fast-moving consumer goods manufacturers in Nairobi City County, Kenya. *International Research Journal of Business and Strategic Management*, 2(2), pp. 249-259. Retrieved from: <https://www.irjp.org/index.php/irjbsm/article/view/41>, 28.08.2025
35. Polak, B. (2014). *Multi-echelon inventory strategies for a retail replenishment business model*. Cambridge: Massachusetts Institute of Technology, Department of Mechanical Engineering.
36. Raa, B., Aghezzaf, E.-H. (2009). A practical solution approach for the cyclic inventory routing problem. *European Journal of Operational Research*, 192(2), pp. 429-441, doi: <https://doi.org/10.1016/j.ejor.2007.09.032>

37. Shakur, M.S., Lubaba, M., Debnath, B., Bari, A.B.M.M., Rahman, M.A. (2024). Exploring the Challenges of Industry 4.0 Adoption in the FMCG Sector: Implications for Resilient Supply Chain in Emerging Economy. *Logistics*, 8(1), pp. 1-28, doi: <https://doi.org/10.3390/logistics8010027>
38. Simic, D., Svirčević, V., Ilin, V., Simić, S., Simić, S. (2019). Particle Swarm Optimization and Pure Adaptive Search in Finish Goods' Inventory Management. *Cybernetics and Systems*, 50(4), pp. 1-20, doi: <https://doi.org/10.1080/01969722.2018.1558014>
39. Singh, R. (2013). Analyzing the Factors for VMI Implementation: A Framework. *Global Business Review*, 14(1), pp. 169-186, doi: <https://doi.org/10.1177/0972150912466476>
40. Szum, K. (2021). IoT-based smart cities: A bibliometric analysis and literature review. *Engineering Management in Production and Services*, 13(2), pp. 115-136, doi: <https://doi.org/10.2478/emj-2021-0017>
41. Taifa, I., Vhora, T. (2019). Cycle time reduction for productivity improvement in the manufacturing industry. *Journal of Industrial Engineering and Management Studies*, 6(2), pp. 147-164, doi: <https://doi.org/10.22116/jiems.2019.93495>
42. Yeshwanth, S., Bhavana, U. (2022). Inventory Management Practices in Manufacturing Industries during the COVID 19: A review. *International Journal of Science, Engineering and Management*, 9(4), pp. 15-20, doi: <https://doi.org/10.36647/IJSEM/09.04.A004>
43. Zhao, D., Strotmann, A. (2015). Foundations of Citation Analysis. In: G. Marchionini (Ed.), *Analysis and Visualization of Citation Networks* (pp. 1-207) Retrieved from: https://www.researchgate.net/publication/272174763_Analysis_and_Visualization_of_Citation_Networks, 01.08.2025.

METHODS OF ADULT TRAINING IN CIVIL PROTECTION AND CIVIL DEFENSE IN LIGHT OF THE 2025 REGULATION OF THE MINISTER OF THE INTERIOR AND ADMINISTRATION

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Purpose: the aim of this article is comprehensive analysis of adult training methods applied and recommended within the Polish system of civil protection and civil defense, as defined by the law regulation. The article aims to what extent the teaching methods recommended by regulations correspond to the theoretical framework of adult training and to the practical needs of public administration and other entities of civil defense and protection system in Poland. This article also indicates basis of civil protection background implemented in training programmes.

Design/methodology/approach: the study adopts qualitative and analytical methodology elements of content analysis and systemic interpretation.

Findings: the findings suggest that the regulation tries to integrate adult learning theory with the strategic objectives of national resilience policy referring to arising civil protection by implementing practical training methods as a legal recommendation.

Research limitations/implications: the article is a conceptual and normative nature. It does not include empirical data on the effectiveness of the training programs, as the regulation was enacted in 2025 and has yet to be comprehensively evaluated. Future research should involve longitudinal studies assessing how these methods affect abilities and knowledge of future training attendees.

Practical implications: the results directs value for training providers, public administration and policy-makers which methods correspond to training which really introduce enhancing of skills valuable in civil protection and defense.

Social implications: introducing valuable methods of training has a measurable effect on community preparedness and institutional resilience. In his sense, the regulation's implementation contributes directly to the enhancement of national safety culture.

Originality/value: this paper is the first academic studies to interpret the 2025 Regulation from a didactic and andragogical point of view, fulfilling the gap between legal prescription and training in use. Additionally it allows to start wider scope of research referring to training system in civil protection.

Keywords: civil defence, adult trainings, security.

Category of the paper: action reaserch, view point.

1. Introduction

In the face of expanding spectrum of international threats to the state safety the Polish government has undertaken an intensive revision of its system of civil protection and civil defense. The transformation is evident both in normative dimension and the executive dimension, reflected in lower-level legal act regulating the training and preparation of personnel responsible for protective and rescue tasks. One of the key element of this reform is the Regulation of the Minister of the Interior and Administration on training programs in the field of civil protection and civil defense and on requirements for entities conducting such training. This regulation is significant for a few reasons.

First, it standardizes the scope of training for various categories of personnel responsible for civil protection at all levels of public administration. All indicated positions are connected with Polish crisis management and the Regulation covers all the levels with training program.

Second, it distinguishes between initial and updating training, thereby formalizing the necessity of maintaining competency readiness over time, rather than treating training as one-time event.

Third, the Regulation defines the training methods recommended to be applied within each training module which includes lectures, conversational lectures, problem-based study, case study, instruction and decision-making role-play decision game.

Fourth, it establishes requirements for training institutions, including organizational, personnel and technical conditions necessary to ensure nationwide consistency and quality of training.

The main purpose of this article is to provide a review and analysis of the adult training methods given in the Regulation in relation to recognized paradigms of adult learning and safety didactics, and to assess how well these methods address the actual expectations of adult training. The paper takes a synthetic and interpretative approach — it is not legal commentary on the regulation itself, but an attempt to place its provisions within the boarder context of adult training theory and the practical realities of providing training.

In doing so, the article seeks to answer three key questions:

1. to what extent do the prescribed methods align with the approach of introducing the most sufficient training, including the level of improving practical capabilities,
2. what kind o methods are should be implemented widely during training in order to enhance skills of attendees?
3. what are the strengths and limitations of the regulatory model in ensuring long-term resilience?

By combining legal, organisational and didactic perspectives, the study situates the Regulation as both a policy instrument and a training framework aimed at professionalizing the civil protection training providers system in Poland.

2. Theoretical and legal framework

The legal reform – from civil protection to societal resilience

The new Act on Civil Protection and Civil Defense replaced the previous, outdated regulation on civil defense. The Act defines what civil protection and civil defense are.

According to the statutory definitions, civil protection is a system composed of public administration bodies performing tasks aimed at ensuring the safety of the population through the protection of human life and health, property (including animals) critical infrastructure, cultural assets, and the environment in situations of threat. These entities are referred to as civil protection authorities, and the entities performing these tasks are referred to as civil protection entities, together with the civil protection resources they utilize.

Civil defense, on the other hand, refers to the implementation of tasks defined in Article 61(a) of the Additional Protocol to the Geneva Conventions of 12 August 1949 relating to the protection of victims of international armed conflicts (Protocol I), signed in Geneva on 8 June 1977 (Journal of Laws 1992, item 175; 2015, item 1056). This document—hereinafter referred to as the *First Additional Protocol to the Geneva Conventions*—aims to protect the civilian population from dangers arising from acts of war and their consequences.

Upon the introduction of martial law and during wartime:

1. civil protection becomes civil defense,
2. civil protection authorities become civil defense authorities,
3. civil protection entities become civil defense entities,
4. civil protection resources become civil defense resources.

The objective of the new Act was to create a comprehensive system of civil protection for times of peace, crisis, and war, integrating public administration, emergency services, social organizations, and citizens. The Act abandons the reactive approach of previous decades - its core lies in prevention, education, and societal resilience, meaning the preparation of people and institutions to function under conditions of threat.

The legislator emphasized the necessity of continuity of action between peace and wartime: in the event of armed conflict, civil protection automatically transforms into civil defense, and all institutions, entities, and resources operating in peacetime shift to a wartime framework. This implies that training and personnel preparation form the very foundation of the entire system—they cannot begin only when a crisis arises. The organization of an effective civil protection system is therefore a crucial element in building the state's overall defense capacity.

The tasks of civil defense extend beyond creating forces and resources to counter non-military threats; they also involve preparing civilians to act under wartime conditions should armed conflict occur (Szydłowski, 2025). The Act defines:

1. the tasks of civil protection and civil defense,
2. the authorities and entities responsible for carrying out civil protection and civil defence tasks,
3. the principles of planning in the field of civil protection and civil defence,
4. the functioning of systems for threat detection, warning, and alerting the population,
5. the rules for the use, registration, and technical conditions of collective protection facilities,
6. the organisation and operation of civil defense, as well as the procedure for appointing civil defense personnel,
7. the financing of civil protection and civil defense (Żurawska-Ochyra, 2025; Marcinek, 2025).

An analysis of the provisions of the Act indicates that the tasks of civil protection and civil defense focus primarily on preparing public administration bodies to perform their statutory duties in this field, including measures aimed at ensuring the continuity of public administration operations, with due regard for the need to maintain coherence between military and non-military actions in the defense of the state (Wróblewski, 2025).

Focusing on the construction of the Act, it may be concluded that it is grounded in the logic of emergency management - its main objective is not only to establish formal bases for responding to threats but also to enhance knowledge, skills, and especially preparedness for handling extraordinary situations. It promotes the reduction of their effects through proactive preparation, culminating in the most essential component of response - civil protection training.

Importantly, the legislator did not confine training obligations solely to formal members of the public security system but extended them to cooperating and potentially co-responsible entities, including private and NGOs sector. This approach aligns with the concept of societal resilience, in which responsibilities related to survival and the restoration of local community functioning after an extraordinary event are distributed among multiple actors, including those outside the sphere of governmental and local administration.

The regulation's training system – standardiaation and professionalisation

The Regulation of the Minister of the Interior and Administration of 6 February 2025 on training programmes in the field of civil protection and civil defense, and on the requirements for entities authorised to conduct such training (Journal of Laws 2025, item 162), constitutes one of the key executive acts to the Act of 5 December 2024 on Civil Protection and Civil Defense.

From the perspective of security studies, this regulation fills a significant gap in the national system of civil security - for the first time, it introduces a standardised educational model encompassing public administration, uniformed services, social organisations, and the general population.

The regulation, issued under statutory authorisation (Article 51 of the Act on Civil Protection and Civil Defense), serves as a crucial bridge between the normative framework of civil protection and civil defense and the actual capacity of public institutions, local government administration, emergency services, businesses, and society at large to act effectively in situations of peace-time, crisis, or wartime threats. The regulation's main objectives are as follows:

- to define uniform training programmes in the field of civil protection and civil defense for clearly delineated groups of addressees,
- to specify organisational, staffing, and technical requirements for the entities authorised to conduct training, thereby ensuring qualitative consistency and comparable standards of preparedness nationwide.

In other words, the regulation functions as an instrument of professionalisation and standardisation in the field of competence-based training for civil protection and civil defense. It establishes not only what must be known, but also who is entitled to teach it, under what conditions, and through which didactic methods.

The regulation is founded on the assumption that the state's capacity for civil protection is not merely a function of specialised formations, but rather depends on the decision-making and operational competencies of a wide range of public and non-public entities. Accordingly, nine distinct training programmes were established and attached as annexes to the regulation. Each programme corresponds to a specific category of public function or operational role. Thus, the regulation encompasses the following training groups (as numbered in the Regulation):

1. senior state executives – ministers, secretaries and undersecretaries of state, and heads of central offices,
2. regional executive staff – voivodes and marshals of voivodships,
3. county-level staff – starosts,
4. municipal-level staff – mayors, town and city presidents,
5. administrative staff employed in units supporting civil protection authorities and other local government organisational entities, as well as in auxiliary units of municipalities,
6. persons holding civil defense mobilisation assignments,
7. personnel of civil protection entities (i.e., entities executing civil protection and civil defense tasks under statutory mandate),
8. members of associations and entrepreneurs performing civil protection-related functions,
9. the general population (training directed at civil society).

Each of the nine programmes annexed to the regulation includes, in a manner typical of training documentation, elements such as: training objectives, thematic scope, minimum instructional hours, forms of teaching (lectures, decision-making seminars, practical exercises), and desired learning outcomes.

Nevertheless, these programmes are formulated at a general level. Given the increasing number of training providers and diverse local conditions, this generality creates a cognitive and methodological gap that opens avenues for further research - particularly concerning the refinement, contextualisation, and adaptation of training content to specific operational environments.

It is, however, an undeniable fact that the regulation not only prescribes what should be taught but also establishes the didactic architecture for conducting such training. The regulation reflects a broader paradigmatic shift initiated by the Act on Civil Protection and Civil Defense: internal security is no longer understood merely as the state's ability to react after a threat occurs, but as its readiness to maintain critical functions and essential services during a crisis. In practice, this means that training no longer focuses solely on emergency response tasks in the narrow sense (e.g., evacuation, first aid), but also on:

- maintaining the continuity of institutional and administrative functions,
- securing supply chains of essential goods and services,
- protecting critical infrastructure and energy resources,
- communicating effectively with the population and counteracting panic,
- safeguarding cultural heritage and the environment under threat conditions.

The Regulation's second pillar, alongside its substantive content, lies in establishing quality assurance frameworks for the institutions conducting training. It specifies the minimum organisational, infrastructural, and personnel requirements that a training entity must meet to be authorised under the regulation. These include:

1. possession of infrastructure and organisational conditions necessary for conducting training in accordance with the prescribed programme, including lawful access to training premises,
2. documented experience within the last five years in delivering education or training in the fields of national security, internal security, crisis management, civil protection, civil defense, or critical infrastructure protection,
3. employment (under contract or civil agreement) of at least two instructors who meet one of the following criteria:
 - hold a doctoral degree in security sciences, defense sciences, military sciences, or safety engineering, with documented scientific and teaching experience relevant to the subject area within the last five years,
 - hold a Master's degree in Fire Engineering and at least five years of service or employment in fire protection or public administration units related to civil protection, civil defense, or crisis management, with documented teaching experience,

- hold a Master's degree in a field related to security and at least five years of relevant professional or service experience in public administration, with documented teaching experience,
- possess documented teaching experience and at least ten years of professional or service experience in public administration units related to civil protection, civil defense, or crisis management.

A crucial research gap, however, concerns the evaluation of training implementation and the assessment of learning outcomes. Future studies should investigate not only the delivery of training content but also participants' acquisition of practical response skills and their cognitive-behavioural adaptation to stress. Such research would open an important interdisciplinary debate within the field of security education.

Andragogy and resilience building – a didactic framework for adult training

Adult education employs a wide range of teaching methods, from traditional lectures to advanced simulation games. The classification of training models can be described as twofold. The first is the traditional education model, which includes teaching methods such as storytelling, description, lecture, discussion, conversation, and group or individual work based on written materials (Makuch et al., 2022). The second is an innovative experiential model, based on active learning methods, which encompasses techniques such as brainstorming, educational games and situational methods (Makuch et al., 2022). According to the literature, activating methods tend to have a stronger impact on learning effectiveness (Makuch et al., 2022).

The choice of method depends on the educational goals, subject matter, and participants' preferences. Research indicates that adults value methods that engage their experience and enable them to solve real-world problems. In a survey among Polish employees aged 50+, the most preferred approaches were problem-based methods (30.6% of responses) and activating methods (25.8%), while traditional, transmission-based methods (e.g., lecture, description) were chosen by only about 20% (Pawłowska-Cypriak, Hildt-Ciupinska, 2022). This suggests that methods emphasizing participant activity and problem discussion are dominant. This aligns with the principles of andragogy—adults learn more effectively when they can use their own experiences and relate new knowledge to practical applications.

For this reason, adult trainers often use case studies, brainstorming sessions, simulations, and training games, supplementing them with a minimal amount of theoretical mini-lectures (Dębska, 2012). The use of gamification—game mechanisms such as points, competition, and badges—has also become increasingly popular to boost participant engagement in both e-learning courses and in-person training sessions (Kupidura, Sułkowski, 2024). Modern technologies further enable the use of virtual simulations and live online training, expanding the array of methods available in adult education.

A key question is which methods yield the best results in adult learning. The literature highlights the superiority of activating methods over purely expository ones in maintaining attention, motivation, and long-term learning outcomes. Adult learners learn more effectively through practical action and problem-solving than through passive listening. Therefore, even in vocational training, it is recommended to reduce one-way lectures in favor of interaction and exercises (Mikołajczyk, 2011).

Empirical findings confirm this relationship. Łączyński (2011) demonstrated that simulation games, as an example of active methods, can increase knowledge acquisition efficiency by several to several dozen percentage points compared with traditional lectures or even case studies. Participants trained through games tend to remember material better and apply it more effectively in practice - an effect attributed to their higher emotional engagement and the ability to make mistakes safely during simulations. Similarly, the application of gamification elements and interactive educational technologies contributes to better knowledge retention, the development of practical skills, and higher participant motivation (Kupidura, Sułkowski, 2024).

It is worth emphasizing that the effectiveness of adult learning depends not only on the form of instruction but also on the adaptation of methods to learners' needs and learning styles. Adults achieve better outcomes when they see the direct usefulness of acquired knowledge; therefore, effective training should reflect participants' professional realities and include practical examples and exercises based on real work situations (Mikołajczyk, 2011). The motivational factor also plays a significant role - adults are primarily driven by intrinsic motivation. Thus, methods that stimulate curiosity, foster a sense of personal development, and allow participants to co-determine the course of training (e.g., selecting case studies or questions for experts) enhance learning outcomes (Mikołajczyk, 2011).

In summary, the most effective approaches are active methods—those that engage participants cognitively and emotionally-supported by an appropriate amount of theoretical knowledge and constructive feedback that allows for error correction. A variety of forms (e.g., combining mini-lectures, discussions, group exercises, and simulations) also accommodates different adult learning styles and increases overall training effectiveness (Pawłowska-Cyprysiak, Hildt-Ciupinska, 2022).

The andragogical theory draws attention to the complexity of the adult teaching-learning process. The dependence of this process on multiple factors usually leads to the occurrence of various difficulties during its course. Generalized difficulties in adult learning can be divided - similarly to the approach used in general didactics - into the following categories:

- those related to the learner,
- those related to the teacher,
- those related to the organization and course of the teaching-learning process (Dam-Knap, 2023).

Effective learning depends on many factors. Zbigniew Pietrasiński identified the factors determining the complexity and specificity of the learning process:

- the individual's diverse life experience,
- the interests, needs, and motivation of learners,
- mastery of learning techniques,
- the course of one's school career and post-school educational activity,
- the social roles performed,
- the amount and structure of free time (Dam-Knap, 2023).

It should be emphasized at this point that the best results in adult education will be achieved by individuals whose approach to the training process, particularly regarding the pedagogical aspects of the instructional process, is characterized by a specific mindset (Pisarczyk, 2023).

To achieve this, instructor should:

- focus the attention of the participants,
- reinforce their sense of self-worth (self-concept),
- build upon their prior experiences and life events,
- refrain from criticizing contributions (even if erroneous), but rather skillfully utilize them to guide participants toward the correct answer or problem resolution,
- employ collaborative working methods (e.g., group work) to facilitate the development of shared conclusions,
- emphasize the participants' co-responsibility for the teaching/learning process,
- create an appropriate learning climate (mutual respect, cooperation, trust) in the educational process (Grzyb, 2015).

To ensure high efficacy in the adult education process, the following principles should be observed:

- adults must understand why they need to learn before they commit to the learning process (need to know/goal orientation),
- the level of self-knowledge is dependent on the readiness for self-directed learning,
- the prior experience of adults constitutes a valuable resource for learning,
- adults typically demonstrate a readiness to learn when they encounter a problematic situation (problem orientation),
- education, for adults, is a process of developing and enhancing competencies that facilitate the achievement of personal and professional growth,
- educational motivation is primarily intrinsic rather than extrinsic (Grzyb, 2015).

Referring to training process in civil protection, there is a need to lead more research concerning the quality and andragogical point of view during lasting trainings.

3. Research methodology

This article is conceptual and normative in nature, and its main objective is to analyze the training methods contained in the new legal act and relate them to the theory of andragogy and the practical needs of the civil protection system. Due to this objective and the fact that the regulation came into force in 2025, with no empirical data yet available on its application, a qualitative approach was deemed most appropriate. The research methodology employed was based on three pillars, responding to the reviewers' comments regarding the operationalisation of the process:

- 1) content analysis - the primary method was the content analysis of source documents, primarily the Regulation of the Minister of the Interior and Administration of 2025 and the superior Act on Civil Protection and Civil Defense. The interpretation criteria included identifying recommended didactic methods (e.g., lecture, case study, decision-making game), defined target groups for training (from management to the general public), requirements for organisers and staff (professionalisation);
- 2) systemic interpretation - the analyzed provisions of the regulation were placed within the broader context of the state's strategic goals arising from the Act. This method allowed for linking specific didactic requirements with the overarching goals of the system, such as building societal resilience and ensuring the continuity of administration;
- 3) comparative analysis - the training methods identified in the regulation were adjacent with established theories of adult learning (andragogy) and modern models of resilience-building training. This allowed for an assessment of the extent to which the legislator integrated didactic theory with legal requirements.

4. Results

Structure of the training system and its didactic philosophy

The training programmes specified in the regulation are organised into a logical hierarchy reflecting the structure of the civil protection system — from the strategic (central) level, through regional and local levels, to the societal level. Knowledge and procedures are disseminated top-down, yet response capability must be built bottom-up, grounded in local experience and capacity. Each programme includes five essential didactic components:

1. a general objective defining the training's function within the civil protection system,
2. the target group of participants,
3. the organisational format, emphasising the practical nature of instruction and indicating the duration of training,
4. the thematic scope, outlining subject areas to be covered without imposing rigid content,
5. the method of evaluation, defining the desired level of competence attainment.

From an andragogical standpoint, the training design is rooted in the paradigm of resilience-building training. Its assumptions correspond to five key theoretical models:

1. preparedness training,
2. stress inoculation training,
3. personal efficacy training,
4. resilience engineering training, and
5. team resilience training (Ketelaars et al., 2024).

This means that training cannot rely on passive knowledge transmission but must function as an active learning process - one that engages participants through simulation, scenario-based exercises, and practical experience, thereby fostering resilience and adaptability. The thematic structure of civil protection training aligns closely with the principles of learning by doing, a pedagogical approach long recognised in emergency management education. Relation between assumption of resilience-building training and training programmes is presented below (Table 1).

Table 1.

Relation between resilience-building training and civil protection programmes

Resilience training type	Polish civil defense training programs	Justification for corelation
Preparedness training	Preparation and planning (e.g., business continuity planning, personnel mobilization)	Covers preparation for foreseeable events, including learning protocols and procedures. The key element is operationalizing and planning the response
	System of threat detection, notification, warning, and alerting	Relates to the early recognition of threats and the application of planned systems (warning/alerting)
	Evacuation of people, animals, and property	Involves a set of planned procedures and actions in case of a threat, aimed at protection (preparation)
	Individual and collective protection measures and shelter locations	An element of preventive preparation and protection
Resilience engineering training	Organization and functioning of (role, functions, tasks, place within the system)	Focuses on developing an understanding of how the system works to effectively contribute to it (understanding the system and one's role)
	Cooperation, support, and coordination	System resilience is a function of cooperation and regulation within the system (many elements: humans, technologies, organizations)
	Risk management and response	Focuses on managing and regulating the variability of system performance
	Security steering/direction in various states of national functioning	The ability to adjust the system's functioning to changing conditions and states

Cont. table 1.

Personal efficacy training	Strategic/situational leadership in civil protection	Develops the personal skills of professionals in demanding roles to perform their duties effectively
	Psychological aspects in security management	Elements developing personal coping skills related to role demands (e.g., stress management)
	Increasing one's own resilience to threats (only for the general population, facultative)	Direct reference to strengthening personal coping capabilities
Stress inoculation training	(No direct thematic blocks, but elements present in the form of) Decisional training method and exercises/decisional games	Although not explicitly named, these methods involve exposing decision-makers to stressors (decisional problems) in a simulated environment to increase stress resistance and improve performance in a critical situation
Team resilience training	Cooperation in a team (only for the general population, facultative)	Concerns the team's ability to maintain performance when faced with interferences. This is the only direct reference to team resilience

Source: own preparedness.

The training approach identifiable in the training programmes may lead to increases in perceived resilience and confidence (reported in 35% of the 20 studies reporting outcomes), improved stress control (reported in 20% of the included studies), improved physical, behavioural, and/or cognitive performance (reported in 25% of the included studies), and other descriptive outcomes (reported in 20% of the included studies) (Ketelaars et al., 2024).

Analysis of training programmes assumptions

Training programmes constitute the core of the Regulation of 6 February 2025. Functionally, they translate the statutory objectives of the Civil Protection and Civil Defense Act into concrete educational activities, practical exercises, and competence-building processes. Contained in nine annexes, these programmes provide a standardised instructional model encompassing both the public and private sectors as well as the general population.

While the Act defines what must be done and who is responsible, the Regulation defines how individuals and institutions must be prepared to fulfill these tasks.

The training programmes addressed to ministers, state secretaries, and heads of central offices are designed to develop strategic awareness. They do not focus on technical procedures, but rather on a systemic understanding of security mechanisms - relationships among national response structures, international competencies, and the principles of crisis communication at the state level.

The central premise of these programmes is that a strategic decision-maker must understand how their decisions affect citizens' safety and the functioning of critical infrastructure. The main didactic assumptions of these programmes include:

- information management under pressure and uncertainty,
- decision-making in complex crisis conditions,
- coordination with lower-level administrative bodies,
- public communication and strategic accountability for decisions.

The intended outcome is to prepare senior government leaders not merely as officials executing orders, but as coordinators of the civil protection system, capable of integrating strategic decisions with operational realities.

At the regional and county levels, training assumes an operational–planning character. Its purpose is not theoretical knowledge of the law, but the development of practical competencies in directing activities under real threat conditions. Key training assumptions at this level include:

- developing evacuation and population-relocation plans,
- ensuring the continuity of public institutions,
- coordinating cooperation among local governments and emergency services,
- strengthening crisis communication capabilities.

The training programmes aimed at mayors, commune heads, and city presidents are intended to prepare them to act as local leaders of safety. The legislator assumes that, in the first hours of a crisis, responsibility for protecting the population rests primarily with local - not central - authorities. The main didactic assumptions include:

- developing local civil protection plans,
- cooperation with residents and non-governmental organizations,
- logistics of shelter and evacuation,
- fundamentals of first aid and crisis psychology,
- leadership under stress conditions.

These programmes are designed to cultivate the ability to act autonomously when higher administrative structures are incapacitated, which constitutes a fundamental element of the local resilience concept.

The primary goal of training at the administrative level is to prepare civil servants to fulfill decision-support and logistical functions. While managerial staff are expected to make strategic decisions, administrative employees must ensure that offices can continue to function despite disruptions - such as power outages, loss of communication, or the need for temporary evacuation. The main didactic assumptions of this training include:

- maintaining institutional continuity,
- documenting crisis response activities,
- communicating with citizens and the media,
- operating warning and alert systems,
- providing basic psychological support.

The training programmes addressed to persons with civil defense mobilisation assignments and to personnel of civil protection entities aim to develop operational readiness within the structures of civil defense. The objective is not merely technical proficiency (e.g., operating protective equipment) but the enhancement of abilities to lead small teams and make independent decisions under threat conditions. Key assumptions include:

- psychophysical preparation for operations under wartime conditions,
- cooperation with uniformed and rescue services,
- principles of decontamination and evacuation of casualties,
- organisation of medical and shelter facilities.

Training for the staff of civil protection entities (e.g., municipal companies, infrastructure operators) focuses on continuity of operations. Its goal is to ensure that enterprises and institutions responsible for essential supplies—water, energy, food, transport, and communications—can function despite disruptions. Thus, the emphasis is placed not only on the protection of people, but also on the protection of processes that sustain the functioning of society.

The training programme for entrepreneurs and social organisations aims to integrate the private and social sectors into the civil protection system. This approach is based on the premise that security is not solely a responsibility of the state, but a shared public good. Training for entrepreneurs focuses on business continuity planning, organisational crisis management, employee protection, and cooperation with public administration. In the case of social organisations, emphasis is placed on humanitarian logistics, psychological support, and coordination of volunteer activities.

The general training programme for the population, directed at citizens, represents the most innovative element of the regulation. It can be described as a form of civic education in security, encompassing:

- the ability to recognise hazards and respond to warning signals,
- fundamentals of first aid and community self-organisation,
- household preparedness for functioning without access to infrastructure,
- information awareness, including verification of information and prevention of panic.

The aim of this programme is to restore basic societal knowledge on behaviour in emergencies - a knowledge base that has significantly eroded over the past decades. Simultaneously, the training has a strong social and cultural dimension: it fosters attitudes of collective responsibility, solidarity, and mutual trust - values that constitute the foundation of societal resilience.

Civil protection and civil defense training methods

An analysis of the regulation's annexes reveals a clear departure from passive forms of knowledge transfer in favor of activating and practical methods. A key element common to almost all training groups (except for the general public, where the form is flexible) is the organization of classes in a mixed formula, comprising theoretical and practical sessions, with a clearly marked predominance of practical classes.

Even in the theoretical part, a tendency to engage participants is visible. While the traditional classical lecture is permitted only in programs for the highest levels, the dominant method in other groups is the conversational lecture. This form, which presupposes dialogue and discussion, is much closer to the andragogical learning model, which views the adult as a partner in the didactic process, not a passive recipient.

Crucially, the regulation widely permits the implementation of theoretical classes using distance learning forms and methods. This includes guided self-study and blended learning. From an andragogical perspective, this is a key provision, respecting the adult learner's principle of autonomy and self-direction, as well as considering the time constraints of professionally active individuals, especially those in high-ranking positions.

The most interesting aspect of the analyzed methodology is the precise differentiation of practical methods depending on the target group and training goals.

In the case of the highest-level management cadres, who are expected to think strategically and manage in crisis situations, the range of methods is the broadest. It includes analytical and creative tools such as case study, expert debate, decision-making training, and design thinking. These methods build on the participants' professional experience and focus on solving complex, ambiguous problems.

At the municipal level, which is closer to the direct operationalisation of tasks, the methodology focuses on the problem-based method, case study, and decision-making training. Expert debate and design thinking are omitted here, suggesting a shift in emphasis from strategy to effective management in specific, defined scenarios.

For groups whose main task is the practical implementation of procedures, the key practical method becomes instruction. It is supported by the problem-based method and case study, which ensures the acquisition of specific, procedural skills necessary for action.

In the program for the general public (Annex 9), the regulation rightly refrains from rigidly defining methods, stating only that the duration of the training is adapted to the specifics of the audience, as well as to the forms and methods of education used. This is the essence of the andragogical approach, placing the learner's needs and capabilities at the center of the didactic planning process.

5. Discussion

The key finding of this analysis is that the 2025 Regulation represents the first attempt in the Polish legal system to consciously integrate the principles of andragogy with the state's strategic goals in the field of security.

For years, the literature on the subject has indicated the higher effectiveness of active teaching methods for adults (as confirmed by, among others, Pawłowska-Cyprysiak and Hildt-Ciupinska or Mikołajczyk), as well as the effectiveness of simulation games in knowledge retention (Łączyński). Similarly, literature on crisis management (e.g., Ketelaars et al.) has emphasized the importance of scenario-based training in building resilience. What was known that was the theory and best practices during processing adult trainings. What this new research contributes is demonstrating that the Polish legislator has transformed these best practices into a legal requirement.

The key finding of this analysis is that the Regulation represents the first attempt in the Polish legal system to consciously integrate the principles of andragogy with the state's strategic goals in the field of security.

The Regulation directly recommends methods preferred by adults, such as case study, problem-based method, or decision-making role-play. As reviewer aptly noted, this requires a stronger link to theory:

- the introduction of case study is a direct response to the andragogical principle of adult learning through problem-solving (problem orientation) and the need to relate to existing life experiences,
- allowing for distance learning respects the key andragogical principle of learner autonomy and self-direction, and considers the time constraints of professionally active individuals, especially for theoretical part of the course,
- differentiating methodology based on the group (different methods for strategic cadres versus executive staff) confirms the thesis that tools must be adapted to roles and goals, a key aspect of effective adult education.

The similarities and differences compared to previous research are clear. The similarity lies in the content of the methods themselves - the regulation recommends exactly what researchers have deemed effective. The fundamental difference, however, is the scale and formalization. This article shows that we are no longer dealing with fragmented training but with a comprehensive, unified system covering all levels of administration and society.

Of critical importance here is also the requirement for the professionalisation of didactic staff. By setting high substantive requirements for instructors, the legislator attempts to ensure that activating methods are applied in practice, not just declared, addressing a common gap between prescribed and actual training delivery.

6. Conclusions

Summary of findings

The main finding of this article is that the 2025 Regulation constitutes a conscious paradigm shift in the approach to training within Polish public administration. This signifies a transition toward a proactive, competency-based model of resilience-building. The article demonstrates that this is a creation of conscious integration of andragogical principles with the state's strategic goals amid adult trainings established in Poland.

This integration is evident on several levels:

- 1) the legislator explicitly recommends the use of methods preferred by adults and recognized as most effective, such as case studies, the problem-based method, and decision-making games or simulations. This is a radical departure from traditional, ineffective training based on transmission lectures, which adult learners do not accept and which fails to build practical competencies. It can be named methodology level;
- 2) the system is based on a differentiated didactic philosophy, precisely tailored to the recipient's role. Different methods (strategic, creative, like expert debates) are intended for management cadres (ministers, voivodes), while others (operational, procedural, like instruction) are for executive staff. This demonstrates a deep understanding that training is not a monolith but a process dependent on its objective. It can be named as structural level;
- 3) the reform's assumption is based on two pillars - programmatic unification (nine coherent programs for the entire country) and the professionalisation of didactic staff. Setting high substantive and experience requirements for instructors is a systemic attempt to guarantee quality and curb market pathologies where security training was conducted by entities lacking appropriate competencies. It can be named as professionalisation level.

In this context, the aim of the training system is no longer merely reacting to a crisis, but above all, ensuring the business continuity of the administration, economic entities, and society under disruptive conditions.

Limitations of the analysis, practical and theoretical implications

It must be strongly emphasized that this article, the first scholarly attempts to describe the new system, is conceptual and normative in nature. The analysis focused on the law as it is written, not as it is functioning. This is a fundamental limitation that gives rise to numerous research questions, but also allows for the formulation of specific implications.

The primary limitation is the complete lack of evaluative research. We do not know, and at this stage cannot know, what the actual effectiveness of the implemented training will be. The article identifies a fundamental implementation gap problem here:

1. high formal requirements for instructors (e.g., a doctoral degree in security sciences) do not automatically guarantee high didactic (andragogical) competencies. There is a risk that academic lecturers will transfer passive university methods to administration training rooms;
2. the recommendation to use decision-making games is simple to write down but complicated to implement. We do not know if instructors are capable of designing and moderating them, or if a simple discussion will be labeled a game. Verifying whether methods are genuinely applied or merely declared in documentation is a key challenge;
3. the framework programs are formulated at a high level of generality, which is an advantage (flexibility) but also a disadvantage (risk of content trivialization).

The article's findings have direct implications for three stakeholder groups:

1. training provider must radically revise their staff and programs. This forces investment in instructor development, not only in substance but primarily in modern andragogical methods. Merely "having" a PhD on staff will not be enough to win a tender - demonstrating real didactic competencies will be necessary;
2. there must be a shift in the philosophy of procurement proceedings, especially in public administration. The lowest price criterion must be replaced by the quality and effectiveness criterion. The client should demand the presentation of specific game scenarios, case studies, and methods for evaluating training outcomes;
3. introducing the Regulation does not end, but begins the reform process. It is necessary to create central or regional mechanisms for monitoring and evaluating the quality of these trainings to ensure that standardization does not become fictitious.

Taking into consideration a theoretical implications the article opens a new research field at the intersection of security sciences, legal sciences, and pedagogy (andragogy). It demonstrates that the analysis of security systems cannot overlook the human factor and the methods of shaping it.

7. Future research directions

To move beyond the normative limitations of this paper, a robust, multi-track research agenda is required to evaluate the *de facto* impact of the reform.

First, evaluative research is urgently needed to measure training effectiveness and identify the implementation gap. This requires longitudinal (long-term) studies using a mixed-methods model. The quantitative component should employ a pre-test/post-test design, with delayed follow-ups, to measure not only declarative knowledge but also procedural skills and perceived resilience. This must be complemented by a qualitative component, primarily participant observation during training sessions, to verify if advanced andragogical methods are genuinely

applied or merely declared. This data should be triangulated with in-depth interviews with participants and focus groups with instructors to understand the barriers to effective implementation.

References

1. Dam-Knap, K. (2023). Difficulties of an adult in learning new technologie. *International Journal of New Economics and Social Sciences*, Vol. 6, No. 22, pp. 61-71. doi: 10.5604/01.3001.0054.5178
2. Dębska, E. (2012). Chaos pojęciowy wokół szkoleń i treningów. Próba uporządkowania terminologii. *Edukacja Dorosłych*, 1, pp. 23-36.
3. Grzyb, J. (2015). Andragogika w służbie bezpieczeństwa państwa. *Bezpieczeństwo i Technika Pożarnicza*, Vol. 37, No. 1, pp. 133-144. doi: 10.12845/bitp.37.1.2015.11
4. Kalinowski, M. (2016). *Dylematy projektowania i stosowania symulacyjnych gier decyzyjnych w rozwoju pracowników*. Retrived from: https://repozytorium.bg.ug.edu.pl/docstore/download/UOG2d18024b81e34e73bb060f18d92272b3/Kalinowski_Marek_Dylematy_projektowania_2016.pdf, 31.10.2025.
5. Ketelaars, E., Gaudin, C., Flandin, S., Poizat, G. (2024). Resilience training for critical situation management. An umbrella and a systematic literature review. *Safety Science*, Vol. 170, No. 106311, pp. 1-19. doi: 10.1016/j.ssci.2023.106311
6. Koptiew, D., Puzio-Waławik, B. (2022). *Edukacja dorosłych jako czynnik rozwoju kapitału ludzkiego*. Retrieved from: <https://journals.anstar.edu.pl/index.php/pel/article/view/446>, 31.10.2025.
7. Kupidura, T., Sułkowski, T. (2024). *Grywalizacja w edukacji dorosłych: narzędzia i skuteczność w procesie nauczania*. Retrived from: <https://www.ceeol.com/search/article-detail?id=1325682>, 31.10.2025.
8. Łączyński, M. (2011). *Gry szkoleniowe w nauczaniu dorosłych. Metoda i zastosowanie na przykładzie gry komunikacyjno-decyzyjnej MaxCom*. Retrived from: https://www.academia.edu/download/65582506/MaxCom_HL_2011.pdf, 31.10.2025.
9. Makuch, A., Kozioł, K., Lasocka, M. (2022). *Model grywalizacji jako narzędzia wspomagającego w edukacji na przykładzie szkolenia z zakresu Lean Management*. Retrieved from: <https://bibliotekanauki.pl/articles/11543314.pdf>, 31.10.2025.
10. Mazurkiewicz, G. (2009). Kadra ucząca dorosłych: warunki, kompetencje i rozwój. *Zarządzanie Publiczne*, 5, pp. 119-131.
11. Mikołajczyk, K. (2011). Jak uczyć się dorośli, czyli co powinien wiedzieć trener o specyfice kształcenia uczestników szkolenia. *e-mentor*, 2(39), pp. 69-76.

12. Nawrat, D. (2013). Jak uczą się dorośli? Wybrane uwarunkowania uczenia się dorosłych. *Edukacja Dorosłych, 1*, pp. 67-79.
13. Pawłowska-Cypriasiak, K. Ciupińska-Hildt, K. (2022). Jak zorganizować szkolenie odpowiadające potrzebom starszych pracowników – najważniejsze wnioski z badań ankietowych. *Bezpieczeństwo Pracy. Nauka i Praktyka, Vol. 11, No. 11*, pp. 12-16. doi: 10.54215/BP.2022.11.28
14. Pisarczuk, A. (2023). *Szkolenia BHP. Komentarz*. Warszawa: Bezpieczeństwo Pracy.
15. Szulejewski, M., Pieniowska, K. (2017). Edukacyjne gry decyzyjne dla bezpieczeństwa. In: H. Batorowska, H., E. Musiał (eds.), *Bezpieczeństwo informacyjne w dyskursie naukowym* (pp. 236-247). Kraków: Uniwersytet Pedagogiczny im. Komisji Edukacji Narodowej w Krakowie.
16. Szydłowski, P. (2025). The concept of civil defense in the republic of Poland. *Studia Bezpieczeństwa Narodowego, Vol. 37, No. 37*, pp. 43-62. doi: 10.37055/sbn/207389
17. Wróblewski, D. (2025). *Business continuity in civil protection and civil defence – local context, Vol. 292, No. 3*, pp. 47-79. doi: 10.34752/2025-3-4
18. Żurawska-Ochyra, K. Marcinek, W. *The future of non-governmental organizations in the light of the civil protection and civil defense act*. Retrieved from: <https://bibliotekanauki.pl/articles/63516970.pdf>, 31.10.2025.

GENERATION Z AS E-CONSUMERS – GENDER DIFFERENCES

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Purpose: The aim of the conducted study was to identify key factors shaping Generation Z's purchasing decisions and examine gender differences in their e-consumer behavior.

Design/methodology/approach: In order to identify the online shopping behaviors of Generation Z consumers, a study was conducted using an original survey questionnaire. The empirical study was preceded by literature research, which was the basis for both the construction of the aforementioned tool and the subsequent discussion of the presented research results.

Findings: The research findings indicate that both women and men representing Generation Z highly value 24/7 shopping availability, time efficiency, and the ability to compare prices. However, women tend to rely more on recommendations from close contacts and influencers, whereas men more frequently use price comparison websites and product or service reviews. The primary barriers to online shopping remain the inability to physically examine the product and discrepancies between its description and reality.

Research limitations/implications: A key limitation of this study is that it was conducted among students from a specific generation, meaning the participants were not only at a particular life stage but also within a specific age range. Furthermore, the relatively small sample size may restrict the generalizability of the findings. To address these limitations, future research could include a broader sample of Generation Z, extending beyond the student population. Furthermore, exploring the influence of cultural and regional factors on young consumers' purchasing preferences could provide valuable insights. Another promising direction for future research is assessing the impact of emerging technologies on the purchasing decisions of this demographic.

Practical implications: The research findings have significant practical value, particularly for e-commerce companies, marketing agencies and sales platforms aiming to better understand and meet the needs of Generation Z consumers.

Originality/value: The study combines two themes that are rarely examined together: generational affiliation and gender differences in the context of e-consumer behavior. Due to the use of statistical significance tests, it was possible to capture subtle differences and similarities between genders in purchasing behaviors.

Keywords: Generation Z, online shopping, shopping preferences of young consumers, online shopping behavior, e-commerce market.

Category of the paper: Research paper.

1. Introduction

The consumer goods market underwent a significant transformation with the advent of online shopping, providing modern consumers (buyers)¹ with extensive product information, a broad selection, and eliminating geographical barriers. The profile of active consumers, particularly in e-commerce, continues to evolve, shaping their expectations and purchasing decisions. This includes preferences regarding online promotion strategies, delivery methods, payment options, and other key aspects of the buying process.

Nowadays, as research shows, more and more Poles make purchases on the Internet (buy online). For example, the report "Polaków Portret Własny. Polacy w Sieci", issued by Santander Consumer Bank in 2024, presents a study conducted on a sample of one thousand adult Polish internet users. Among the respondents, 88% declared that they shop online, and 60% of this group stated that they had shopped online more frequently in the year preceding the study compared to previous years (Polaków Portret Własny. Polacy w Sieci, 2024).

Given the above, it is essential for organizations facilitating online purchases to understand consumer expectations and preferences to better align their offerings with market demands.

Currently, various generations (cohorts) of consumers coexist in the market. Some, such as Baby Boomers and Generation X, clearly remember a time when shopping was only possible in traditional retail stores. The next generation, Generation Y, is a distinct community whose members, during their teenage years, witnessed the widespread adoption of the Internet. This often changed their perspective on the world - suddenly, with Internet access, it became "within reach", and geographical barriers lost their significance, including in the realm of shopping.

Alongside these generations, there is also one for whom online shopping is, or is becoming, an unquestioned norm. This group is undoubtedly Generation Z, also known as Gen Z, iGen, Gen Tech, "always clicking", post-millennials, C Generation and other names (Dolot, 2018; Ciałek, 2021)². This group represents a crucial target audience for e-commerce businesses³, as many are already financially independent from their guardians, making it essential to understand their shopping preferences. Notably, Generation Z is not only an active participant in the online shopping market but also plays a key role in shaping trends, whether consciously or unconsciously.

¹ The authors will use the terms "consumer" and "buyer" interchangeably. However, they are aware of the fact that there are differences between them, which, nevertheless, do not affect the reception of the content presented in the study. A "consumer" is limited to purchasing goods to meet their own needs, while a "buyer" can make a purchase to meet the needs of other people, i.e. they do not have to consume the goods themselves (Kuberska, Suchta, 2016).

² The terms are used interchangeably in the article (authors' note).

³ According to the study conducted in 2024 by the agency SW Research on a representative group of Generation Z members, as many as 86.2% of young Poles decide to shop online once a month or more often (<https://ecommercenews.pl/gen-z-ponad-86-mlodych-polakow-przypowiedzi-raz-w-miesiacu-kupuje-online-lub-w-aplikacji-mobilnej/>). The results obtained by the agency are comparable to the results presented in the previously cited report "Polaków portret sobie. Polaków w sieci".

The need to focus more on this generation as consumers has also been highlighted by scholars such as e.g. M. Ortiz-Pimentel, C. Molina, and G.A. Ronda-Pupo. In their study, they conducted a bibliometric analysis of articles on generational issues in management, identifying a research gap in this area (Ortiz-Pimentel et al., 2020).

The term iGen refers to people born between 1995 and 2009 (McCrindle, Wolfinger, 2014). However, the time frame of births of representatives of this generation is defined differently in the literature. This results from the fact that the basis for specifying subsequent generations in a given country is the development of technology. Thus, different authors set the lower and upper birth limits of these units differently (Dewalska-Opitek, Wiczak, 2023). Regardless of these arrangements, these are people aged 15 to a maximum of 34. Among them, we will find both people attending secondary schools, potentially students, and people who are active or passive participants in the labor market. According to data from the Central Statistical Office, there are approximately 8,237,960 people aged 15-34 in Poland, which is approximately 21.9% of the country's entire population (<https://stat.gov.pl/obszary-tematyczne/ludnosc/ludnosc/ludnosc-piramida/>). This is therefore a huge group of consumers, with their specific values and the attitudes and behaviors resulting from them, manifesting themselves, for example, in the views or needs they hold and express within various areas of their lives, including the area related to purchasing products and services on the Internet.

In the academic literature on the subject, numerous studies characterize e-consumers. These include both Polish and international research; however, they typically examine consumer preferences without distinguishing between generational cohorts. More detailed studies that incorporate generational divisions tend to offer only limited differentiation of e-consumers based on gender. Thus, the aim of the undertaken study, and then its results presented in this article, was to **identify the online shopping behaviors⁴ of Generation Z consumers. In the analysis of the identified behaviors, gender differences among respondents were taken into account.** Therefore, the conducted research allowed to obtain novelty and originality of the presented topic in terms of its specific focus on gender-based differentiation in online shopping behaviors among Generation Z consumers.

2. Theoretical background

Generation Z, alongside Baby Boomers, Generation X and Generation Y, is a distinct cohort of people, distinguished by specific criteria, to whom different characteristics can be assigned⁵.

⁴ "Purchasing behavior" can be defined as all actions taken related to the acquisition, use and disposal of products and services, along with the decisions that precede and condition these actions (Krzepicka, Tarapata, 2013).

⁵ Some sources, mainly American, also point to the existence of older generations. These include the so-called "Lost Generation" - which devoted its life to fighting in World War I and was described by, among others, the writer G. Stein, or the "Best Generation" - which, in turn, fought in the next World War, and whose name we owe to the American journalist T. Brokow (Rosenberg, 2019). However, it is the subsequent generations, starting with the aforementioned Baby Boomers, that both publicists and researchers have devoted more attention to.

Researchers have noticed that being born in a specific time period, and thus existing in specific economic, social, political or technological conditions, influences our cultural traits, values or preferences (e.g. shopping ones) (Berkup, 2014; Parry, Urwin, 2021). As A. Dolot (2018) emphasizes, spending life in similar conditions, participating in the same events (e.g. cultural, environmental) and being influenced by similar technologies can cause people to think, make decisions and behave in a comparable way.

In the literature, various sources are attributed to the creation of generation names. For example, the term "Baby Boomer" refers to people conventionally⁶ born between 1945 and 1964, and the authors of *The New Yorker* magazine are considered responsible for defining it (Salt, 2003). In turn, the creators of the names of next generations, i.e. Generation X (born in the years 1965-1979) and Y (1980-1994), are considered to be, respectively, the Canadian author D. Coupland, who presented the first of the concepts in his 1991 book entitled "Generation X: Tales for an Accelerated Culture", and historians N. Howe and W. Strauss, who popularized the concept of "Millennials" in reference to the next cohort, i.e. Y. Interestingly, in the literature, there is no clear answer to the question of who is considered the pioneer in naming the next generation as "Generation Z". The literature on the subject abounds in descriptions of specific characteristics of this cohort, and the term "Generation Z" appears in it quite naturally. It is also worth mentioning that currently another generation is being distinguished, i.e. Generation Alpha (2010-2024), which owes its name to the Australian researcher M. McCrindle. He used it in his book "The ABC of XYZ: Understanding the Global Generations" (Jayatissa, 2023).

Due to the subject of the article, it was decided to provide a broader description of only one generation, i.e. Generation Z. Analysis of the available literature prompted the authors of this paper to reflect that being born in a certain period of time cannot be the only determinant differentiating the discussed generation from other cohorts. The results of available studies are so different in some respects, especially those concerning the characteristics of the post-millennial generation from different countries, that indicating universal characteristics describing this generation becomes impossible. It is all the more justified to conduct research among this age group, but reaching out for representatives from a specific country, because some characteristics, including shopping behaviors, do not necessarily have to result from the age of the respondents, but from the cultural differences.

There is no doubt about the description of the iGen that they were born at a time when access to computers, smartphones, the Internet, and mobile technologies was common in most places in the world (Singh, Dangmei, 2016). And, as A. Catek (2021) states, the post-millennial generation did not have to learn to use these fruits of technological progress (like older cohorts),

⁶ The conventionality of the time frame in which representatives of a specific generation were born does not only apply to Baby Boomers, but also to other generations. The problem of establishing the time frame for the births of representatives of different cohorts is indicated by, for example, B. Przybylski. In his work, the author undertook to identify and systematize these frames. See: (Przybylski, 2023). Additionally, as A. Dolot (2018) states, Generation Z is the most problematic among other generations in terms of establishing the aforementioned time frame.

but instead they were raised and socialized in an environment of mobile phones, constant access to the network, and active presence in social media⁷. According to a report by McKinsey&Company, almost 98% of this cohort has smartphones, and 85% declare that they use social media on a daily basis (Żydek, 2024). Moreover, in addition to the fact that the representatives of the discussed generation can be considered a digital and mobile generation, they are, according to the aforementioned M. McCrindle and A. Fell, also “global” (access to the Internet makes them aware of trends from all over the world), “social” (thanks to social media, they are influenced by their peers to a greater extent than older generations) and “visual” (they prefer to watch a video, e.g. on YouTube, about an issue that interests them, rather than read an article on it in a web browser) (McCrindle, Fell, 2019).

One of the authors studying iGen is the American psychologist J. M. Twenge. The author, based on in-depth quantitative and qualitative research, the respondents of which were representatives of this generation in the United States (USA), created a fairly extensive characteristic of this cohort and presented it in a book: "iGen: Why Today's Super-Connected Kids Are Growing Up Less Rebellious, More Tolerant, Less Happy - and Completely Unprepared for Adulthood - and What That Means for the Rest of Us". According to J.M. Twenge, American post-millennials spend most of their lives online, consistently preferring to establish and develop social contacts in this form, especially in the aforementioned social media. What's more, compared to previous generations, they are less willing to leave home for social purposes (Twenge, 2019). And while the research conclusions may be attractive to organizations that are part of the e-commerce⁸ market, the psychological costs of this situation can be very high. The implication of consciously giving up face-to-face contacts is often the emergence of a tendency to significantly limit telephone conversations in favor of text communication, which, in turn, affects the gradual loss of competence in direct communication. In addition, the feeling of constant compulsion to be online generates stress related to creating and maintaining one's image on the network in the way one expects and being assessed by other social media users, and also causes anxiety related to the possibility of being cut off from information (FOMO - Fear of Missing Out). Finally, in terms of mental health, it is considered that GenZ is a generation that is mentally weaker than previous ones, with a tendency for its representatives to experience periods of low mood, a sense of unhappiness or loneliness (Twenge, 2019). In opposition to the views of J.M. Twenge, one can indicate, for example, those presented by the Hungarian researcher Z.E. Csobanka. The author points out that despite attaching great importance to establishing and developing social contacts in the virtual world, the importance of direct communication is perceived by Gen Z as comparable to the importance of communication on the Internet (Csobanka, 2016). In relation to Polish representatives of post-millennials, less catastrophic views than J.M. Twenge are presented by, among others, A.K. Żarczyńska-Dobiesz and B. Chomątowska. The researchers indicate that representatives

⁷ As B. Sudomir quite boldly emphasizes, Generation Z are people who believe that the digital world has existed forever (Sudomir, 2020).

⁸ It can be assumed that, in this case, Generation Z will be more willing to purchase goods online than in a traditional way (authors' note).

of Generation Z are able to function in both the real and the virtual world, perceiving them as complementary to each other (Żarczyńska-Dobiesz, Chomątowska, 2014).

J.M. Twenge also points out that post-millennials living in the USA are reluctant to engage in political or social life, underestimating the impact it has on their existence. Additionally, they are treated as a more inclusive generation than previous cohorts, i.e. issues such as psychosexual orientation, cultural gender or skin color are, as the author puts it, not so much irrelevant as transparent. The generation in question is also characterized by a loss of religiosity (Twenge, 2019). Research in this area, among others, was conducted on Polish post-millennials by a group of scientists from the SWPS University and others. In the report entitled „Gen Z o sobie i otaczającym ich świecie. Jakie są polskie Zetki?”⁹ published in 2024, researchers indicate that Polish iGen representatives believe, unlike their American counterparts, that politics has an impact on their lives (89% of responses), but their spirituality is also losing its importance (64% indicated that they do not actively participate in religious ceremonies) (Gen Z o sobie i otaczającym ich świecie..., 2024). M. Grabowska also points to the greater interest of post-millennials in politics and changes in the area of religiosity (a radical weakening of practice and deteriorating assessments of the Church institution) than among previous generations (Grabowska, 2021). As for the tolerance of Polish iGens we can use the results of research presented, among others, by M. Sroczyńska. The author describes that representatives of the discussed cohort as tolerant and open-minded people who focus on interpersonal relations. Moreover, M. Sroczyńska characterizes Polish post-millennials as self-focused, neurotic, open to changes, sensitive¹⁰, postponing making important life decisions and living "here and now" (Sroczyńska, 2024). From the presented report¹¹ we can also learn that Polish iGens care about their health - they practice sports 1-2 times a week (43% of respondents) and trust traditional methods of treatment (79%). In terms of pro-ecological behavior, they are a conscious group, and as many as 78% of the survey respondents are afraid for the future of the planet, which is why almost half of them declare a life in the spirit of "less/zero waste". An interesting conclusion from the study included in the cited report is that post-millennials are looking for - at least partial - financial independence very early on and are willingly entering the job market (49% of respondents) (Gen Z o sobie i otaczającym ich świecie..., 2024).

Sketching the profile of post-millennials as e-consumers, it can be seen that an important motive for shopping online among this cohort is the ability to compare prices and shop from anywhere and at any time. Post-millennials also point to the option of purchasing goods at more favorable prices than in traditional retail stores, or simply at bargain values (https://www.icsc.com/uploads/about/2023ICSC_Gen_Z_Report.pdf).

⁹ The study involved 2554 people from all over Poland, representing Generation Z (Gen Z o sobie i otaczającym ich świecie. Jakie są Polskie Zetki?, 2024).

¹⁰ Individual sensitivity and low resistance to difficulties and hurts prompt some researchers to call post-millennials the "snowflake" generation (Sroczyńska, 2024).

¹¹ This is about the report: „Gen Z o sobie i otaczającym ich świecie. Jakie są Polskie Zetki?” (authors' note).

Already at the initial stage of the decision-making process leading to the purchase of a given good, representatives of Generation Z look for as much information as possible about it and about the organization that offers the good. And, as A. Dewalska-Opitek and O. Witczak report (2023), women from Generation Z are more likely than men to seek this data. iGen considers opinions posted on the Internet by other users to be a reliable source of the aforementioned information, and the opinions posted must be authenticated by a specific person, known, however, not necessarily in the real world, but only in the virtual one (Grzybowska-Brzezińska et al., 2022; Maciejewski, 2018). Most iGen representatives are also guided, to a similar extent, by the opinions of family members, friends and acquaintances, or generally - close people (https://www.icsc.com/uploads/about/2023ICSC_Gen_Z_Report.pdf). Opinions found on internet forums¹², on websites rating shops, or presented in advertisements and during promotional campaigns are generally considered to be less valuable, but brand profiles in social media are seen as a reliable source of information on the goods they offer (Maciejewski, 2018; Sobura, 2023; Paczka, 2020; Dewalska-Opitek, Witczak, 2023). The least common source of information about products and services for post-millennials are price comparison websites (Grzywińska-Rąbca, Grzybowska-Brzezińska, 2018). This is an interesting conclusion, because according to a study published by J. Syta, conducted among young women (up to 25 years of age, i.e. from the iGen cohort), the price of a product and/or service is a frequently sought-after aspect - more often than among other age groups (<https://nowymarketing.pl/jak-mlode-uzytkowniczk-kupuja-online-badanie-zachowan-nabywcze-mlodych-kobiet-w-srodowisku-e-commerce/>).

It may also be interesting to consider the impact of digital influencers¹³ on the purchasing decisions made by Generation Z, who, along with the growing popularity of using social media worldwide, have become one of the specific tools for implementing marketing strategies by companies. Some studies conducted in this area indicate that influencers significantly shape the perception and purchasing decisions of young consumers, being one of the most reliable sources of information about products and services for them. For example, according to a study conducted by Territory Influence, a global agency specializing in providing influencer services, as many as 76% of Generation Z representatives are guided by the opinions of influencers when making purchasing decisions (<https://nowymarketing.pl/zachowania-zakupowe-i-wplyw-influencer-marketingu-na-pokolenie-z-badanie/>). A slightly different light on this issue is shed by studies conducted by, among others, J. Szydło together with E. Potmalnik, or W. Krakowska. The first mentioned authors studied the impact of influencers on the purchasing decisions of Generation Z regarding products from the fashion industry. Their research shows that the effect of influencers on the aforementioned decisions is negligible (Szydło, Potmalnik, 2022).

¹² Although in a study conducted by J. Sobura, representatives of Generation Z valued opinions found on online forums more than opinions presented by family members or friends (Sobura, 2023).

¹³ An influencer is, for example, a public figure and/or an internet creator who has recipients of their content (their community). This is a person who, through the trust they have built, has the ability to influence their recipients. (<https://www.newspoint.pl/Analizy-i-monitoring-influencerow-Raport-Newspoint.pdf>). C. Abidin identifies influencers with an exclusive group of internet celebrities (Abidin, 2018).

W. Krakowska et al. conducted a study on a group of 115 students (classified as part of the discussed generation), indicating that influencers' recommendations resulted in the purchase of a product or service in the case of 57% of them. Interestingly, the respondents also indicated that in their opinion, the activity of influencers can hardly be considered a source of reliable information about the goods offered by a given brand. In addition, the vast majority of respondents also rather disagree with the statement that the opinion of an influencer determines the purchasing decisions they make (Krakowska et al., 2024). Similar conclusions can be drawn from the previously cited report issued by the SWPS University and others. The report shows that more than half of Polish iGens indicated recommendations from close people as a factor influencing their purchasing decisions, and only 3%(!) of respondents use influencer suggestions when making purchases (Gen Z o sobie i otaczającym ich świecie..., 2024).

The preferred forms of payment for online purchases among post-millennials, as reported by A. Dewalska-Opitek and O. Witczak, are cashless transactions (Dewalska-Opitek, Witczak, 2023).

Consumers' shopping preferences, including their preferences in the area of online shopping, are more often considered in the literature on the subject without taking into account the time range of consumers' births as a factor determining these preferences. Thus, certain general trends can be observed, e.g. among Polish e-consumers. The previously mentioned report entitled "Polaków portret własny. Polacy w sieci" shows, among other things, that the greatest advantages of online shopping among Poles from different age groups include: the ability to read the opinions of other users, better descriptions of products/brands, more attractive prices than in stationary stores, the ability to compare products/brands, a greater number of payment methods than offered when shopping in stationary stores, and a wider range of products. The cited studies also show that Poles are very keen to use platforms such as Allegro, Ceneo, Empik, etc., i.e. the so-called marketplace platforms. 86% of respondents indicated that they used these services, and as many as 91% of respondents from the age group 18-29, i.e. from the group of post-millennials (Polaków portfel własny. Polacy w sieci, 2024).

According to the report "E-commerce w Polsce. 2024", prepared by Gemius, Polish Internet Research and IAB Polska, Polish consumers perceive the primary advantage of online shopping as its continuous availability, eliminating the necessity of visiting physical stores and allowing for unrestricted time in selecting desired products. Furthermore, respondents highlighted the significance of pricing, which is often more competitive than in traditional retail stores, along with the broader product assortment and the convenience of comparing various offers. It should be noted that respondents from the 15-24 age group also indicated more often than those from other age groups that discount codes or those for online buyers, fast delivery, better product photos, a wider choice of delivery methods, more information about products on the store's website and better accessibility of websites on mobile devices are also important to them. Interestingly, the surveyed women more often than men indicated that they are motivated by financial factors. On the other hand, men were more often motivated by better warranty conditions and better product quality. Among the negative aspects of online shopping,

respondents indicated three areas: intrusive advertisements for previously viewed products, long waiting times for delivery and its high costs. Despite these negatives, approx. 75% of respondents indicated that they most often make online purchases on Polish websites, while foreign websites enjoyed less interest (36% of indications). In terms of delivery of ordered products, parcel machines turned out to be the most popular, followed by courier deliveries. The most frequently chosen form of payment for purchased goods were fast transfers made using payment services (69% of indications) (https://gemius.com/documents/66/RAPORT_E-COMMERCE_2024.pdf).

3. Methods

In order to identify the online shopping behaviors of Generation Z consumers, a study was conducted using an original survey questionnaire. The empirical study was preceded by literature research, which was the basis for both the construction of the aforementioned tool and the subsequent discussion of the presented research results. The survey questionnaire consisted of 17 questions, mainly multiple-choice. The research tool was available for respondents to complete online.

The study involved 276 adult participants who declared their gender. All respondents met the condition of being classified as Generation Z representatives. The research sample included 93 men (33.7%) and 183 women (66.3%). The sociodemographic profile of the participants, grouped by gender, is presented in Table 1.

Table 1.
Sociodemographic profile of the participants of the conducted research

Characteristics	n	Gender		p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
Age:	276			0,255
< 22 years old		86 (46,99%)	37 (39,78%)	
≥ 22 years old		97 (53,01%)	56 (60,22%)	
Degree of study:	276			0,871 ^c
Engineer's Degree		4 (2,19%)	2 (2,15%)	
Bachelor's Degree		146 (79,78%)	77 (82,80%)	
Master's Degree		33 (18,03%)	14 (15,05%)	
Professional status:	276			0,096
I study and work		81 (44,26%)	51 (54,84%)	
I only study		102 (55,74%)	42 (45,16%)	
Source of income:	276			0,197
I benefit from the support of the relatives		63 (34,43%)	27 (29,03%)	
I have mixed sources of income		74 (40,44%)	33 (35,48%)	
I support myself financially		46 (25,14%)	33 (35,48%)	

^a n (%)

^b Pearson chi-square test

^c Fisher's exact test

Source: Own work based on research results.

Analyzing the data in Table 1, no significant differences ($p = 0.255$) were observed in the age categories (<22 years and ≥ 22 years). In both groups, the proportions of women and men were comparable (46.99% women vs. 39.78% men in the younger group and 53.01% vs. 60.22% in the older age group), confirming the demographic homogeneity of the sample. The level of education also seems to be similar in both groups, with the majority of respondents having a bachelor's degree (79.78% women and 82.80% men). The share of study participants with an engineering education and a master's degree was also comparable, showing no significant differences ($p = 0.871$). This suggests a balanced distribution of educational qualifications in the sample, regardless of gender. Employment status further emphasizes the homogeneity between female and male respondents. About 44.26% of women and 54.84% of men were studying and working at the same time, while 55.74% of women and 45.16% of men were exclusively studying. The lack of significant statistical differences ($p = 0.096$) indicates that both genders showed similar patterns in combining academic and professional commitments. Another area of comparative analysis was sources of income, where women and men showed similar distributions. Among women, 34.43% received financial support from the relatives, 40.44% had mixed sources of income, and 25.14% were self-supporting. Correspondingly, 29.03% of men received support from their relatives, 35.48% had mixed sources of income, and 35.48% were self-supporting. The lack of significant differences in sources of income ($p = 0.197$) emphasizes the comparable economic conditions between the genders in the study population.

In the conducted study, the significance level of $\alpha = 0.05$ was set, which means allowing for a 5% risk of type I error. Descriptive statistics were used to summarize the characteristics of the data. Categorical variables were presented as frequencies (n) and percentages, which allows for a better understanding of their distribution in the study cohort. When analyzing two nominal variables, associations were assessed using the Pearson chi-square test or Fisher's exact test, depending on the expected sample size for the category. Analyses were performed using the R statistical language (version 4.3.3; R Core Team, 2024) on Windows 11 pro 64 bit (build 22631), using the report (version 0.5.8; Makowski et al., 2023), gtsummary (version 1.7.2; Sjoborg et al., 2021), and dplyr (version 1.1.4; Wickham et al., 2023) packages. The study results presented in Tables 2-7 were developed for questions in which respondents had the option of multiple choice of answers. For the results presented in Tables 8 and 9, study participants could choose only one answer when responding the questions.

A limitation of the study may be considered to be that it was conducted among students from the studied generation, i.e. people in a specific life situation, but also representing a specific age range. The authors of the article are aware that the above fact may constitute a limitation in generalizing the study results, as the respondents constituted a closed group, and, as indicated by, among others, P.A. Korneta and A. Lotko, demographic factors, as well as those from the group of factors related to education and profession, may additionally

differentiate consumer behavior on the market (Korneta, Lotko, 2021). The relatively small sample size may also be a problem.

4. Research results and Discussion

The first issue that was analyzed was the identification of key factors influencing the decision to purchase a given product online. The distribution of answers by gender of respondents is presented in Table 2.

Table 2.

Motives for online shopping by gender among Generation Z representatives

Characteristics	n	Gender		p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
What determines your online shopping?				
Possibility of purchasing 24 hours a day	276	126 (68,85%)	63 (67,74%)	0,851
Time savings	276	147 (80,33%)	73 (78,49%)	0,720
Lower product prices than in traditional retail stores	276	132 (72,13%)	69 (74,19%)	0,716
Access to products that are hard to find on the traditional market	276	92 (50,27%)	49 (52,69%)	0,704
A collection method tailored to your needs (e.g. in a delivery machine, by courier, in a traditional retail store, etc.)	276	97 (53,01%)	51 (54,84%)	0,773
Possibility of comparing products in terms of prices, parameters, etc.	276	150 (81,97%)	79 (84,95%)	0,534
A wider product range	276	120 (65,57%)	66 (70,97%)	0,366
Possibility of making deferred payments (e.g. cash on delivery)	276	25 (13,66%)	15 (16,13%)	0,582
^a n (%)				
^b Pearson chi-square test				

Source: Own study based on survey results.

Based on the survey results, it can be seen that the majority of respondents, regardless of gender (68.85% of women vs. 67.74% of men), appreciate the possibility of shopping 24 hours a day, which emphasizes the importance of accessibility and flexibility offered by e-commerce. The differences in the percentages of responses are minimal ($p = 0.851$), which suggests that both groups have similar priorities in this regard. Another important factor that gained significant recognition among the survey participants is time saving. The responses indicate that 80.33% of women and 78.49% of men perceive this aspect as key ($p = 0.720$). The lower price of products compared to traditional retail stores also remains at the top of the preference hierarchy, with a response rate of 72.13% for women and 74.19% for men. However, these differences are marginal ($p = 0.716$), which indicates the convergence of consumer expectations in this area. Access to hard-to-find products on the traditional market also shows similar interest in both groups ($p = 0.704$), with 50.27% of women and 52.69% of men considering this factor important. In the context of changing market trends, the availability of unique products can

therefore become a key element of an organization's marketing strategies. A tailored delivery method, such as the option of collection from parcel machines or by courier, shows balanced approval in both groups ($p = 0.773$), which highlights the growing importance of flexibility in order collection. And the high percentage of responses regarding the possibility of comparing goods in terms of prices and parameters without differences between genders (81.97% of women, 84.95% of men, $p = 0.534$) emphasizes the importance of informed purchasing decisions and the role of information in the purchasing process. Similarly, comparable cross-gender behavior was noted in the issue of a wider product offer ($p = 0.366$). Another interesting aspect is the possibility of making a deferred payment, which enjoys relatively low but comparable interest among both groups (13.66% of women and 16.13% of men, $p = 0.582$). This may suggest that consumers do not attach much importance to this type of possibility, which may be the result of trust in online payment systems or a preference for immediate settlement of the transaction. The obtained results are consistent with the results of the studies cited in the section related to the analysis of the literature. It should be remembered that the respondents of the previously discussed studies were, among others, American post-millennials. The results of this study may therefore indicate the fact that in so-called Western cultures, the country of origin does not determine the preferences of the discussed cohort. However, this conclusion requires further research.

Respondents were also asked to indicate the disadvantages of shopping online, because in the context of the growing popularity of online shopping, understanding the barriers that can affect consumer decisions is becoming crucial for the further development of e-commerce. Many people still struggle with concerns related to online transactions, so we wanted to check whether these concerns also apply to representatives of Generation Z¹⁴. The results are presented in Table 3.

Table 3.

Barriers to online shopping by gender among Generation Z

Characteristics	n	Gender		p ^b
		Men, n ₁ = 183 ^a	Women, n ₂ = 93 ^a	
What do you think are the most significant disadvantages of shopping online?				
No possibility of physical contact with the product	276	139 (75,96%)	74 (79,57%)	0,499
Differences between the description and the actual state of the product	276	114 (62,30%)	49 (52,69%)	0,125
Long waiting time for the product	276	25 (13,66%)	14 (15,05%)	0,754
Delays related to payments	276	11 (6,01%)	4 (4,30%)	0,554
Lack of basic data on the store/manufacturer's website	276	41 (22,40%)	22 (23,66%)	0,815
I do not see any defects	276	16 (8,74%)	9 (9,68%)	0,798
^a n (%)				
^b Pearson chi-square test				

Source: Own study based on survey results.

¹⁴ This situation is visible mainly among representatives of older generations (authors' note).

The results of the study show that the representatives of the discussed generation considered the lack of physical contact with the product to be the most significant barrier to online shopping (75.96% of women and 79.57% of men, which leads to a p value of 0.499, i.e. no significant differences between respondents by gender). This obstacle might be reduced by using high-resolution, zoomable product images, video demos and 360° product views and/or AR/VR tools for “trying on” products (especially in fashion/beauty). Another factor that can be considered a significant barrier is the difference between the description and the actual state of the product (62.30% of women and 52.69% of men, which gives a p value of 0.125). Although both groups notice this barrier, men seem to be slightly less concerned about this discrepancy. Among the factors perceived as less significant disadvantages of online shopping were: prolonged delivery times, payments delays and insufficient basic information on the store's or manufacturer's website. Long waiting time for the product was reported by 13.66% of women and 15.05% of men, showing no significant differences ($p = 0.754$). It seems that both genders have similar expectations regarding this aspect, which may lead to the conclusion that post-millennials perceive the mentioned factor as inherent in making purchases on the Internet. Delays related to payments are an issue reported by 6.01% of women and 4.30% of men. Also in this case, no significant differences ($p = 0.554$) were found between the genders. The lack of basic data on the store's or manufacturer's website is perceived as a problem by 22.40% of women and 23.66% of men, with a value of $p = 0.815$.

The last category regarding the lack of noticing any disadvantages, presents the answers of 8.74% of women and 9.68% of men ($p = 0.798$). The results suggest that almost every tenth of the respondents doesn't see any barriers to online shopping, which may indicate a growing trust in shopping in this form among Generation Z consumers.

Next, the sources of searching for information about products and services before making their purchase on the Internet were identified. The distribution of survey participants' responses, broken down by gender, is presented in Table 4.

Table 4.

Sources of information about products and services by gender among Generation Z representatives

Characteristics	n	Gender		p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
Where do you usually get information about products you buy online?				
Advertising papers	276	19 (10,38%)	8 (8,60%)	0,638
Leaflets	276	6 (3,28%)	4 (4,30%)	0,737 ^c
Price comparison tools	276	32 (17,49%)	35 (37,63%)	< 0,001
Recommendations from friends/relatives	276	94 (51,37%)	32 (34,41%)	0,008
Tests/reviews	276	71 (38,80%)	47 (50,54%)	0,062
Advertisements in magazines	276	2 (1,09%)	5 (5,38%)	0,045 ^c
Information on the manufacturer's website	276	36 (19,67%)	29 (31,18%)	0,033
Advertisements on the web	276	98 (53,55%)	37 (39,78%)	0,031
Influencers' recommendations	276	74 (40,44%)	9 (9,68%)	< 0,001

Cont. table 4.

Internet forums	276	36 (19,67%)	34 (36,56%)	0,002
Packaging/instructions	276	9 (4,92%)	4 (4,30%)	1,000 ^c
Online store website	276	82 (44,81%)	46 (49,46%)	0,464
^a n (%)				
^b Pearson chi-square test				
^c Fisher's exact test				

Source: Own study based on survey results.

Among the study participants, online advertising is the most frequently chosen source of information, with more than half of women being influenced by it (53.55%), but less than half of men (39.78%). The p value = 0.031 indicates significance, which may suggest that online advertising effectively influences the purchasing decisions of both genders, although women seem to be more open to this type of marketing communication. This is a surprising result, because, as indicated in the literature review, post-millennials generally do not trust advertisements for goods available online. The "positive" result obtained by the female representation of the research sample thus confirms the validity of identifying gender differences in the study of the preferences of the discussed generation, and, probably, of the other generations as well.

Another important source of information about products and services offered on the Internet are recommendations from friends and family, with 51.37% of women and 34.41% of men indicating this option. This confirmed the results of studies conducted in this area by G. Maciejewski and J. Sobura, among others. The p value = 0.008 suggests a significant statistical difference, which may indicate that women trust the opinions of their „loved ones” more in the process of making purchase decisions. Product tests and reviews were indicated by 38.80% of women and 50.54% of men, and the p value = 0.062 suggests that this difference may be close to significance. These results may indicate the need for an objective analysis of products, but among men, who indicate a greater interest in reviews than women.

Other sources of information were indicated each time by less than half of the respondents, both among women and men. For example, when analyzing the distribution of indications regarding price comparison websites, it can be seen that men prefer this method to a much greater extent (37.63%) compared to women (17.49%), and the p value < 0.001 indicates very strong statistical significance. This may suggest that men are more inclined to look for the best offers and compare prices, which may, in turn, be related to their approach to saving and making financial decisions. Thus, the conclusions of M. Grzywińska-Rąbca and M. Grzybowska-Brzezińska were not confirmed. In the case of information on the manufacturer's website, the differences in the results indicate 19.67% of women and 31.18% of men, with a p value = 0.033, which suggests that men may be more inclined to use official sources of information about products. The analysis of the results regarding online forums also reveals significant differences, with 19.67% of women and 36.56% of men, which is statistically significant (p = 0.002). Men seem to use forums as a source of information to a greater extent than women, albeit to a relatively limited extent, which may be related to their tendency to seek advice and

opinions in online communities. Finally, the phenomenon of influencer recommendations should be examined. Again, less than half of the respondents indicated that this is a source of information they use, with 40.44% of women giving such an answer compared to only 9.68% of men. The p value < 0.001 indicates the significance of this result, which may suggest that women are more likely to obtain information about products from social media and influencer platforms. The obtained research results therefore stand in opposition to the commonly presented view on this subject on the Internet, while confirming the results of research obtained by, among others, J. Szydło with E. Potmalnik, or W. Krakowska.

In the case of other sources of information, such as advertising papers, leaflets, packaging and instructions, as well as shop websites, no significant differences in preferences were observed between the genders.

In order to address the above mentioned needs of the iGen's consumers, organizations may implement different marketing approaches. In terms of marketing adoption to women's needs, it is possible, for example, to use influencers partnerships, especially on Instagram and TikTok where women are more responsive. Also highlighting social proof, such as user reviews and recommendations from friends should be considered as good idea. On the other hand, to meet the needs of men it can be recommended to provide technical specs, detailed product comparisons and reviews from trusted sources. Also – highlight product value and efficiency, such as cost-per-use and/or durability. Organizations may also utilize forums and Reddit-style communities for product discussions and campaigns.

At this point, it is worth indicating what information the representatives of the surveyed generation are looking for before making a purchase online. The information sought is presented in Table 5.

Table 5.

Information sought before making a purchase by gender among Generation Z representatives

Characteristics	n	Gender		p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
What information do you look for before making a purchase online?				
Warranty period	276	27 (14,75%)	24 (25,81%)	0,025
Seller reviews	276	107 (58,47%)	69 (74,19%)	0,010
Product availability	276	78 (42,62%)	42 (45,16%)	0,688
Product specification	276	93 (50,82%)	69 (74,19%)	< 0,001
Prices	276	153 (83,61%)	76 (81,72%)	0,694
Shipping methods	276	68 (37,16%)	27 (29,03%)	0,179
Payment methods	276	60 (32,79%)	23 (24,73%)	0,168
Order processing time	276	59 (32,24%)	33 (35,48%)	0,589
Product reviews	276	135 (73,77%)	67 (72,04%)	0,759
^a n (%)				
^b Pearson chi-square test				

Source: Own study based on survey results.

As the research shows, the key information that post-millennials are looking for before making a purchase online is the price of the product they are interested in (83.61% of women and 81.72% of men), and the p value = 0.694 suggests no significant differences. Both groups seem to be largely focused on financial aspects when making purchase decisions. Product reviews are sought by 73.77% of women and 72.04% of men, which leads to a p value = 0.759, indicating no significant differences in this regard. Both genders show similar interest in these reviews, which may indicate general trust in social proof of effectiveness. Another important factor indicated by respondents is the seller's opinions. This factor was noted by 58.47% of women and 74.19% of men, and the p value = 0.010 indicates significance, which may suggest that men are more likely to check the seller's reputation before making a purchase. The situation is similar when looking for technical product data. According to the study, this information is sought by 50.82% of women and 74.19% of men, which leads to a p value of < 0.001 , indicating very strong statistical significance. Men may be more interested in technical details, which may result from, for example, their greater tendency to analyze products in terms of their functionality and specifications. In order to meet those needs of male representation of the respondents, organizations could e.g. create educational product pages with specs, how-to videos and comparison tools. Also, organizations may develop separate FAQ sections or mini-guides tailored for detailed-oriented (typically male) buyers versus quick-decisions (typically female) ones.

The information that is sought to a lesser extent by respondents turned out to be: product availability, order processing time, shipping methods and warranty length. Product availability does not show significant differences between the genders, with 42.62% for women and 45.16% for men, which gives a p value of 0.688. Both groups seem to have similar expectations regarding product availability. Order processing time, with values of 32.24% for women and 35.48% for men, also does not reveal significant differences ($p = 0.589$), suggesting that both groups have comparable expectations regarding timely deliveries. Both women (37.16% and 32.79% respectively) and men (29.03% and 24.73%) have a similar approach to shipping and payment methods (with p values of 0.179 and 0.168 respectively). The length of the warranty turned out to be the sought-after information only in the case of 14.75% of women and 25.81%, which leads to a value of $p = 0.025$, suggesting a statistically significant difference. This may indicate a greater attention of men to consumer protection aspects related to the warranty.

Representatives of post-millennials use various types of online services to purchase goods. Most often, both women and men from this generation use online stores of Polish manufacturers, as well as Polish shopping platforms (Table 6).

Table 6.

Preferences regarding online services used to purchase goods by gender among Generation Z representatives

Characteristics	n			p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
What types of services do you use when making purchases?				
Polish online stores	276	181 (98,91%)	92 (98,92%)	1,000
Foreign online stores	276	98 (53,55%)	65 (69,89%)	0,009
Group shopping portals (e.g. Groupon)	276	6 (3,28%)	5 (5,38%)	0,516 ^c
Social media platforms (e.g. Pepper)	276	6 (3,28%)	13 (13,98%)	0,001
Polish shopping platforms (e.g. Allegro, Vinted, etc.)	276	150 (81,97%)	75 (80,65%)	0,789
Foreign shopping platforms (e.g. e-Bay, etsy, etc.)	276	14 (7,65%)	21 (22,58%)	< 0,001
Cashback platforms	276	21 (11,48%)	11 (11,83%)	0,931
^a n (%)				
^b Pearson chi-square test				
^c Fisher's exact test				

Source: Own study based on survey results.

As previously mentioned, the results presented in the table above highlight the dominance of Polish online stores, with usage rates of 98.91% among women and 98.92% among men. This near-universal engagement suggests a high level of trust in domestic e-commerce platforms, likely driven by factors such as perceived reliability, familiarity, and ease of access. Such a high percentage may therefore indicate that the Polish e-commerce market meets the expectations of consumers of both sexes ($p = 1.000$). In the case of foreign online stores, the differences in preferences are more pronounced. 53.55% of women indicate the use of these services, while in the case of men this percentage is 69.89%. The statistical significance of this difference, with a value of $p = 0.009$, suggests that men are more inclined to explore foreign markets, which may be related to, for example, the search for unique products or better prices. When analyzing group buying portals, both men and women show minimal interest in this type of service, which emphasizes their limited attractiveness among the respondents. Only 3.28% of women and 5.38% of men declared using such platforms, and the p value = 0.516 indicates a lack of statistical significance of this difference. The obtained values may suggest that consumers are not convinced about the benefits of group buying. Equally little interest among respondents is in shopping on social media platforms. In the case of this method, 13.98% of men declared using it, compared to only 3.28% of women. This difference, with a p value = 0.001, is statistically significant, suggesting that men are more likely to engage in shopping via social media. In the context of shopping platforms (marketplace platforms), both Polish and foreign, the results are similar. In the case of Polish platforms, 81.97% of women and 80.65% of men use such services, which, although a slightly lower result than those obtained in other cited studies, confirms a strong preference for local shopping sources, and the p value = 0.789 suggests no significant differences. On the other hand, on foreign shopping platforms, the differences are clear - 7.65% of women and 22.58% of men use these services, with a p value of < 0.001 , which emphasizes a significant difference in openness to international shopping in favor of men. Therefore, convergence with the previously presented results regarding the use of foreign online stores was obtained, as men showed a greater propensity in

this respect than women. Finally, the analysis of cashback platforms showed that 11.48% of women and 11.83% of men use such services, which indicates a similar interest in these platforms, and the p value = 0.931 suggests resembling consumer behavior. However, this interest can be considered small.

After purchasing a given product, the next usual step during the entire online shopping process is to choose the method of delivery of the given product. Not only the preferred methods of delivery of purchased goods were analyzed, but also the factors determining the method of delivery.

The analysis of factors determining the choice of the method of delivery is presented in Table 7.

Table 7.

Factors determining the choice of the form of delivery of purchased goods by gender among Generation Z representatives

Characteristics	n	Gender		p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
What makes you choose a particular form of delivery for a product or service purchased online?				
Shipping cost	276	79 (43,17%)	40 (43,01%)	0,980
Possibility to collect the shipment at a time convenient for you	276	146 (79,78%)	82 (88,17%)	0,082
Possibility to use "other" forms of payment (e.g. mobile payments, payments in installments, deferred payments, etc.)	276	19 (10,38%)	6 (6,45%)	0,282
Possibility to have the shipment collected by another person (e.g. at a parcel machine)	276	91 (49,73%)	40 (43,01%)	0,291
Possibility to choose the place of collection of the shipment (e.g. near home, university, work, or at your current location)	276	98 (53,55%)	41 (44,09%)	0,137
^a n (%)				
^b Pearson chi-square test				

Source: Own study based on survey results.

The presented results indicate that the most frequently indicated factor that representatives of Generation Z pay attention to, regardless of gender, is the possibility of collecting a parcel at a convenient time. This option was chosen by the majority of women and men from the group of respondents - 79.78% and 88.17%, respectively. The p value = 0.082 indicates a marginally significant difference, which suggests that men are slightly more inclined to emphasize the importance of time flexibility in collecting parcels. Interestingly, the cost of delivery was indicated by less than half of the respondents, both among men (43.01%) and women (43.17%). This is probably because, as a rule, the costs of different delivery options are similar on the market. The high p value = 0.980 also suggests that there are no significant gender differences in this matter. In the context of the possibility of using different forms of payment, only 10.38% of women and 6.45% of men considered this factor important, which can be interpreted as a low priority for both groups. The p value = 0.282 suggests that there are no significant gender differences in this regard. The option of having someone else pick up the parcel is more popular among women (49.73%) compared to men (43.01%). The p value = 0.291 indicates

no significant differences, however the discrepancy in the frequency of responses may suggest that women are more open to flexibility in this regard. Finally, the option to choose the location of the parcel pick-up is also significant, with 53.55% of women and 44.09% of men pointing out to this factor. The p value = 0.137 suggests that these differences are not statistically significant, but may indicate a tendency to prefer the location of the pick-up, which may be an important factor for suppliers who should offer a variety of delivery pick-up options.

The most preferred delivery methods turned out to be parcel machines, clearly outclassing other options for collecting purchased goods. They were indicated as the preferred delivery method by 85.79% of women and 87.10% of men, respectively (Table 8). This confirms the result obtained in other studies, the results of which were presented in the literature review.

Table 8.

Preferences regarding the method of delivery of goods purchased online by gender among Generation Z representatives

Characteristics	n	Gender		p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
What form of shipment do you choose most often?	276			0,989
Parcel machines (e.g. Inpost, Orlen Paczka, etc.)		157 (85,79%)	81 (87,10%)	
Pick-up at a Post Office		2 (1,09%)	1 (1,08%)	
Pick-up at a Point (e.g. Żabka)		5 (2,73%)	2 (2,15%)	
Pick-up at a traditional retail store		1 (0,55%)	1 (1,08%)	
Courier delivery		18 (9,84%)	8 (8,60%)	
^a n (%)				
^b Fisher's exact test				

Source: Own study based on survey results.

In the case of other forms of delivery, such as collection at a Post Office, only 1.09% of women and 1.08% of men use this option, which indicates the marginal importance of traditional delivery methods among the respondents. Similarly, collection at points such as Żabka and a traditional retail store enjoys minimal interest - 2.73% of women and 2.15% of men and 0.55% of women and 1.08% of men, respectively. Such low values indicate a preference for more modern and convenient delivery methods. Interestingly, courier delivery, chosen by 9.84% of women and 8.60% of men, also does not enjoy much interest. The obtained results confirm those presented in Table 7 regarding the factors determining the choice of the form of delivery of purchased goods among representatives of Generation Z. In principle, the only way to receive purchased goods on the Internet that meets three conditions at the same time, i.e. the possibility of receiving the parcel at a convenient time, by another person, or giving the option of choosing the place of collection of the parcel (e.g. close to home, university, work, or current location) is, indeed, the parcel machine. The result of the statistical analysis, $p = 0.989$, indicates no significant differences between the genders in the choice of delivery methods, which suggests that both women and men have similar preferences in this matter.

The last element subjected to analysis and related to the purchasing behavior of representatives of the post-millennials on the Internet was the preferences regarding the methods of payment for purchases made. The research results in this area are presented in Table 9.

Table 9.

Preferences regarding the method of payment for goods and services purchased online by gender among Generation Z representatives

Characteristics	n	Gender		p ^b
		Women, n ₁ = 183 ^a	Men, n ₂ = 93 ^a	
How do you most often pay for your online purchases?	276			0,600
BLIK		14 (7,65%)	4 (4,30%)	
Cash on delivery/COD		10 (5,46%)	3 (3,23%)	
Payment card (credit, debit, etc.)		57 (31,15%)	33 (35,48%)	
Postal order		1 (0,55%)	0 (0%)	
Bank transfer		17 (9,29%)	13 (13,98%)	
Via dedicated payment services (e.g. PayPal, PayU, etc.).		84 (45,90%)	40 (43,01%)	
^a n (%)				
^b Fisher's exact test				

Source: Own study based on survey results.

Based on the general distribution of responses, it can be concluded that the most popular payment method for both groups turned out to be dedicated payment services, indicated by 45.90% of women and 43.01% of men. In the case of card payments, it was 31.15% of women and 35.48% of men. This difference, although small, may suggest that men are slightly more inclined to use cards as a payment method. Other payment methods, such as BLIK, cash on delivery and bank transfer, show some differences in preferences. Only 7.65% of women and 4.30% of men use BLIK, which can be interpreted as low popularity of this method among both genders, despite the fact that BLIK is often promoted as a convenient form of payment. Cash on delivery, chosen by 5.46% of women and 3.23% of men, indicates either a certain level of distrust towards online payments or a lack of possibility to pay in this form, which is more noticeable in the case of women. Bank transfer enjoys similarly moderate interest among iGen representatives (9.29% of indications among women and 13.98% among men). The p value = 0.600 indicates no significant statistical differences. However, although the disparities in gender preferences are small, there are certain trends that may be important for e-commerce providers, allowing for better adaptation of payment tools to the expectations of consumers from the discussed generation.

Organizations may address the above outlined needs of the post-millennials e-consumers by e.g. prioritizing fast, seamless integrations with dedicated payment services (like PayU, PayPal etc.), offering multiple options but de-emphasizing COD, postal orders and manual transfers and also highlighting security and speed of payment options in UX (user experience) and marketing.

5. Summary

The evolving expectations of younger generations necessitate the adoption of innovative strategies by organizations across the entire sales process, particularly within the e-commerce sector. Merely developing new digital retail formats is no longer sufficient; rather, it has become imperative to ensure that products are accessible in the appropriate locations and timeframes, offered at competitive price points, and accompanied by mechanisms that facilitate informed and efficient purchasing decisions. Furthermore, organizations must implement solutions that enhance consumer convenience, security, and overall user experience, thereby fostering trust and engagement within the online marketplace. The study conducted and presented in this article aimed to identify the shopping preferences of young e-consumers on the Internet - representatives of Generation Z, taking into account gender differences. This goal was achieved, and the analysis conducted indicated many common elements in the shopping preferences of both genders, which may suggest a convergence of values and consumer expectations in both groups. At the same time, it allowed for understanding subtle differences in the perception of key factors, which may constitute a basis for further research and development of marketing strategies that will more precisely respond to the needs of different market segments.

The representatives of the surveyed generation, regardless of their gender, indicated a great many factors that motivate them to make purchases online instead of in traditional retail stores. The three most frequently selected factors included: the ability to compare goods in terms of their parameters and prices, saving time and the competitive price of goods available online compared to their prices in traditional retail stores. Generation Z representatives considered the possibility of making deferred payments to be the least important factor in this matter.

However, the survey participants were also aware of the disadvantages of the form of shopping under consideration. Interestingly, the respondents clearly pointed out to only two main limitations, i.e. the lack of physical contact with the product and the differences between the description and the actual condition of the product. The long waiting time for the ordered product was not perceived as a disadvantage of purchasing goods online. Before buying, iGen representatives look for a range of information about the goods they are interested in. Above all, these are prices, opinions about the product and opinions about the seller. According to the results of the conducted survey, it can be noticed that opinions about the seller are more important for men than women. Men are also more likely than women to look for information about the technical data of the products. For the post-millennials, information about the length of the warranty, payment method, shipping method or, what is particularly interesting - the order processing time turned out to be of little importance.

The sources of the above information for iGens are mainly online advertisements and recommendations from friends/relatives. It is worth emphasizing that the above sources of obtaining data about products are more important for the female part of the respondents. Women from Generation Z exhibit a greater propensity than their male counterparts to be influenced by social media influencers. The study also provided a basis for formulating the conclusion that it is completely unprofitable for organizations that want to reach the post-millennials to invest in leaflets, advertising papers, detailed instructions or advertisements in magazines. The respondents did not consider these sources to be important in searching for information that interests them. When shopping online, post-millennials mainly use Polish online stores and Polish shopping platforms. They are less likely to use the offer of foreign stores and platforms, and if they do make purchases there, men are more willing to do so than women. Group shopping portals, social media platforms or cashback platforms are not very popular among the iGens regardless of their gender.

When choosing the form of delivery, iGen representatives definitely lean towards parcel machines. They are not very interested in the option of courier delivery or collection at points (e.g. Żabka, Orlen) and Post offices. The results obtained are consistent with the expectations that the Generation Z presents regarding the delivery of ordered products. The most important aspect for respondents of both genders turned out to be the possibility of collecting the parcel at a time convenient for them and delegating another person to perform this task. Post-millennials pay for their purchases using dedicated payment services, less often by credit card. The option of paying for purchased products via "cash on delivery" is also not particularly appealing to them.

The research results obtained have significant practical value, especially for e-commerce companies, marketing agencies and sales platforms that want to reach Generation Z consumers more effectively. First of all, understanding the differences in purchasing behavior of women and men allows for better adjustment of marketing strategies. Since women are more often guided by the opinions of friends and relatives or influencers, brands can invest in influencer marketing campaigns aimed at this group, while emphasizing elements of social proof, such as customer reviews or recommendations on social media. In turn, men, who are more likely to use online forums and manufacturer websites, can be more effectively engaged through educational content, product tests and price comparisons. The research results also indicate that the biggest barrier for both genres is the lack of physical contact with the product before purchase. Companies can minimize this obstacle by offering, for example, detailed product photos, videos presenting their effects, the possibility of returning without giving a reason or the option of virtual testing of the item (e.g. in the fashion or cosmetics industry). Another practical application is the optimization of payment and delivery methods. Since both women and men prefer fast online payments, it is worth investing in the development of intuitive and secure payment systems. The popularity of parcel machines as a form of collection suggests the

need to cooperate with logistics operators to provide customers with the widest possible access to this type of service.

The methodological part points out to the limitations of the conducted study. In order to eliminate them, the study can be conducted on a wider group of Generation Z representatives, also going beyond the student community. In addition, it is worth exploring the area of influence of cultural and regional factors on the purchasing preferences of young consumers. An interesting direction of research may also be an attempt to assess the influence of new technologies on the purchasing decisions of this group. The development of artificial intelligence, augmented reality (AR) or shopping in the metaverse¹⁵ may influence the way young consumers make choices and what factors will become key for them in the future.

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References

1. Abidin, C. (2018). *Internet Celebrity: Understanding Fame Online*. Emerald Publishing.
2. Berkup, S.B. (2014). Working with Generations X and Y in Generation Z Period: Management of Different Generations in Business Life. *Mediterranean Journal of Social Sciences*, No. 5, pp. 218-229, doi: <https://doi.org/10.5901/mjss.2014.v5n19p218>
3. Całek, A. (2021). Pokolenie Z - próba diagnozy. *Zeszyty prasoznawcze*, Vol. 64, No. 1(245), pp. 105-108.
4. Csobanka, Z.E. (2016). The Z Generation. *Acta Technologica Dubnicae*, Vol. 6, No. 2, pp. 63-76, doi: 10.1515/atd-2016-0012
5. Dewalska-Opitek, A., Witczak, O. (2023). Generation Z as consumers - contemporary relationship challenges. *Zeszyty Naukowe Akademii Górnośląskiej*, No. 4, pp. 53-61, doi: 10.53259/2023.4.06
6. Dolot, A. (2018). The characteristic of Generation Z. *“e-mentor”*, No. 2(74), pp. 44-50, doi: <http://dx.doi.org/10.15219/em74.1351>

¹⁵ Metaverse is a concept that uses the digital environment to penetrate the boundaries of our physical world (Szpringer, 2023, p. 6).

7. *E-commerce w Polsce* (2024). Gemius, Polskie Badania Internetu, IAB Polska. Retrieved from: https://gemius.com/documents/66/RAPORT_E-COMMERCE_2024.pdf, 03.03.2025.
8. *Gen Z o sobie i otaczającym ich świecie. Jakie są polskie zetki?* (2024). SWPS, They.pl. Retrieved from: <https://swps.pl/nauka-i-badania/nasze-dzialania/badania-i-wdrozenia/35313-jakie-sa-polskie-zetki-raport-ekspercki-o-mlodej-generacji>, 05.03.2025.
9. *Gen Z: ponad 86% młodych Polaków przynajmniej raz w miesiącu kupuje online lub w aplikacji mobilnej*. Retrieved from: <https://ecommercenews.pl/gen-z-ponad-86-mlodych-polakow-przynajmniej-raz-w-miesiacu-kupuje-online-lub-w-aplikacji-mobilnej/>, 20.01.2025.
10. Grabowska, M. (2021). *Religijność młodych na tle ogółu społeczeństwa*. Fundacja Centrum Badania Opinii Społecznej. Retrieved from: https://www.cbos.pl/SPISKOM.POL/2021/K_144_21.PDF, 03.03.2025.
11. Grzybowska-Brzezińska, M., Grzywińska-Rapca, M., Batyk, I., Janusz, M. (2022). *Determinanty decyzji rynkowych Pokolenia Z na rynku dóbr i usług ze szczególnym uwzględnieniem zmian ich zachowań konsumpcyjnych spowodowanych pandemią COVID-19*. Olsztyn: Instytut Badań Gospodarczych, doi: 10.24136/eep.mon.2022.2
12. Grzywińska-Rapca, M., Grzybowska-Brzezińska, M. (2015). Preferencje zakupowe studentów wykorzystujących nowoczesne technologie informacyjno-telekomunikacyjne. *Roczniki Kolegium Analiz Ekonomicznych*, Vol. 36, pp. 451-460.
13. Jayatissa, D. (2023). Generation Z – A New Lifeline: A Systematic Literature Review. *Sri Lanka Journal of Social Sciences and Humanities*, No. 3(2), pp. 179-186, doi: 10.4038/sljssh.v3i2.110
14. Korneta, P.A., Lotko, A. (2021). Determinanty i modele zachowań konsumenta. Wnioski z przeglądu literatury. *Marketing i Rynek*, No. 9, pp. 3-13, doi: 10.33226/1231-7853.2021.9.1
15. Krakowska, W., Kulmacz, K., Gorzoch, W., Tomaszewska, E. (2024). Influencer marketing a zachowania zakupowe studentów. *Akademia Zarządzania, Wydział Zarządzania Politechniki Białostockiej*, Vol. 8, No. 2, pp. 225-246, doi: 10.24427/az-2024-0023
16. Krzepicka, A., Tarapata, J. (2013). Psychologiczne determinanty zachowania się konsumenta na rynku. *Nowoczesne Systemy Zarządzania*, Vol. 8, No. 1, pp. 145-155, doi: 10.5604/18969380.1159096
17. Kuberska, D., Suchta, K. (2016). Marka jako determinanta zakupu na rynku certyfikowanej żywności dla niemowląt i małych dzieci. *Marketing i Zarządzanie*, No. 3 (44), pp. 351-360, doi: <http://dx.doi.org/10.18276/miz.2016.44-32>
18. Maciejewski, G. (2018). Pokolenia "Y" oraz "Z" o zakupach w Internecie. *Handel Wewnętrzny*, No. 6(2), pp. 255-264.
19. Makowski, D., Lüdecke, D., Patil, I., Thériault, R., Ben-Shachar, M., Wiernik, B. (2023). *Automated Results Reporting as a Practical Tool to Improve Reproducibility and Methodological Best Practices Adoption*. CRAN. <https://easystats.github.io/report/>.

20. McCrindle, M., Fell, A. (2019). *Understanding Generation Z: Recruiting, Training and Leading the Next Generation*. Retrieved from: <https://mccrindle.com.au/resource/report/understanding-generation-z/>, 10.02.2025.
21. McCrindle, M., Wolfinger, E. (2014). *The ABC of XYZ: Understanding the Global generations*. Bella Vista NSW: McCrindle Research Pty Ltd.
22. Ortiz-Pimentel, M., Molina C., Ronda-Pupo, G.A. (2020). Bibliometric assessment of papers on generations in management and business journals. *Scientometrics*, pp. 445-469, doi: <https://doi.org/10.1007/s11192-020-03670-8>
23. Paczka, E. (2020). Zmiana zachowań rynkowych pokolenia Z. *Acta Universitatis Wratislaviensis, Ekonomia - Wrocław Economic Review*, No. 26(1), pp. 21-34, doi: <https://doi.org/10.19195/2658-1310.26.1.2>
24. Parry, E., Urwin, P. (2021). Generational Categories: A Broken Basis for Human Resource Management Research and Practice. *Human Resource Management Journal*, No. 31, pp. 857-869, doi: <https://doi.org/10.1111/1748-8583.12353>
25. *Piramida wieku ludności Polski od 1970 roku (wraz z prognozą)*. Retrieved from: <https://stat.gov.pl/obszary-tematyczne/ludnosc/ludnosc/ludnosc-piramida/>, 29.01.2025.
26. *Polaków portfel własny. Polacy w sieci* (2024). Santander Consumer Bank. Retrieved from: https://www.santanderconsumer.pl/gfx/santander/userfiles/_public/o_banku/raport_ppw_polacy_w_sieci.pdf, 31.01.2025.
27. Przybylski, B. (2023). Pokolenie X, Y oraz Z. Próba uporządkowania ram czasowych i etykiet pokoleniowych. *Pedagogika społeczna*, No. 3(89), pp. 27-44, doi: <https://doi.org/10.35464/1642-672X.PS.2023.3.02>
28. Salt, B. (2003). *Baby Boomer Culture Gets its Comeuppance*. Retrieved from: <https://ipa.org.au/wp-content/uploads/archive/Review55-2Babyboomerculture.pdf>, 03.03.2025.
29. Singh, A.P., Dangmei, J. (2016). Understanding the Generation Z: The Future Workforce. *South-Asian Journal of Multidisciplinary Studies*, Vol. 3, No. 3, pp. 1-5.
30. Sjöberg, D., Whiting, K., Curry, M., Lavery, J., Larmarange, J. (2021). Reproducible Summary Tables with the gtsummary Package. *The R Journal*, No. 13, pp. 570-580, doi:10.32614/RJ-2021-053
31. Sobura, J. (2023). Social media marketing jutro - oczekiwania pokolenia Z wobec aktywności marek w mediach społecznościowych. *Marketing i Rynek*, No. 3, pp. 33-44, doi: 10.33226/1231-7853.2023.3.3
32. Sroczyńska, M. (2024). *Pomyślę o tym jutro. Portret pokolenia Z*. Retrieved from: <https://uksw.edu.pl/pomysle-o-tym-jutro-portret-pokolenia-z/>, 03.03.2025.
33. Sodomir, B. (2020). Młode pokolenie w mediach społecznościowych. In: A. Sawicki (Ed.), *Wybrane problemy zarządzania* (pp. 96-109). Pelplin: Bernardinum.
34. Syta, J. (2022). *Jak młode użytkowniczki kupują online? Badanie zachowań nabywczych młodych kobiet w środowisku e-commerce*. Retrieved from: <https://nowymarketing.pl/jak->

- mlode-uzytkowniczki-kupuja-online-badanie-zachowan-nabywczych-mlodych-kobiet-w-srodowisku-e-commerce/, 24.02.2025.
35. Szpringer, W. (2023). Metaverse - nadmierny szum czy nowe szanse dla biznesu? (Cz. 2). *Kwartalnik Nauk o Przedsiębiorstwie*, No. 4, pp. 5-18, doi: <https://doi.org/10.33119/KNoP.2023.70.4.1>
36. Szydło, J., Potmalnik, E. (2022). Decyzje zakupowe przedstawicieli Pokolenia Z na przykładzie branży modowej. *Marketing i Rynek*, No. 9, pp. 15-36, doi: 10.33226/1231-7853.2022.9.2
37. *The rise of the Gen Z Consumer: Career-driven, credit-adverse and tempted by immerse retail*. ICSC. Retrieved from: https://www.icsc.com/uploads/about/2023ICSC_Gen_Z_Report.pdf, 10.02.2025.
38. Twenge, J.M. (2019). *iGen. Dlaczego dzieciaki dorastające w sieci są mniej zbuntowane, bardziej tolerancyjne, mniej szczęśliwe i zupełnie nieprzygotowane do dorosłości - i co to oznacza dla nas wszystkich*. Sopot: Smak Słowa.
39. Wickham, H., François, R., Henry, L., Müller, K., Vaughan, D. (2023). *A Grammar of Data Manipulation*. R package version 1.1.4, <https://CRAN.R-project.org/package=dplyr>
40. *Zachowania zakupowe i wpływ influencer marketingu na Pokolenie Z (badanie)*. Retrieved from: <https://nowymarketing.pl/zachowania-zakupowe-i-wplyw-influencer-marketingu-na-pokolenie-z-badanie/>, 03.03.2025.
41. Żarczyńska-Dobiesz, A., Chomątowska, B. (2014). Pokolenie „Z” na rynku pracy – wyzwania dla zarządzania zasobami ludzkimi. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, No. 350, pp. 405-415, doi: 10.15611/pn.2014.350.36
42. Żydek, M. (2024). *Pokolenie Zet - co to za pokolenie i co wyróżnia je na rynku pracy?* Retrieved from: <https://www.gazetaprawna.pl/praca/artykuly/9551308,pokolenie-zet-co-to-za-pokolenie-i-co-wyroznia-je-na-rynku-pracy.html>, 03.03.2025.

AFFILIATIVE MANAGEMENT STYLE IN SECONDARY SCHOOL IN VUCA AND BANI TIMES

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Purpose: Secondary school headteachers, tasked with overseeing performance and achieving goals, face the challenge of managing their institutions in a VUCA and BANI reality. Being acquainted with organisation management styles in problematic situations and in a state of flux may prove helpful when making decisions, leading a team or enforcing the fulfilment of duties.

The aim of the article is to present one of school management styles adopted in unpredictable situations which require specific decisions to be made and actions to be taken in order to ensure the correct functioning of an educational institution in a changeable environment.

Design/methodology/approach: This article references the literature on VUCA, BANI and management styles; it is also based on the knowledge and experience of the authors -academic and secondary school teachers (one of the authors has 20 years of experience of working in a school). In addition, analyses both Polish and international studies on the aforementioned phenomena and tracks trends in secondary education. The article also presents sample stages of handling a crisis situation.

Findings: The dynamics of VUCA and BANI have increasingly permeated secondary education. Educational reforms, the introduction of new subjects, the decline in birth rate or the war in Ukraine are only some of the issues the consequences of which need to be handled by school authorities or teaching staff. The headteacher's knowledge, experience, openness and communication skills determine whether a given educational institution copes with change, survives on the educational market and gains the confidence of students and their parents. In the context of change, affiliative leadership is a management style which may be implemented in a secondary school. It should be noted, however, that it brings the desired results if certain conditions are met both by the team led by the headteacher and the school-governing body.

Practical implications: There is no single universal management style which could be successfully used in every situation regardless of circumstances. VUCA and BANI exposed schools' flaws and proved that change management, mastering leadership styles, flexibility, openness and innovative approach to dealing with a difficult reality are fundamental abilities of the contemporary headteacher.

Originality/value: This study discusses the problem of an affiliative management style for secondary schools in VUCA and BANI times. Thanks to their expertise, experience and skills, headteachers can employ various leadership styles or management models. The present article

presents the affiliative management style, which, once certain conditions are met, may help deal with a challenging and changeable reality.

Keywords: VUCA, BANI, affiliative school management style.

Category of the paper: viewpoint, literature review.

1. Introduction

The VUCA and BANI reality, so frequently analysed from the perspective of for-profit enterprises, also affects secondary schools -institutions which prepare young people for work or secondary education exams.

The abolition of junior secondary schools, introduction of new subjects, modifications to the core curriculum, the Covid-19 pandemic, and successive reforms have all contributed to a lack of sense of security among teachers and students. Schools have to function in a changing reality, which requires flexible approach to management, fast and effective responses to unforeseeable events (e.g. the war in Ukraine and enrolment of students who were unable to communicate in Polish).

A school is managed by its headteacher, who makes decisions and is responsible for the fulfilment of the tasks of the educational institution, ensures the safety of students and teachers. The headteacher's knowledge, experience, personality and skills determine the school's survival and performance in trying times. Regardless of circumstances, the school must perform its goals, prepare students for school-leaving exams and the job market, instruct, educate, provide support in difficult life situations. A headteacher who knows his or her staff is able to manage the institution in reliance on a number of available leadership models or styles. One such model is the affiliative management style, which highlights interpersonal relations. The affiliative style has both positive and negative sides; it is not universal by any means and as such will not work in all possible situations, yet it may be helpful in emergencies or crises.

The aim of the article is to present one of school management styles employed in unpredictable situations which require specific decisions to be made and actions to be taken in order to ensure the correct functioning of an educational institution in a changeable environment.

The authors formulated the following research hypotheses:

1. A correctly functioning school means that solutions ensuring its continued operation must be designed and implemented quickly.
2. The affiliative style is one of several styles which can be applied in an unpredictable reality.
3. The affiliative management style promotes responsible and mature teamwork.

Like all institutions, secondary schools need to respond to changes which are not always planned, predictable or easy to implement. In the case of schools, adaptation to consecutive reforms requires a great deal of responsibility, experience, knowledge and skills on part of its headteacher and staff.

VUCA and BANI are most often analysed from the perspective of for-profit enterprises. Although school is not a business entity in the strict sense, it has to be flexible, open and forward-thinking, like a business. School authorities should be acquainted with management styles and able to apply them practically in cooperation with school staff, being aware that their personality, communication skills, responsibility for actions taken may strengthen the team they work with. For a school, VUCA and BANI mean a new concept of work, management, teaching, contacts with teachers, students and other school staff, as well as the ability to make informed and rational decisions in trying and complex times,

2. Methods

This article references Polish and international publications on managing organisation in the VUCA and BANI reality; both terms were explained in the context of secondary school. The issue is global in nature rather than limited to a single country, as VUCA and BANI affect every school irrespective of stage of education or country of location.

There are publications which present the situation in schools and education in terms of the two phenomena. Nevertheless, VUCA is analysed more extensively (the Covid-19 pandemic revealed a host of problems related to the online management of an educational institution, its staff, students and other entities). BANI is usually discussed in the context of businesses, partnerships or companies. Like any other organisation, school must be managed through tough times of change, crises or hardship.

The authors (including a professionally active secondary school teacher with more than 20 years of experience) also presented an affiliative management style which may be an answer to the unpredictable reality of contemporary schools.

There is a scarcity of publications on the subject of managing a school in the context of BANI, the role of the headteacher responsible for the performance of school's goals and tasks in a changeable reality, building teams composed of teachers with different experience and seniority.

The following methods were applied in this article:

1. Analysis of texts and studies on VUCA, BANI and the affiliative leadership style published in Poland and other countries.
2. Tracking trends in secondary schools.
3. The article also presents sample stages of handling a crisis situation.

The choice of methods was determined by the research problem analysed in this article.

3. The VUCA and BANI world

A headteacher managing a contemporary school must adopt an interdisciplinary approach to a number of phenomena such as consecutive reforms of the education system, introduction of new technologies, staff insufficiency or depopulation, which causes classes, and ultimately schools, to be closed. In such an unpredictable, ambiguous and often difficult reality, it is necessary to adapt to change quickly, efficiently and effectively.

VUCA is an acronym for:

- Volatility.
- Uncertainty.
- Complexity.
- Ambiguity (Taskan, Junça-Silva, Caetano, 2022; Ziarko, 2024).

In the school context, VUCA made itself felt during the closure of lower secondary schools, the COVID-19 pandemic, the outbreak of war in Ukraine and the integration of Ukrainian youth into Polish schools without prior knowledge of the Polish language or familiarity with the realities of the Polish educational system. This broader issue also encompasses the adaptation of educational pathways to the demands of the labour market and future professions, which involves a shift in perspectives regarding education, competencies and skills of young individuals entering adulthood -a forward-looking approach to the learning process.

The response to VUCA was encapsulated in a concept proposed by Bob Johansen from the Institute for the Future, who emphasized key skills necessary to cope with the challenges of this reality (see Fig. 1). This concept is known as VUCA PRIME. According to Johansen, leaders require a strategic approach to effectively manage volatility, uncertainty, complexity and ambiguity (Arnott, 2024).

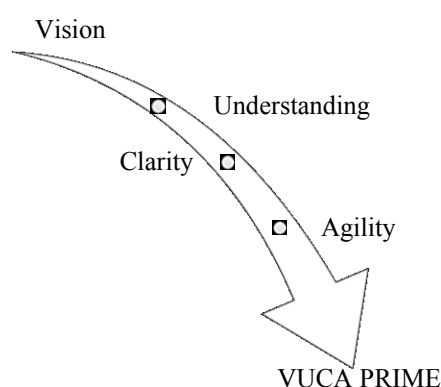


Figure 1. VUCA PRIME components.

Source: Illustration by the authors, based on: Skarbek R. (2023). Świat VUCA i BANI: zarządzanie zmianą i celami. Niepewność i złożoność, <https://www.empowerment-coaching.com/post/swiat-vuca-i-wyznaczanie-celow>, 12/09/2025; Arnott R. (2024). Adapting to Change: The Evolution from VUCA to VUCA Prime and the Executive Assistant's Role, <https://executivesupportmagazine.com/vuca-prime>, 12/09/2025.

In the educational sector, the VUCA reality especially came to the fore during the pandemic. The closure of schools and the transition to remote learning exposed the vulnerabilities of the system, such as unpreparedness of teachers, students and parents for online work, as well as a lack of necessary digital skills and equipment across all entities involved.

In 2020, American anthropologist and futurist Jamais Cascio put forward the idea of BANI, a new model reflecting this reality, a concept which far from optimistic (Rosalska, 2022).

BANI is an acronym which stands for:

- brittle,
- anxious,
- non-linear,
- incomprehensible (Sidor-Rządkowska, 2022; Kruse, 2025).

In secondary education, these four adjectives describe the reality that school management and pedagogical staff must confront (see Table 1).

Table 1.
Analysis of BANI in the context of Polish secondary schools

BANI reality	Analysis
Brittle	The COVID-19 pandemic, war in Ukraine, staff shortages and other phenomena have demonstrated that planning-one of the fundamental management elements-is not always feasible.
Anxious	Educational reforms, demographic decline, plans to close schools, unpredictability related to class sizes and the low prestige of the teaching profession create instability in employment. All of these factors are not conducive to stability at work.
Non-linear	The educational process is driven by change: introducing new subjects requires hiring specialists, revising curricula and modifying final exams, impacting not only the headteacher, teachers and students but also school counsellors, psychologists, career advisers and other personnel.
Incomprehensible	The nature of some phenomena is beyond comprehension, and it is unclear in which direction they will develop. It may take several years to observe the outcomes of certain decisions, such as the establishment of junior secondary schools. It remains unknown what decisions will be made with regard to future changes in secondary school final exams or the new health education subject.

Source: authors' own work.

The BANI environment has become a daily reality in schools in Poland and worldwide, and beyond the secondary level (Baskoro, 2023; Kondrashkina, Novichkova, 2024; Tantasit, 2025). Many events and phenomena are unpredictable, yet schools, as organizations, must fulfil their strategic objectives and tasks. Developing a certain style of organizational management that at least partly mitigates the effects of VUCA and BANI is essential. Research by Z. Tshetshe indicates that recognizing the uniqueness of individuals at the workplace helps alleviate the challenges posed by the BANI era. Consequently, it is necessary to develop methods, strategies or concepts that emphasize employees' well-being and ensure sustained engagement (Tshetshe, 2025). An affiliative management style offers such possibility within the school context.

4. Affiliative management style in the school environment

Effective and efficient school management requires selecting appropriate methods, styles and tools tailored to the specific team which one manages and works with. School management is the responsibility of the headteacher, who is increasingly seen as a manager tasked with overseeing the educational institution, managing staff, collaborating with students' parents, the external environment of the school and other entities. In this context, the headteacher must methodically and continuously expand his or her knowledge of management and communication. Each manager should possess appropriate skills to ensure the success of the organisation which they lead. Figure 2 presents three types of skills.

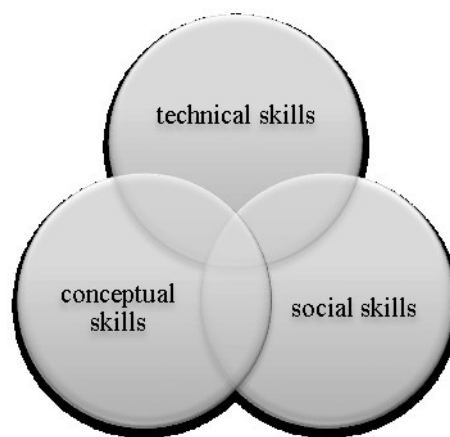


Figure 2. Three skill types according to D. Katz.

Source: Illustration by the author, based on: Korzeniowski, 2019, p. 35.

- For a headteacher, technical skills include primarily specialist knowledge of management, economics, finance, logistics and other areas.
- The headteacher's social skills are defined as the ability to cooperate with the faculty, students and their parents, as well as external entities. This also encompasses understanding and empathising with the people with whom the headteacher works on a daily basis.
- The headteacher's conceptual skills involve treating their school as an organisation which undergoes changes and needs to meet the requirements of the educational market. Consequently, the headteacher must be intuitive, plan the school's expenses wisely, analyse the job market and adjust the educational pathways to the needs of the local, domestic and European job market.

All three skill sets must overlap, since every headteacher in possession of this expertise will be able to cope in a volatile, challenging and unpredictable reality. An organisation is frequently capable of overcoming hardship thanks to its leader, who not only makes strategic decisions but also supports employees (Olkowicz, Kozłowski, Jarosik-Michalak, 2024, p. 504).

Secondary school is a unique type of organisation, bringing together adults and minors; those who are emotionally and professionally mature and those whose personality is not fully developed and who are yet to make their career choices. Therefore, such an organisation should be based on mutual trust between teachers, students and student's parents (Bilgic, Iker Gumuseli, 2012; Akdogan, 2021; Holzer, Daumiller, 2025). This trust defines the school's first functional tier; however, the organisation needs to be managed skilfully.

American psychologist David Goleman identified six leadership styles based on emotional intelligence (Figure 3).

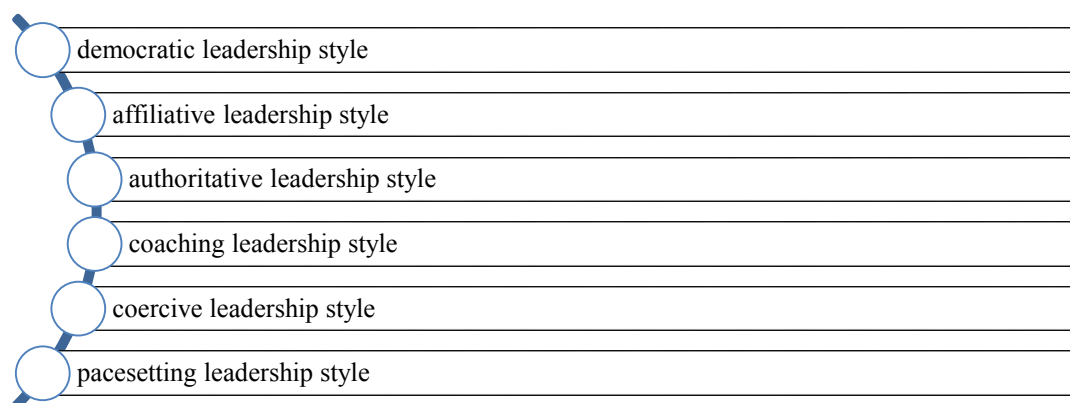


Figure 3. Management styles according to D. Goleman.

Source: Illustration by the authors, based on: Szymczyk, 2022; Goleman, 2000; Layton, Pearson-Shaver, 2021.

An affiliative management style means forming bonds in the workplace and prioritising interpersonal relations. It also involves creating a positive work environment by fostering cooperation between employees. Managers who use this leadership style are empathetic, have regard for the well-being of employees and promote teamwork. Of key importance to this style is creating a positive atmosphere in the team, which encourages employee loyalty. Leaders have communicative competences, are oriented on active listening, boost their employees' morale, help to form strong intra-team relations, have high emotional intelligence, create supportive work environment, wherein employees feel safe to voice their opinions, ideas and concerns. In this style, leaders offer constructive feedback and motivate their people to work. This helps foster a positive work culture based on continuous learning. It also involves building trust and mutual respect. The affiliative style emphasises supporting employees' growth, which involves training, upgrading skills, qualifications and competences (Style zarządzania zespołem..., 2023; Affiliative Leadership; Imer, 2024). Affiliative leadership is characterised by specific qualities, which have their positive and negative aspects, as seen from the perspective of Polish secondary schools (Table 2).

Table 2.*Benefits and drawbacks of affiliative leadership in secondary school*

Benefits and drawbacks of affiliative leadership*	Benefits	Drawbacks
Focus on problem-solving	In the school context, this entails mitigating conflicts (which frequently arise in large and diverse teams).	Conflicts are inevitable, yet the school principal cannot focus solely on this aspect. The team should acquire the ability to cope with crises and challenging situations without the direct involvement of school leadership.
Recognition of staff	Acknowledging and appreciating staff members has a motivating effect on their work, engagement and performance.	However, excessive or unjustified praise may lead to a decline in effectiveness, as employees might display behaviour unacceptable in the school environment, such as neglecting to conduct lessons, arriving late, or failing to complete documentation. Praise must therefore be well-founded and stem from concrete achievements.
Interpreting emotions	Empathy and the proper interpretation of an employee's behaviour support an understanding of their actions and decisions. This contributes to team integration and fosters positive relationships among staff members.	Nevertheless, the headteacher may not always be able to accurately interpret employees' emotions, which can in turn deteriorate the overall atmosphere within the team.
Flexibility	Flexibility facilitates adaptation to change and prepares the school and its stakeholders for new realities. It also demonstrates the trust of school authorities in the innovations introduced by teachers.	However, excessive flexibility can result in chaos, a lack of task completion and disregard for established rules. Flexibility must therefore be clearly defined and bounded.
Creativity and innovation	This primarily concerns the introduction of new elements into the curriculum, engaging students more actively in the educational process, unlocking their potential and developing their skills. From the perspective of the headteacher, it also involves implementing new models, styles, or methods of school management.	Nonetheless, creativity and innovation may lead to unjustified changes that cause significant disruption in both teaching and administration. They may also generate considerable costs.
Resilience	Like all other institutions, schools are subject to reforms (whether positively or negatively assessed by stakeholders) that require substantial organizational, financial and structural resources. The composure and calmness of the leadership help all members of the school community navigate such periods of change.	Not every headteacher is able to manage reforms, especially those that must be implemented within a short timeframe. This demands strong organizational skills, psychological resilience, the ability to work under pressure and effective stress management. It also entails maintaining control over school documentation and procedures.
Empathetic communication	This involves understanding the emotions and problems of staff and students, as well as dedicating time and attention to listening to others. It also requires the ability to overcome communication barriers in interactions with staff, students, or parents.	However, excessive empathetic engagement must not lead to burnout on the part of the headteacher. The headteacher should be familiar with manipulative techniques as well as different types of communication barriers. Here too, clear boundaries of compassion and emotional involvement must be established.

* What is Affiliative Leadership? The "People First" Approach, <https://status.net/articles/affiliative-leadership/>, 12/09/2025.

Source: Benefits and drawbacks: Authors' own work.

It is the headteacher's experience and expertise that determines the effectiveness of the style of leadership in the institution that he or she manages. "Effective management is a multi-faceted process, with setting goals, organisation, employee orientation, problem solving, motivation and inspiration as its integral components" (Łyszkowska, 2024, p. 43). This style prioritises the role of the team. A motivated and competent team who are aware of their tasks and know how to complete them will be able to cope in a crisis. Open, sincere communication which builds trust among workers is of primary importance. "Open communication is essentially the 'bloodstream' of every organisation; in a way it means sharing part of yourself" (Królik, 2015, p. 72). The affiliative style will not work without this crucial component. However, within this style, the headteacher should also, when justified, admonish, discipline and remind staff of the school's functions as well as the duties of teachers and other employees. Equally important is the headteacher's ability to make decisions promptly, decisively and responsibly. For this reason, the school authority should define the limits of applying the affiliative leadership style and, when necessary, introduce additional management techniques. Employees must be held accountable for their work; in this style, pedagogical supervision remains applicable, along with the timely completion of school documentation, participation in faculty meetings and meetings with parents (including online meetings), continuous professional development, participation in training and related activities. The affiliative style must not introduce disorder -since this would only exacerbate a school's crisis situation - nor relieve employees of their responsibility for task completion and the achievement of institutional goals.

5. Sample stages of handling a crisis situation

In connection with the influx of Ukrainian youth into Polish secondary schools, headteachers, teachers, psychologists and counsellors faced the problem of the admission and education of the new intake. In Poland, education is compulsory up to the age of 18 years. Ukrainian teenagers who arrived in Polish schools did not know the Polish language or system of education; they had no Polish coursebooks. Moreover, the new students' levels of knowledge and skills varied, which stemmed from the characteristics of the Ukrainian education system. In addition, some students declared that they would like to take the Polish "matura" exam. For school authorities, this meant the necessity to execute hitherto inapplicable strategies. This also called for a change in the method of managing an educational institution, communication with students and parents, as well as hiring teachers who spoke Ukrainian or a related language. Figure 4 shows a flowchart for coping with a crisis situation, with the enrolment of Ukrainian students used as an example.

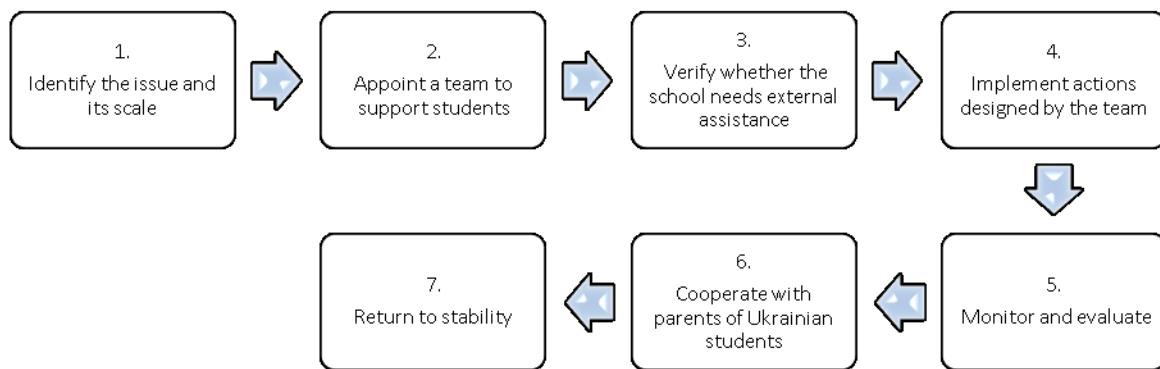


Figure 4. Sample stages of handling a crisis situation.

Source: Author's own work.

1. Identifying the issue and its scale: in Polish school realities, this involves determining the number of students from Ukraine, their command of the Polish language and their knowledge of the Polish secondary education system.
2. During the second stage, the headteacher consents for a student support team to be appointed. The team comprises form tutors, school counsellor, school psychologist and, optionally, support teachers. The scope of the team's responsibilities must also be defined.
3. It needs to be determined whether the school needs external support, e.g. from the regional board of education, local government, local psychological and pedagogical counselling centre, etc.
4. Implementation of actions designed by the team in order to:
 - verify the Ukrainian students' integration with the Polish students and the faculty,
 - evaluate academic progress (especially with regard to the Polish language) and the extent to which the new students have mastered the material in individual subjects,
 - at this stage it is important to provide a sense of security and stability for those who were forced to leave their country.
5. Monitoring and evaluation: the assessment of the effectiveness of actions taken and making corrections.
6. Cooperation with parents of the Ukrainian students and communicating key information relevant to the student's development.
7. School's return to stability.

Depending on the complexity of the issue, the headteacher may use other methods, e.g. training for all school staff, summoning an extraordinary faculty meeting.

6. Results

VUCA and BANI made it necessary for headteachers to adopt a new outlook on managing their secondary schools in challenging or crisis situations. The headteacher is increasingly perceived as a manager who needs to possess specific management, communication, planning and decision making skills in difficult situations or in a crisis. Consequently, school authorities must keep relevant areas of their expertise up to date.

The affiliative style means, first and foremost, building a friendly atmosphere based on honesty and trust. In education it constitutes one of the foundations of effective teamwork. It favours engagement, reinforces employee loyalty, accentuates interpersonal relations, supports integration, harmony and conflict resolution. Still, not every headteacher is able to adopt this leadership style. Since a lot depends on the team one works with, every headteacher needs to know his or her employees well. It proves particularly problematic in schools with large staff, with part of teachers working for other educational institutions or coming to work for a few hours only (as is the case e.g. with retired teachers).

Moreover, affiliative leadership highlights the significance of the school manager's personality. The leader must possess relevant qualities such as empathy, communicative skills and openness in interpersonal interactions. The headteacher must not avoid confrontation with reality, teachers or students; he or she will have to demonstrate decisiveness, ability to delegate tasks and supervise their completion, and adherence to practices and procedures. Although decisions may be consulted with the staff, only the headteacher can be held accountable for managing the school.

The affiliative style should not cause chaos: employees must be aware of their duties and the way in which they are to achieve the set goals. This requires considerable responsibility, discipline, well-developed competences and skills. For this reason, the affiliative style, which puts a human being in the centre, must have clearly defined limits.

7. Discussion

The affiliative style is one of many approaches which may be used when coping with change in secondary school. Pursuant to Article 7 of the Teacher's Charter Act, the headteacher manages the school, represents it outside, acts as the official supervisor of all school employees and presides over the teacher's council. (...) is responsible for caring for children and young people attending the school (the Teacher's Charter Act). There is substantial responsibility for running the school in a lawful and effective manner. "Hence, in Poland the position of a headteacher is multi-dimensional, since it encompasses organisational, legal, social,

pedagogical and economic matters” (Sudoł, 2024, p. 360). The manifold tasks must be completed in difficult and unpredictable circumstances. In secondary school, VUCA and BANI affects school authorities, teachers, students and their parents. Nevertheless, regardless of the situation, students must follow compulsory education and the school needs to perform its functions. The affiliative style puts the teacher, the student and the parent in focus. By building a friendly atmosphere based on kindness, understanding and support, the organisation cultivates a sense of security. However, a number of matters should be addressed before the headteacher decides to put the affiliative style into practice. First, they need to assess the team they work with. If the team is composed of loyal, competent staff who know their capabilities and limitations, and who are open to change, the affiliative style will be helpful in managing a crisis. Second, the headteacher must not be afraid of making changes, even if they do not match the expectations of all employees. Third, the affiliative style should support team-building as long as the team are aware of the purpose of individual undertakings. This necessitates open communication and transparency. This skill has not been mastered by every headteacher. An employee has the right to express their opinions, views and concerns. The role of the headteacher is to listen to their team and clarify any issues. This is the foundation of trust and honesty between the school authority and the entities which interact with it. The affiliative style has its benefits and drawbacks; it does not necessarily work in every school and every crisis. It is the headteacher who is obliged to ensure the operational continuity of the educational institution; however, he or she will fail without up-to-date knowledge of management techniques. Each crisis necessitates a different approach, course of action, implementing the appropriate procedures (which became clear during the Covid-19 pandemic). Managing a school has two main dimensions: the first one is strictly defined by law, whereas the other one comes from experience, intuition and the headteacher’s personality traits.

8. Conclusions

In a school, the affiliative management style should be seen as a possibility rather than a universal solution. There is simply no one-size-fits-all model for all situations. How successful an organisation is in dealing with changes, unpredictability or rearrangement of plans depends on the expertise, experience and commitment of the headteacher and the staff. The affiliative management style puts the employee and interpersonal relations based on kind and friendly atmosphere first. It involves teamwork to build trust between the headteacher and the faculty. School managers also prioritise training and upgrading employee qualifications, as it facilitates coping in a crisis. Open communication provides a sense of security, supports employee involvement and loyalty. Still, the affiliative style cannot be effectively used with every team and in every organisation. A headteacher who wishes to adopt this model must be

aware of several issues. Firstly, the goals and tasks of the school must always be kept in mind. Each educational institution is held accountable for the fulfilment of this obligation. Secondly, the headteacher manages the school and makes key decisions with regard to the functioning of the school (at times, decisions can be difficult and meet with criticism on part of the employees). For this reason, the team must be integrated well enough to comprehend the motives behind the headteacher's actions. Thirdly, the manager must know other leaderships styles which will prove more successful and effective in a given situation. The headteacher, as well as any other employee, should update their knowledge on management as well as the so-called soft skills. On the one hand, the VUCA and BANI reality forced take a new look at education and the role of the school in the process from a different angle, exposed its shortcomings and indicated areas for improvement. On the other hand, it showed us that change is inevitable and affects all organisations, including schools, which need competent staff open to learning and upgrading their skills. Development cannot be stopped; it is impossible to predict many phenomena which may soon become an integral part of schooling, education or work.

Several aspects deserve consideration in this context. The first one is the way in which the candidates for the position of headteacher are prepared for managing an educational institution. This entails verifying their knowledge and experience in the face of new challenges, adaptation skills with regard to changes which are unplanned but demand decisiveness and action. The second aspect is the need to keep the headteacher's knowledge of management, communication or conflict resolution up to date. Like any other teacher, the school authority must expand their expertise in these areas.

Last but not least, teacher training programmes must prepare students for working in schools in terms of coping with challenges posed by VUCA and BANI. This may be seen as an attempt to answer the question of how well such students would cope with a reality of changing, uncertain and unpredictable phenomena. This approach would make it necessary to review university programmes, introduce new subjects to address relevant demands and adapt teaching methods to today's reality.

References

1. *Affiliative Leadership*, <https://humaans.io/hr-glossary/affiliative-leadership>, 12/09/2025.
2. Akdogan, E. (2021). Life and Education Built on Trust. *Journal of Research in Social Sciences and Language*, 1(2), 128-137. DOI: <http://dx.doi.org/10.20375/0000-000E-75B8-F>.
3. Arnott, R. (2024). *Adapting to Change: The Evolution from VUCA to VUCA Prime and the Executive Assistant's Role*, <https://executivesupportmagazine.com/vuca-prime/>, 12/09/2025.

4. Baskoro, G. (2023). From VUCA to BANI: A Challenge of Strategic Environment for Higher Education in Indonesia. *Proceedings of the 3rd International Conference on Business and Engineering Management (ICONBEM 2022). Series: Advances in Economics, Business and Management Research, Vol. 249*, pp. 229-235. DOI:10.2991/978-94-6463-216-3_18
5. Bilgic, O., Gumuseli, A.I. (2012). Research on teacher's level of trust to the colleagues, the students and the parents. *Procedia - Social and Behavioral Sciences*, 46, 5470-5474. DOI: <https://doi.org/10.1016/j.sbspro.2012.06.459>
6. Goleman, D. (2000). *Leadership That Gets Results*, *Harvard Business Review*, https://content.leadershipacademy.nhs.uk/aspce3/files/Leadership_that_gets_results_goleman.pdf, 12/09/2025.
7. Holzer, A., Daumiller, M. (2025). Building trust in the classroom: perspectives from students and teachers. *European Journal of Psychology of Education*, 40(2), 1-24. DOI: <https://doi.org/10.1007/s10212-025-00961-7>
8. Imer, D. (2024). *What is the Affiliative Leadership Style At Work?*, <https://teamflect.com/blog/hr-basics/affiliative-leadership-style>, 12/09/2025.
9. Kondrashkina, L.R., Novichkova, N.M. (2024). BANI World: a New Reality and Educational Meanings. *Development of education*, 7(1), 36-42. DOI: <https://doi.org/10.31483/r-109426>
10. Korzeniowski, L.F. (2019). *Podstawy zarządzania organizacjami*. Warszawa: Difin, p. 35.
11. Królik, G. (2015). Rola zaufania w relacjach interpersonalnych jako determinanta efektywności zespołu. *Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, 230, p. 72.
12. Kruse, K. (2025). *Forget VUCA. The World Is BANI Now*, <https://www.forbes.com/sites/kevinkruse/2025/02/03/forget-vuca-bani-is-the-new-framework-world/>, 12/09/2025.
13. Layton, E., Pearson-Shaver, A. (2021). Leadership. *HCA Healthcare Journal of Medicine* 2(1). DOI: <https://doi.org/10.36518/2689-0216.1099>
14. Łyszkowska, E. (2024). Teorie, modele i koncepcje przywództwa w organizacjach i ich kulturowe uwarunkowania. In: A. Janus, E. Łyszkowska (eds.), *Exellent Menager* (p. 43). Warszawa: Instytut Nauk o Zarządzaniu i Jakości.
15. Olkowicz, J., Kozłowski, A., Jarosik-Michalak, A. (2024). The role of a leader in shaping employee behaviour in the VUCA/BANI world. *Journal of Modern Science*, 56(2), p. 504. DOI: 10.13166/jms/188913
16. Rosalska, M. (2022). *Czy Twój zawodowy świat też jest (do) BANI?* EPAL-Elektroniczna Platforma na rzecz uczenia się dorosłych w Europie, <https://epale.ec.europa.eu/pl/blog/czy-twoj-zawodowy-swiat-tez-jest-do-bani>, 12/09/2025.

17. Sidor-Rządkowska, M. (2022). VUCA or BANI?—the challenges of human capital management in post (?) pandemic times. *Zeszyty Naukowe. Organizacja i Zarządzanie*, 159. Politechnika Śląska, 393-402. DOI: 10.29119/1641-3466.2022.159.31.
18. Skarbek, R. (2023). *Świat VUCA i BANI: zarządzanie zmianą i celami. Niepewność i złożoność*, <https://www.empowerment-coaching.com/post/swiat-vuca-i-wyznaczanie-celow>, 12/09/2025.
19. *Style zarządzania zespołem, które powinien znać każdy manager* (2023). Akademia Leona Koźmińskiego, <https://www.kozminski.edu.pl/pl/review/style-zarzadzania-zespolem-ktore-powinien-znac-kazdy-manager>, 12/09/2025.
20. Sudół, G.K. (2024). Bezpieczna szkoła – rola i zadania organów zarządzających. *Rocznik Administracji Publicznej*, 10. DOI: <https://doi.org/10.4467/24497800RAP.24.021.20239>, p. 360.
21. Szymczyk, J. (2022). *Style przywództwa - jak można zarządzać przedsiębiorstwem?* Poradnik Przedsiębiorcy, <https://poradnikprzedsiębiorcy.pl/-style-przywodztwa-jak-mozna-zarzadzac-przedsiębiorstwem>, 12/09/2025.
22. Tantasit, R. (2025). National Language under VUCA and BANI World: The Predicament of Teaching Thai Language and Perspectives from Southern Thailand Educational Institutions. *Journal of Education Culture and Society*, 16(1), 963-983. DOI: <https://doi.org/10.15503/jecs2025.2.963.983>.
23. Taskan, B., Junça-Silva, A., Caetano, A. (2022). Clarifying the conceptual map of VUCA: a systematic review. *International Journal of Organizational Analysis*, 30(7), 196-217. DOI: <https://doi.org/10.1108/IJOA-02-2022-3136>.
24. Teacher's Charter Act of 26 January 1982 r. (Journal of Laws of 2024, items 986 & 1871 and of 2025, items 620 & 1019).
25. Tshetshe, Z. (2025). Recognising 'Being' in the BANI world. *International Journal for Multidisciplinary Research (IJFMR)*, 7(1), pp. 1-9.
26. *What is Affiliative Leadership? The "People First" Approach*, <https://status.net/articles/affiliative-leadership/>, 12/09/2025.
27. Ziarko, J. (2024). Uwarunkowania zarządzania problemami bezpieczeństwa w świecie VUCA. *Bezpieczeństwo. Teoria i Praktyka*, 54(1), 23-41. DOI: 10.48269/2451-0718-btip-2024-1-001

USING VALUE-BASED MARKETING MESSAGES TO PROMOTE SUSTAINABLE CONSUMER BEHAVIOUR ON THE FOOD MARKET

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Purpose: The purpose of this study is to empirically analyze the value references embedded in the marketing messages of selected food brands. It focuses on manufacturer brands and the private labels of Poland's two largest retailers – Biedronka and Lidl – across dairy products and their plant-based counterparts. The objective is to identify the dominant values in brand communication and determine how these differ by product type.

Design/methodology/approach: The study was based on the methods of case study and content analysis of selected food promotional messages in terms of the overt and covert appeals to values they contain (as conceptualised by Cieciuch, Schwartz, 2018). The focus was on messages about dairy products and their plant-based alternatives, broadcast on in Poland. Both the verbal layer of the messages and their visual side were analysed and evaluated. The content analysis was complemented by an exploration of the world literature and empirical research in this area.

Findings: Analysis of the marketing messages of brands of traditional dairy products and their plant-based substitutes reveals clear differences in the values exhibited. The former focus on tradition and safety and make stronger use of ethnocentric and conservative narratives, which reinforces their position as guarantors of stability and quality. Plant-based brands, on the other hand, are more likely to appeal to hedonism, openness to change and ecological universalism, willingly combining pleasure with encouraging variety in their culinary experiences. Interestingly, values from the area of transcending oneself, such as caring, tolerance or ecological universalism communicated explicitly in terms of environmental responsibility, appear infrequently, which may be due to insufficient market readiness for ideological communication.

Research limitations/implications: The study was limited to online campaigns in Poland, which constrains generalisability. Further comparative research across media, product categories and cultural contexts would enhance understanding of value communication strategies.

Originality/value: The findings highlight that the effectiveness of communication using value appeals will depend on the authenticity of the message and the consistency of the brand's actions with the declared values and the sharing of these values with the target segment.

Keywords: food products, sustainable food behaviours, values, online marketing communication.

Category of the paper: Research paper.

1. Introduction

Contemporary marketing communication is increasingly moving beyond the realm of communicating functional product attributes to focus on emotional, identity and axiological aspects. One important area of interest for marketing researchers and practitioners is now becoming the role of values in marketing communication (see Bernytė, 2018; Taufique, 2022; Kolwas, Domanski, 2023). In marketing, values are understood as essential components of the brand narrative, the use of which contributes to creating deeper connections with consumers (Altkorn, 2001; Keller, 2012). Messages referring to specific values can have an informational, persuasive or competitive function (Wiktor, 2013). The literature indicates that consumers are more likely to choose brands that resonate with their own beliefs and lifestyles (Kotler, Kartajaya, Setiawan, 2017). Values not only determine consumer attitudes and decisions, but can also be an important part of brand construction and narrative. In particular, it seems important to understand how values are present and communicated in marketing messages, and how they influence brand perception and purchasing behaviour.

This article attempts to empirically analyse the marketing messages of selected food brands in terms of the presence and type of value references appearing in them. Both manufacturer brands and private labels of the two largest retail chains in Poland - Biedronka and Lidl - were analysed, focusing on dairy products and their vegetable equivalents. The aim of the study was to identify the values that dominate the brands' communication. In addition, an attempt was made to identify how they are differentiated according to the type of product. The study was based on a content analysis and a comparative analysis of selected food advertising messages in terms of the overt and covert appeals to values they contain (as conceptualised by Cieciuch, Schwartz, 2018).

2. Schwartz's value model

Consumers' behaviour in the market is not only driven by the needs they feel, but also by the values they hold in their lives. In psychology, values are understood as certain kinds of preferences, whether realised or not, that determine human perception or action. They are assumed to have a motivational meaning - they are a force that motivates people to behave in different ways or are a manifestation of motivation (Cieciuch, Schwartz, 2018). In Schwartz's terms, values are defined as the cognitive representation of a 'motivational, desirable, supra-situational goal' (Cieciuch, 2013). At the same time, he points to six main characteristics of values (Alaminos-Fernández et al., 2023):

- they are beliefs related to affect,
- they refer to desirable goals that motivate action,
- they transcend specific situations and actions,

- guide the evaluation of actions, people and events,
- are ordered in order of importance,
- given order of importance guide action.

In his model, Schwartz proposes a circular structure of values (cf. Figure 1) indicating that values are not categories isolated from each other, but are interrelated.

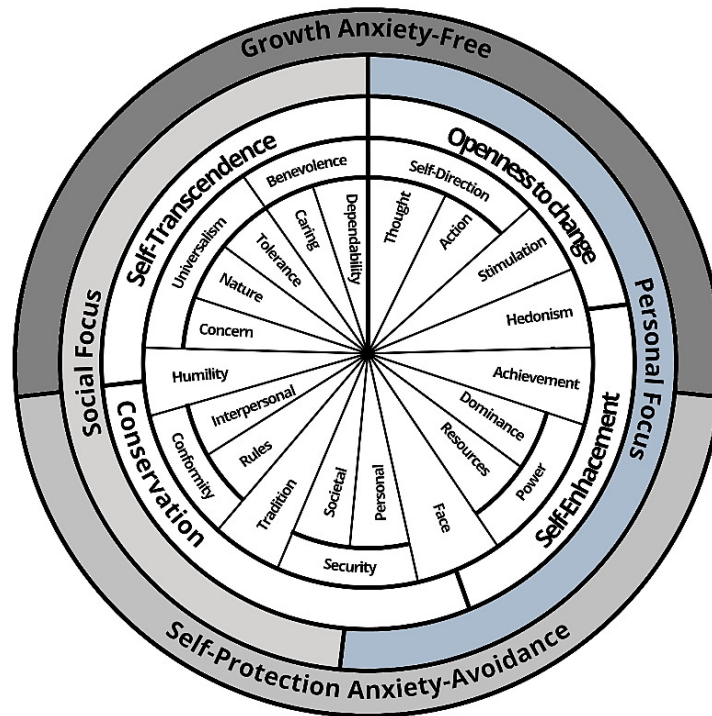


Figure 1. Modified Schwartz value circle.

Source: (Schwartz et al., 2012).

The values in the wheel are ordered according to rules of congruence and conflict. Adjacent values are co-executable due to the fact that they represent similar goals. In contrast, values on opposite sides of the circle represent conflicting goals and as such are not co-executable. The similarity between values thus decreases as the distance between them increases in location on the circle (Cieciuch, 2013; Cieciuch, Schwartz, 2018).

Schwartz's initial 1992 model included 10 basic universal values: self-direction, stimulation, hedonism, achievement, power, security, adaptation, tradition, benevolence and universalism. These form four groups: transcending self, empowering self, openness to change and conservatism. The borderline value is hedonism, which falls into two adjacent groups. In addition, the four groups represent the extremes of two dimensions - the first is transcending the self, versus strengthening the self, and the second is openness to change versus conservatism (Cieciuch, 2013). In 2012, the traditional division was modified, distinguishing an additional nine values in the circle. A summary of all values with their definitions is included in Table 1.

Table 1.
Characteristics of values in the modified Schwartz model

Group of values	Value	Definition	Focus
openness to change	self-direction-thought	independence of thought; freedom to explore and choose one's own ideas and develop one's own skills; forming one's own view of the world	personal ("I")
	self-direction-action	independence to make decisions and pursue own chosen goals; freedom to choose action	personal ("I")
	stimulation	changeability, novelty, excitement	personal ("I")
self-enhancement	hedonism	pleasure, sensual gratification	personal ("I")
	achievement	personal success achieved in accordance with social standards	personal ("I")
	power-dominance	power over people, exercising control over people	personal ("I")
	power-resources	power over resources, control of material and social resources	personal ("I")
	face	maintaining and protecting one's public image, social status, avoiding humiliation	personal ("I")
conservation	security-personal	security in one's immediate environment	personal ("I")
	security-societal	security and stability in society	social ("others")
	conformity-rules	compliance with rules, law (also formal requirements of those in authority)	social ("others")
	conformity-interpersonal	avoidance of hurting and annoying other people	social ("others")
	tradition	acceptance and maintenance of the customs, ideas and traditions of one's own culture, religion or family; respect for tradition	social ("others")
	humility	recognition of the smallness of one's place in the world and in history	social ("others")
self-transcendence	benevolence-dependability	being a reliable, trustworthy member of the group	social ("others")
	benevolence-caring	concern for the welfare of other group members	social ("others")
	universalism-concern	striving for equality, justice and the well-being of all people	social ("others")
	universalism-nature	environmental protection, nature conservation	social ("others")
	universalism-tolerance	acceptance and understanding of others who are different from oneself	social ("others")

Source: own elaboration based on (Cieciuch, 2013; Gauthier et al., 2020; Schwartz et al., 2012).

Consumers' value system influences not only their attitudes, but also their market behaviour and purchasing decisions. Schwartz's value theory is widely used in food consumption research (Barthes, 2018; Bryla, 2021; Grunert et al., 2014; Olsen et al., 2016; Puska, 2019; Sihvonen, Luomala, 2017). To date, value associations have been shown with (after: Bryla, 2021):

- convenience food consumption (related to values motivating people to seek new experiences, act independently and enhance their own personal interests),
- consumption of organic food (associated with values such as safety, hedonism, universalism, benevolence, stimulation, self-direction and conformity),
- the choice of healthier eating practices in the broadest sense (linked to values such as achievement, tradition or universalism).

Given that consumer behaviour is not only conditioned by their value system, but can also be influenced by marketing communication activities, it is worth incorporating the value motif into the messages used to stimulate more sustainable consumption. In the next section, existing research related to this issue will be discussed.

3. Value motifs in communication messages and sustainable consumption

Sustainable consumer behaviours (a.k.a. pro-environmental or environmentally responsible behaviours) are behaviours undertaken by consumers with the intention of reducing negative and/or positive environmental impacts (Gallo et al., 2023; Ghaffar et al., 2023; Irfan, Bryla, 2025). Increasingly, in addition to environmental impacts, the social dimension of consumption is also taken into account by pointing to the concept of socially responsible consumption, which implies consumer behaviour and purchasing decisions that prevent or minimise not only environmental but also social problems (Lee, Cho, 2019).

In the case of food consumption, the catalogue of sustainable behaviours can include (Nestorowicz et al., 2024):

- limiting the consumption of commodities whose production largely contributes to environmental degradation, such as foods of animal origin, especially red meat or dairy,
- buying and consuming meat, fish, eggs from ethical farms where animal welfare is taken care of,
- buying and eating certified products (e.g. organic food, fair trade),
- buying food mainly from local suppliers/farmers and choosing mainly seasonal fruit and vegetables when shopping,
- buying only the amount of food that will be eaten before the products expire or spoil,
- buying food without unnecessary packaging or in environmentally friendly packaging,
- buying and using products with a short shelf life so that they do not go to waste; and sharing food when you have too much.

Sustainable behaviour in the food market is therefore not only related to dietary and shopping choices, but also to what happens to leftover food or the waste that food consumption generates. Due to the limited volume of the article, the authors will focus their analysis on behaviours related to reducing the consumption of animal products, in particular the substitution of dairy for its plant-based counterparts, as well as the choice of products identified with higher quality values, such as organic or locally produced food.

As indicated earlier, people's values are an important motivating force for certain behaviours, including environmentally sustainable behaviours, constituting - together with beliefs and norms - their main antecedents (Lima et al., 2024). In relation to Schwartz's values model, research (Lee, Cho, 2019) has shown that benevolence and universalism have a positive impact on socially responsible consumer behaviour, while achievement and power interact negatively. Consequently, interest in social status, prestige, power, authority and wealth decreases the tendency to engage in this type of behaviour, while concern for the well-being of all people, world peace and living in harmony with nature increases the propensity.

Consumer values are used in various marketing activities, e.g. as one of the criteria in segmentation processes and also as the basis of communication and advertising strategies (Olsen et al., 2016). Extensive communication and sales activities are used to stimulate demand

for specific food products. A special role in the context of shaping pro-environmental eating behaviour is played by any communication activity that aims to encourage consumers to choose a more environmentally sustainable diet or to deal appropriately with the food they buy and the waste resulting from its consumption. Appealing to values in communication activities can draw an individual's attention to the need to engage in a particular pattern of behaviour and support them in making pro-environmental and pro-social decisions, including in their food consumption (Campbell-Arvai et al., 2014).

Communication messages, particularly advertising messages, are designed to attract the attention of the recipient and then, through an appropriately designed appeal, encourage a specific action or behaviour (Rogala, 2011). The inclusion in the message (in an indirect or direct, overt or covert manner) of values consistent with the consumer's value system seems to be the right direction in the context of increasing the effectiveness of the impact of the message and evoking specific reactions on the part of the recipient. Previous research in this area yields interesting findings. According to research (Gauthier et al., 2020), for the effectiveness of advertising, in addition to the congruence between advertising messages and the values of the target group (including cultural values), the congruence between the values included in the advertising message and the values activated by consumers is essential (Gauthier et al., 2020). When creating value congruent messages, practitioners should first identify the values of the target audience (Fischer et al., 2021) and then create a message based on the framing that has the greatest potential to stimulate specific behaviours. Research in the area of sustainable consumer behaviour indicates that combining different forms of framing (e.g. self - other framing, positive - negative framing) has the greatest potential in this regard (Florence et al., 2022).

In the case of so-called green advertising, activating an appropriate response towards sustainable behaviour is conditioned by several factors. These include the nature of the message (including the type of green behaviour promoted), the profile of the consumer (including their values), and the context (e.g. culture or social norms) (Lima et al., 2024). Appealing to the value system is thus one possible means of influencing the upscaling of sustainable consumption. For example, with regard to ethical products, the values held by the consumer determine the level of receptivity to their advertising, which consequently influences their willingness to purchase (Osburg et al., 2019). In the following section, the authors will analyse the phenomenon of incorporating appeals to values in the marketing communication of selected brands of dairy products and their plant-based alternatives.

4. Research methodology

Considering food production, the dairy industry is one of the most negatively impacting on the environment. Indeed, it contributes to significant greenhouse gas emissions, water and land

consumption (Crippa et al., 2021; Finnegan, Goggins, 2021; Intergovernmental Panel on Climate Change, 2019). On the other hand, dairy products such as milk, yoghurt and butter are one of the most frequently chosen product categories and constitute an important component of many societies' diets (Hawashin et al., 2025). Consequently, it is becoming an important challenge to meet the growing demand for these goods, with the need for greater environmental sustainability in their production (Ivana, Puvača, 2024; Peterson, Mitloehner, 2021). Changes in the area of consumption related to reducing dairy products in the diet, choosing organic versions or plant-based substitutes are one promising solution (Kumar, Choubey, 2023; Pocol et al., 2020; Randall et al., 2024), especially with the assumption of supporting consumers on their path towards more sustainable consumption using modern technologies (Nestorowicz et al., 2024).

In this article, the communication messages of selected dairy product brands broadcast in various media were analysed. The choice of this product category was dictated by both the importance to consumers and the environmental impact of their production. The analysis was narrowed down to products such as natural and fruit yoghurts and plant-based yoghurts and milk equivalents as the most common consumer choices. Sales in the category of plant-based dairy substitutes are growing dynamically year on year, with the discounters' private labels dominating (Listonic Ads, 2024b), which is why the Go Vege (Biedronka) and Vemondo (Lidl) brands were also included in the analyses. The communication of the most popular brands on the Polish market was analysed in detail (Listonic Ads, 2024a, 2024b):

- in the case of private labels - Mleczna Dolina, FruVita and Go Vege from the Biedronka offer and Pilos and Vemondo from the Lidl offer,
- for other brands - Zott, Jogobella, Bakoma, Piątnica and Alpro.

As mentioned earlier, plant-based dairy substitutes, including plant-based drinks, are the best-selling category in discounters, hence the dominance of Biedronka and Lidl's private labels. However, in addition to private labels, the Alpro brand (Danone) also occupies an important place in this product category, hence its inclusion in the analyses (Pankowiak, 2024).

In the next step, the authors collected advertising messages from brands' social media profiles (e.g. Facebook, Instagram, YouTube) and websites. This content was analysed in detail, according to the criteria adopted earlier:

- frequency of product mentions on the website and social media,
- the presence of values in the message,
- nature of references to the consumer (e.g. educational, informative, emotional),
- the presence and type of calls to action (e.g. try, dare, explore),
- the visual presentation of the product,
- modes of argumentation used in advertising messages,
- language used in advertising communication.

Each material was independently analysed by the authors, who assessed the content based on predetermined criteria. Once the independent assessments were completed, the inter-rater agreement (IRA) was calculated, yielding a satisfactory level of consistency across all coded dimensions. The results were then compared and verified. The focus was on identifying

recurring patterns and trends in the communication of the brands under study, which ensured the objectivity and reliability of the results. Based on the verified results, a synthesis of the results was carried out to isolate the key communication strategies used by the brands under study and to identify the values present in them.

5. Discussion of results

In the first step, private labels - Mleczna Dolina, FruVita and Go Vege (brands from the Biedronka discount store) and Pilos and Vemondo (from the Lidl offer) were analysed. In the case of Biedronka's private labels, the chain's social media profiles on Facebook, Instagram and Youtube platforms, as well as its website, were analysed. In social media, publications from a 12-month period (March 2024-March 2025) were taken into account. It was noted that the Biedronka chain devotes relatively little attention in its communication activities to the brands analysed in the article. In the case of the brand's official profile on Instagram, only 5 posts are related to private label dairy products. For the Fruvita brand product, it emphasises the nutritional values and the simple composition. In the case of the low-carbohydrate product series, the social media communication is worth highlighting the reference to personal focus related to self-enhancement. An example of this communication is presented in Figure 2.



Figure 2. Example of a message referring to values related to self-enhancement¹.

Source: Biedronka brand profile on Instagram.

¹ 🍌 A filling breakfast? ☐ With Fruvita yogurts and skyr! ☐

Add some granola or muesli, a handful of your favorite nuts and dried fruit, plus fresh fruit, and enjoy a perfect meal. 🥰🥰🥰

So, what do you prefer – yogurt or skyr? ☐

#biedronka #fruvita #skyr #jogurt #dairy #breakfasttime #breakfast #morningmeal

Biedronka's website presents only informative messages, focusing on brief product descriptions. The information provided under 'Private labels' presents a brief description of the product, along with promotional messages and information relating to taste and nutritional qualities. For some of the brands, slogans or promotional slogans were identified that can be classified as messages relating to the values discussed in the theoretical chapter. A summary of these is presented in Table 2.

Table 2.

Analysis of the values communicated by Biedronka's private labels

Private label	Message	Identified value
Fruvita	"Everyone has their own taste"	self-transcendence - universalism - tolerance
Fruvita Pure	"Pleasure itself - just indulge"	self-enhancement - hedonism
Milk valley	"New packaging - same taste"	conservation - tradition, security-personal
Go Vege	"The plant challenge"; "You have the right to decide what you eat"	1. Openness to change - stimulation; self-transcendence - universalism-nature. 2. Self-transcendence - universalism - tolerance; openness to change - self-direction-action

Source: own compilation based on: www.biedronka.com (read 23.03.2025).

An analogous analysis was conducted for Lidl's private labels - Pilos and Vemondo. Its effects are presented in Table 3.

Table 3.

Analysis of the values communicated by Biedronka's private labels

Private label	Message	Identified value
Pilos	"All the best from milk"	conservatism - tradition
Vemondo	"Say YES to plant-based products"	openness to change - stimulation; self-transcendence - universalism-nature

Source: own compilation based on: www.lidl.pl (read on: 23.03.2025).

It is worth noting that, unlike Biedronka's private labels of dairy products, Lidl's brands do not refer to values in their marketing messages published on the website. However, it should be noted that the Vemondo brand explicitly encourages consumers to take action (call to action), while Pilos emphasises the animal origin of the products. The messages themselves therefore leave no room for misinterpretation of the products' composition and reduce the potential for consumer error. This distinction is also evident in the visual sphere, where Vemondo products are dominated by the colour green and Pilos by the colour white, together with coloured visual elements denoting the individual flavours.

Also in the case of Lidl's private labels, only a few messages published on the Facebook and Instagram channels refer to dairy products. It is worth noting that by far more messages refer to high-protein products (3 messages in January-March 2025) and lactose-free products (2 messages).



Figure 3. Example of a message highlighting product composition².

Source: Lidl brand profile on Instagram.

It is also worth noting that dairy product messages, if present on the profile, appeal to ethnocentric attitudes, highlighting the local origin of the products (Figure 4).



Figure 4. Example of a message emphasising the origin of a product³.

Source: Lidl brand profile on Instagram.

Private label dairy product messages also explicitly refer to traditional taste, focusing around values such as conservatism and tradition (Figure 5).

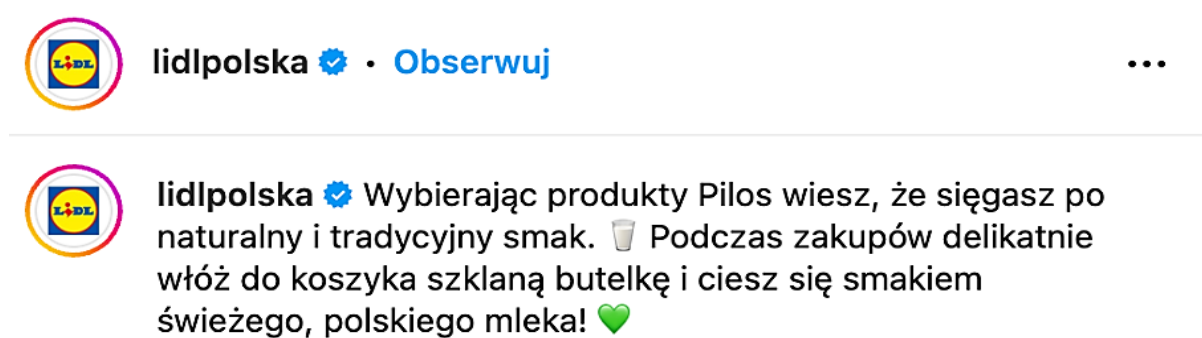


Figure 5. Example of a message appealing to tradition⁴.

Source: Lidl brand profile on Instagram.

² 🌱 Plant-based smoothies from Vemondo come with no added sugar, so maybe we should sweeten them up a little? ☐

Let us know what compliments come to your mind for them. 🗣️

Let them blush! 😊❤️

#Lidl #LidlPolska #Vemondo #smoothie #vege #veganuary #fruits

³ Cottage cheese from your region? Now you can find it at Lidl! 🛒 It's Regional Week, so when you go shopping at Lidl, don't forget to grab the cheese available in your area! ☐🌟

#Lidl #LidlPolska #RegionalWeek #cheese #cottagecheese

⁴ By choosing Pilos products, you know you're reaching for a natural and traditional taste. ☐ While shopping, gently place a glass bottle in your basket and enjoy the taste of fresh Polish milk! 🍷

It is worth noting that only one brand (Go Vege) directly refers in its communication to values defined as ecological universalism. In the case of the others, the messages emphasise encouraging people to take action or 'push the boundaries'.

In the second part of the analysis, attention was focused on widely distributed retail brands. These brands were: Zott, Jogobella, Bakoma, Piątnica and Alpro. Table 4 presents a summary of the marketing slogans used by the above brands on their official websites.

Table 4.

Summary of marketing slogans for brands Zott, Jogobella, Bakoma, Piątnica and Alpro

Private label	Message	Identified value
Jogobella (Zott)	"Deliciously fruity yoghurt with extra large chunks of fruit that will give you a juicy portion of joy every day."	self-enhancement - hedonism
Jogobella Vege (Zott)	"Jogobella in a vegan version is a delicious alternative for all fans of plant-based products. The combination of coconut cream with extra-large pieces of fruit provides a fullness of flavour exactly like the classic version of Jogobella."	self-enhancement - hedonism; conservatism - security-personal
Zott Protein	"Zott Protein - always a win-win."	self-enhancement - achievement
Bakoma Bio	"Appetising snacks created from fresh milk and ripe Polish fruit."	conservation - tradition; conservation - security-personal
Ave Vege (Bakoma)	"Welcome to the plant-based side of life. "Awaken your appetite for life".	1. Openness to change - stimulation; self-transcendence - universalism-nature 2. Openness to change - stimulation; self-enhancement - hedonism
Piatnica	"For those who need to recharge their batteries and for those who simply want something delicious: yogurts of various textures with a variety of tasty additives".	conservatism - security-personal; self-enhancement - hedonism
Piatnica Roślinna	"They work well wherever traditional milk is used".	conservatism - tradition; security-personal
Alpro	"Turn up your breakfast"; "Vegetable doesn't bite".	1. openness to change - self-direction-action 2. self-transcendence - universalism - tolerance;

Source: own compilation based on the websites of the brands surveyed.

It is worth noting that two of the surveyed brands (Ave Vege and Alpro) have separate websites and social media channels. In the case of the other brands, the communication somewhat resembles the communication strategy of private labels - messages encouraging change, focused on the 'I' and one's own experiences stand out. Among the traditional products, as in the case of private labels, references to the region or country of origin of the milk, and to nutritional and taste values stand out. Contrary to expectations, in the case of vegan products it is in vain to find references to environmental values. Such information is available, but not at the product level, but at the level of the company-wide strategy. The exception in this respect is the Alpro brand, which communicates the environmental impact of the product (Figure 6). In the case of the other plant-based dairy counterparts, the taste qualities are mainly emphasised. When analysing the content of marketing messages, their educational role in the area of changing consumer habits is also clearly visible - in the case of vegan products, recipes

and methods of use dominate, while in the case of dairy products, references to the origin of the products' components, traditions and taste qualities attract attention.



Figure 6. Example of appeal to organic universalism⁵.

Source: Alpro brand profile on Instagram.

During the research, values appearing in messages on pages or subpages dedicated to individual brands were also analysed (Table 5). It is worth noting that the main messages of the brands analysed are largely dominated by conservative and self-enhancement values. Values related to openness to change are less prominent in the messages, while values related to transcending oneself are the least frequent. It is interesting to note that the main narrative line of all the brands surveyed, on their websites or sub-sites, basically omits values directly related to ecology, with only subtle references expressing themselves by emphasising the plant-based origin of the product. Above all, there are no explicit references to environmental issues, animal welfare or social responsibility. This may be surprising, especially in the context of the growing importance of sustainable consumption in the literature (White, Habib, Hardisty, 2019; Vergura et al., 2023). The absence of such a narrative presumably may be due to fears of over-ideologising the message or a belief that the market is not mature enough to adopt pro-social attitudes as a primary purchase motive.

⁵ DELICIOUS
HEALTHY*
GOOD FOR THE PLANET
#switch to alpro

Table 5.*The messages of the brands surveyed on their websites or subsites*

Brand	Website website/sub-site	Messages	Identified value
Fruvita	subpage (biedronka.pl)	1. The No. 1 yoghurt brand in Poland, recognised with the Good Brand 2022 label. 2. Discover a wealth of delicious yogurts for everyone, whatever your needs. Natural and with fruit. Creamy and drinkable. Large and small. Find your favourite flavour and type for every occasion. 3. All Fruvita yoghurts are produced in Poland. They are created in cooperation with the best producers from selected Polish milk and the highest quality delicious fruit.	1. self-enhancement – face, 2. openness to change - self-direction-action, self-transcendence - benevolence - caring, universalism - tolerance, 3. conservation - security-personal / conservation – tradition
Fruvita Pure	subpage (biedronka.pl)	1. Everyone has their own taste. 2. Polish milk. Every day we take care to offer you the highest quality. 3. Drinking yoghurts. Simple composition. 4. Yoghurts in a cup. Fruvita Pure is just two ingredients, with no added sugar.	1. self-transcendence - universalism – tolerance, 2. conservation - tradition, self-transcendence - benevolence - caring, conservation - security-personal, 3. conservation - security-personal, 4. conservation - security-personal
Milky Valley	subpage (biedronka.pl)	1. New packaging. Same taste.	conservation - tradition / conservation – security-personal
GoVege	subpage (biedronka.pl)	1. Taste grows with GoVege. 2. We take care to offer you the highest quality every day.	1. self-enhancement – hedonism, 2. conservation - security-personal
Pilos	subpage (lidl.pl)	1. Delicious, because it's Polish! Choose products with the "Polish Product" label to support regional dairies and enjoy traditional flavours. 2. Delicious, because made with Polish milk! More than 100 products made from Polish milk. Simple recipe and traditional taste. 3. Delicious because diverse! Some Pilos products are awarded with unique certificates.	1. conservation - tradition, self-transcendence - benevolence – caring, 2. conservation – tradition, 3. openness to change - stimulation, conservation - security-personal, self-transcendence - universalism – tolerance

Cont. table 5.

Vemondo	indication on the subpage (lidl.pl)	1. Say YES to plant-based products! Are you vegan? Are you looking for products without meat or milk? Or do you want to broaden your culinary horizons and occasionally rely on products or ready-made dishes to add variety to your daily diet? In Lidl you will find a whole range of plant-based brands with delicious offerings based on oats, coconut or legumes.	openness to change - stimulation, self-enhancement - hedonism, achievement, self-transcendence - universalism-nature
Jogobella (Zott)	subpage (jogobella.com)	1. Deliciously fruity yoghurt with extra-large chunks of fruit to give you a juicy dose of joy every day.	self-enhancement – hedonism
Jogobella Vege (Zott)	subpage (jogobella.com)	1. Fruity, plant-based and delicious.	self-enhancement - hedonism, self-transcendence – universalism-nature
Zott Protein	subpage (zott-dairy.com/en/)	1. The combination of fruit and fresh milk in our Zott Protein yoghurts is ideal as a snack between meals or as a post-workout meal. With 20g of protein per serving and no added sugar, it helps build muscle. It is gluten-free and low in fat, but still fruity and perfectly creamy!	self-enhancement - hedonism, self-enhancement – achievement
Bakoma Bio	website (bakomabio.pl)	1. Simple composition - yoghurt, fruit, cane sugar.	conservation= – security-personal
Bakoma Ave Vege	website (avevege.pl)	1. Welcome to the plant-based side of life. Try introducing more plant-based joy into your diet today. Ave Vege is full of delicious and light variants and flavours created with 100% plant-based ingredients. Discover them all and expand your natural appetite for life. 2. We contain no boredom or unnecessary calories. 3. We have plenty of variants without preservatives. 4. We restore vitality without lactose or gluten.	1. openness to change - stimulation, self-enhancement - hedonism, self-transcendence - universalism-nature, 2. conservation – security-personal, self-enhancement – hedonism, 3. conservation - security-personal, openness to change – stimulation, 4. conservation – security-personal, self-enhancement – achievement
Piatnica	website (https://piatnica.com.pl/)	1. Naturally from here. From Piatnica, well from where. 2. River topic. The best flavours from the banks of the Narew River. 3. Breakfast is a must. You have to eat in the morning, so do not begrudge yourself delicacies from Piatnica!	1. conservation - tradition, self-transcendence - universalism-nature, 2. conservation - tradition, self-enhancement – hedonism, 3. conservation - tradition, self-enhancement - hedonism

Cont. table 5.

Piatnica Roślinna	subpage (https://piatnica.com.pl/) ⁶	Delicious, 100% natural vegetable drinks from Piatnica will work well wherever traditional milk is used. Great for coffee, cereals, smoothies and baked goods. Find them in the shop fridge - you will definitely recognise our characteristic bottle with a handle!	conservation - security- personal, conservation - tradition, self- transcendence - universalism-nature
Alpro	website (alpro.com)	1. Boost your breakfast - mmm! We encourage you to try delicious breakfast recipes that will turn your morning up! Find out how to start your day simply and deliciously using plant-based products! 2. There are so many plant-based products waiting for you. 3. Plant-based doesn't bite. Plant-based tastes good! We encourage you to enter the world of plants with us, where you will see that plant-based products do not bite, but taste delicious.	1. openness to change - stimulation, self- transcendence – universalism-nature, 2. openness to change - stimulation, self- transcendence - universalism-nature, 3. conservation - security- personal, self- enhancement - hedonism, self- transcendence - universalism-nature

Source: own elaboration based on: (Biedronka, 2025a, 2025b, 2025c, 2025d; Lidl, 2025a, 2025b; Jogobella, 2025a, 2025b; Zott, 2025; Bakoma Bio, 2025; Bakoma Ave Vege, 2025; Piatnica, 2025a, 2025b; Alpro, 2025).

An interesting phenomenon evident in the messages appearing on the websites is the differentiation of values according to the nature of the product. Standard dairy brands are more likely to emphasise personal security and tradition, while plant-based brands are more likely to use the values of stimulation and hedonism in their messages - offering change, freshness and alternatives to traditional habits. The use of different strategies demonstrates the diversity of market expectations and the need for segmentation. From this angle, it is also interesting to note the emergence of messages containing elements representing opposite values (e.g. security and stimulation). This may be a deliberate effort to combine stabilising values with those favouring change in order to interact more effectively with diverse audiences and minimise the risk of excluding any of them. A large proportion of messages not only convey values, but also have an educational function. This is particularly evident in the case of plant-based brands. The messages often contain instructions and suggestions for the use of the products, which can have a supportive function in the process of changing eating habits. The values of stimulation, self-direction-action and universalism-nature are thus not only present here declaratively, but supported by communication activities that facilitate their realisation.

⁶ The manufacturer invites you to visit the brand website <http://www.piatnicaroslinna.pl/>, but as of 25.03.2025 the link is inactive.

6. Summary

Analysing in detail the values that appear in the communication of the brands, it is possible to notice differences between the content for traditional and plant-based products (Figure 7). Content for traditional products very often refers to tradition and personal safety. In contrast, the most frequently appearing values for plant-based products are universalism-nature and hedonism. It is also worth noting the slightly different approach to communication in terms of the range of emerging values among private labels and manufacturer brands, particularly for traditional products. Private label communication is to some extent more differentiated in this respect. The situation is the opposite for plant-based products, but there similar values are more often communicated among own and manufacturer brands.

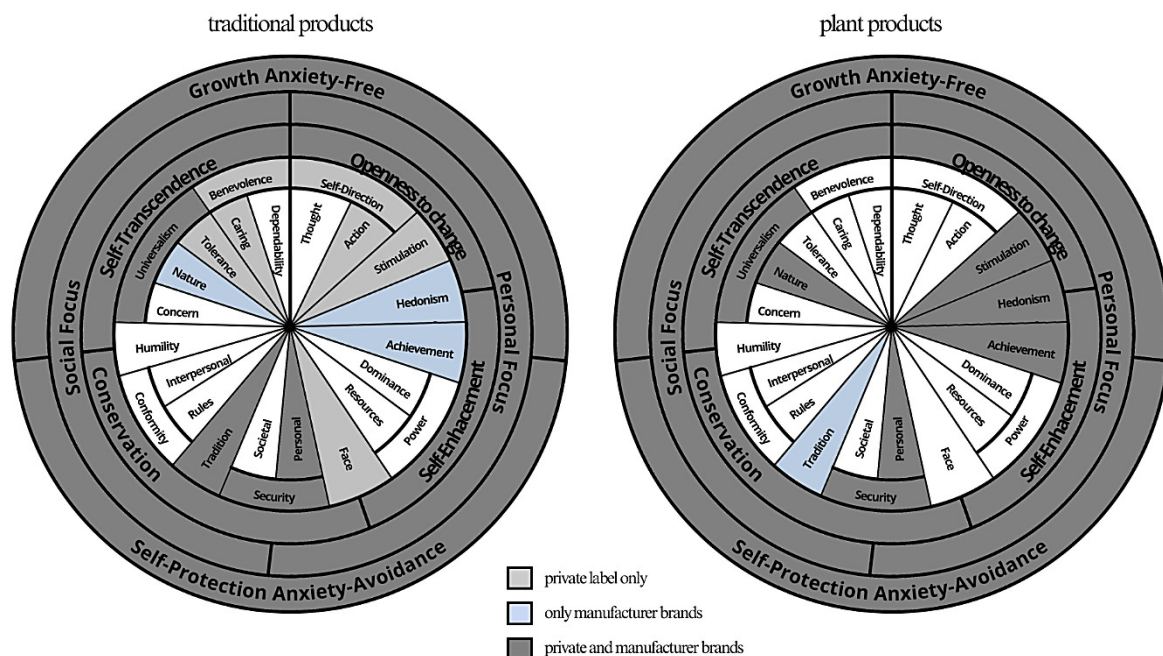


Figure 7. Values communicated by the brands surveyed, divided into traditional and plant products.

Source: own elaboration.

In the communications of the surveyed brands, a clear domination of values from the area of conservatism, especially tradition and personal security, is noticeable. These types of values appear first and foremost in the communication of dairy product brands such as Mleczna Dolina, Pilos, Piątnica and Bakoma Bio. Their content is mainly centred around the constancy of taste, the origin of milk from Poland, the simplicity of composition or the maintenance of known quality standards. In the context of Schwartz's model, these values play a kind of stabilising role - they respond to consumers' needs for security and predictability, which is particularly important in collectivist cultures and with a high avoidance of uncertainty (Schwartz, 2012; Cieciuch et al., 2014). Among Polish consumers, the adoption of such a strategy may therefore serve to build trust in an unstable and rapidly changing world. This is often further reinforced by components related to consumer ethnocentrism, which are

present in the messages of brands such as Pilos or Fruvita ('Produkt Polski', 'z polskiego mleka'). This leads to the reinforcement of narratives of safety and reliability, as well as supporting consumers' belief in the 'natural' advantage of local products and the need to support the national or regional economy (Cleveland, Laroche, Papadopoulos, 2009; Balabanis, Siamagka, 2022).

The brands analysed are also keen to apply values related to self-enhancement, in particular hedonism and achievement. Such messages appear, for example, in the brands Jogobella, Zott Protein, Fruvita Pure, Ave Vege or Alpro. They aim to highlight sensory experiences, enjoyment of consumption and convenience of use, as well as functional benefits (e.g. Zott's high-protein products or Ave Vege's lactose-free yoghurts). In the context of contemporary consumer culture, where food choices often play a role as an element of self-expression and lifestyle (Enriquez, Archila-Godinez, 2022), hedonistic and achievement-related values have an important motivational function (Wulandari, Putri, 2023). It is also worth noting that functional brands, such as Zott Protein, combine hedonism with an achievement component in their messages, building the image of the product as a tool to support success and goal achievement. This is particularly evident in messages relating to nutritional components, such as protein content, lack of sugar or the presence of quality certificates. This type of strategy can be interpreted as a form of „healthy selfishness” – consumption focused on self-care, embedded within the framework of one's own well-being (Kaufman, Jauk, 2020; Próchniak et al., 2025).

On the other hand, values from the area of openness to change appear mainly in messages about plant-based products, especially brands such as Go Vege, Vemondo, Alpro or Ave Vege. They appear in the form of incentives to experiment with diet, discover new flavours or make lifestyle changes ("Say YES to plant-based products", "Plant challenge", "Boost your appetite for life"). These messages are meant to stimulate the recipient to seek out new sensations and emotions, as well as being a kind of invitation to make new decisions. They can be interpreted as an invitation to change and to break the routine of eating and shopping. At the same time, these messages are part of the current of contemporary marketing, where the product is not only supposed to lead to the satisfaction of physical needs, but often also has the potential to inspire personal growth and new experiences (Kotler, Kumar, 2024; Kotler, Kartajaya, Setiawan, 2024). This may suggest that it is precisely this type of message, which combines stimulation with self-direction in action, that may have particular potential to influence consumers seeking valuable, authentic consumption experiences.

In contrast, values from the area of self-transcendence, especially universalism - concern and tolerance - are surprisingly rare. Although some communications (e.g. Fruvita, Pilos) refer to inclusivity and local community, these values are not exposed as a central element of the communication strategy. This may indicate a still limited use of pro-social narrative in the Polish food industry, which is in contradiction with the growing consumer interest in the topics of sustainability and ethical consumption (NielsenIQ, 2022). A similar situation also applies to nature universalism. Only some brands, such as Go Vege or Alpro, communicate the ideas of environmental responsibility or an ethical approach to food in any way, but even they usually

do not do so explicitly. Interestingly, plant-based brands, which intuitively could convey these values, overwhelmingly focus on taste, convenience and product appeal, leaving out the ideational aspect. However, the above observations are confirmed by the scientific literature. As White, Habib and Hardisty (2019) point out, effective pro-environmental communication requires not only the presence of information, but also a well-chosen narrative that resonates with consumers' motivations. The lack of presence of universalism in the messages analysed may also be due to marketers' belief that ideational messages are not yet sufficiently sales effective (Peattie, Crane, 2005).

It is also worth noting that there is a broader, as yet underdeveloped potential concerning the use of values in marketing communications, especially in the context of the increasing role of personalisation of messages. The modern consumer not only expects a product to match his or her functional needs, but also his or her emotional and identity needs. Tailoring advertising content to the characteristics of the consumer, including his or her value system, can contribute to the effectiveness of communication, building deeper emotional engagement, stronger identification with the brand and, ultimately, loyalty (Bajak, Spendel, 2022). Given the advanced targeting capabilities, both behavioural and psychographic, the values held by the individual consumer have particular potential in the context of hyper-personalisation. This approach makes it possible not only to deliver personalised offers, but also to communicate with the consumer at the level of their identity, beliefs and life goals (Kotler, Kartajaya, Setiawan, 2017; Blazeovich, 2021). In this case, the values held by the individual can become the foundation for developing a common ground between the brand and the consumer.

The analyses discussed in the article are not free of limitations that may affect the interpretation of the results obtained. First and foremost, the message analysis was based solely on messages published directly by the brands under study on social media and websites. In addition, the attribution of values to individual messages, despite the authors' efforts, may bear the mark of subjectivity. In order to take a broader perspective, it would be worth considering methodological triangulation in the future, combining content analysis with quantitative or qualitative research. Another limitation is the lack of direct reference to audience engagement and the effectiveness of the messages analysed. Finally, only brands operating on the Polish market were analysed, which limits the possibility of generalising the results. A potentially interesting direction for further research would be to compare the axiological communication of food brands on markets with different cultural profiles. At the same time, the above limitations can be treated as further directions of research on the subject outlined in this article.

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References

1. Alaminos-Fernández, P., Fernández, A.F.A., Alaminos, A.F. (2023). *Schwartz: Value structure in forty European societies. An exploratory approach based on Shalom Schwartz's theory*. <https://doi.org/10.13140/RG.2.2.36294.24646>
2. Alpro (2025). *Alpro*. <https://www.alpro.com/pl>
3. Altkorn, J. (2001). *Brand strategy*. Warsaw: PWE.
4. Bajak, M., Spendel, Ł. (2022). Building consumer engagement and loyalty while traversing the customer journey in the online space. *Scientific Papers of Silesian University of Technology. Organization & Management*, 160, 39-52. <https://doi.org/10.29119/1641-3466.2022.160.3>
5. Bakoma Ave Vege (2025). *Bakoma Ave Vege*. <https://avevege.pl/>
6. Bakoma Bio (2025). *Bakoma Bio*. <https://bakomabio.pl/>
7. Balabanis, G., Siamagka, N.T. (2022). A meta-analysis of consumer ethnocentrism across 57 countries. *International Journal of Research in Marketing*, 39(3), 745-763. <https://doi.org/10.1016/j.ijresmar.2021.12.002>
8. Barthes, R. (2018). Toward a psychosociology of contemporary food consumption. In: A. Julier (Ed.), *Food and culture* (pp. 13-20). Routledge.
9. Bernytė, S. (2018). Sustainability Marketing Communications Based On Consumer Values And Principles. *Regional Formation & Development Studies*, 3(26), 26-35. <https://doi.org/10.15181/rfds.v26i3.1807>
10. Blazeovich, G. (2021). Marketing automation. Towards artificial intelligence and hyper-personalization. Warsaw: PWN.
11. Bryla, P. (2021). The Impact of Consumer Schwartz Values and Regulatory Focus on the Willingness to Pay a Price Premium for Domestic Food Products: Gender Differences. *Energies*, 14(19), 6198. <https://doi.org/10.3390/en14196198>
12. Campbell-Arvai, V., Arvai, J., Kalof, L. (2014). Motivating Sustainable Food Choices: The Role of Nudges, Value Orientation, and Information Provision. *Environment and Behavior*, 46(4), 453-475. <https://doi.org/10.1177/0013916512469099>

13. Cieciuch, J. (2013). *The formation of a value system: From childhood to early adulthood*. Liberi Libri Publishing House. http://otworzksiazke.pl/images/ksiazki/ksztaltowanie_sie_systemu_wartosci/ksztaltowanie_sie_systemu_wartosci.pdf
14. Cieciuch, J., Schwartz, S.H. (2018). Measuring value in Schwartz's circular model. In: H. Gasiul (Ed.), *Methods for the study of emotions and motivation* (pp. 307-334). Difin.
15. Cleveland, M., Laroche, M., Papadopoulos, N. (2009). Cosmopolitanism, consumer ethnocentrism, and materialism: An eight-country study of antecedents and outcomes. *Journal of International Marketing*, 17(1), 116-146. <https://doi.org/10.1509/jimk.17.1.11>
16. Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F.N., Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, 2(3), 198-209. <https://doi.org/10.1038/s43016-021-00225-9>
17. Enriquez, J.P., Archila-Godinez, J.C. (2022). Social and cultural influences on food choices: A review. *Critical Reviews in Food Science and Nutrition*, 62(13), 3698-3704. <https://doi.org/10.1080/10408398.2020.1870434>
18. Finnegan, W., Goggins, J. (2021). Environmental impact of the dairy industry. In: *Environmental Impact of Agro-Food Industry and Food Consumption* (pp. 129-146). Elsevier. <https://doi.org/10.1016/B978-0-12-821363-6.00004-7>
19. Fischer, L.M., Abbot, K., Jennings, K., Meyers, C. (2021). Visualizing Values: A Content Analysis to Conceptualize Value Congruent Video Messages Used in Agricultural Communications. *Journal of Applied Communications*, 105(2). <https://doi.org/10.4148/1051-0834.2368>
20. Florence, E.S., Fleischman, D., Mulcahy, R., Wynder, M. (2022). Message framing effects on sustainable consumer behaviour: A systematic review and future research directions for social marketing. *Journal of Social Marketing*, 12(4), 623-652. <https://doi.org/10.1108/JSOCM-09-2021-0221>
21. Gallo, T., Pacchera, F., Cagnetti, C., Silvestri, C. (2023). Do Sustainable Consumers Have Sustainable Behaviors? An Empirical Study to Understand the Purchase of Food Products. *Sustainability*, 15(5), 4462. <https://doi.org/10.3390/su15054462>
22. Gauthier, C., Fornerino, M., Werle, C.O.C., Jolibert, A., Lee, M.S., Sego, T. (2020). Social and personal values in advertising: Evidence from food advertising in South Korea. *International Studies of Management & Organization*, 50(2), 174-200. <https://doi.org/10.1080/00208825.2020.1758422>
23. Ghaffar, A., Zaheer Zaidi, S.S., Islam, T. (2023). An investigation of sustainable consumption behavior: The influence of environmental concern and trust in sustainable producers on consumer xenocentrism. *Management of Environmental Quality: An International Journal*, 34(3), 771-793. <https://doi.org/10.1108/MEQ-05-2022-0153>
24. Grunert, K.G., Hieke, S., Wills, J. (2014). Sustainability labels on food products: Consumer motivation, understanding and use. *Food Policy*, 44, 177-189. <https://doi.org/10.1016/j.foodpol.2013.12.001>

25. Hawashin, D., Salah, K., Jayaraman, R., Ahmad, R.W., Kanhere, S., Damiani, E. (2025). Enhancing sustainability in dairy industry: Blockchain-based waste reduction. *Sustainable Futures*, 9, 100529. <https://doi.org/10.1016/j.sftr.2025.100529>
26. Intergovernmental Panel on Climate Change (2019). *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems*. <https://www.ipcc.ch/site/assets/uploads/2019/11/SRCCLFull-Report-Compiled-191128.pdf>
27. Irfan, A., Bryla, P. (2025). Green marketing strategies for sustainable food and consumer behaviour: A systematic literature review and future research agenda. *Journal of Cleaner Production*, 486, 144597. <https://doi.org/10.1016/j.jclepro.2024.144597>
28. Ivana, B., Puvača, N. (2024). Economic and Ecological Sustainability of Dairy Production. *Journal of Agronomy, Technology and Engineering Management (JATEM)*, 7(3), 1088-1104. <https://doi.org/10.55817/TQXU2115>
29. Jogobella (2025a). *Jogobella*. <https://www.jogobella.com/pl/nasze-produkty/detail/a/show/c/ProductLine/pl/jogobella-14/>
30. Jogobella (2025b). *Jogobella Vege*. <https://www.jogobella.com/pl/nasze-produkty/detail/a/show/c/ProductLine/pl/jogobella-vege-114/>
31. Kaufman, S.B., Jauk, E. (2020). Healthy selfishness and pathological altruism: Measuring two paradoxical forms of selfishness. *Frontiers in psychology*, 11, 1006.
32. Keller, K.L. (2012). *Strategic Brand Management: Building, Measuring, and Managing Brand Equity*. London: Pearson.
33. Kolwas, S., Domanski, J. (2023). Axiological and Praxeological Dimensions of Marketing Communication Effectiveness-A Conceptual Framework. *Foundations of Management*, 15(1), 79-88. 10.2478/fman-2023-0006
34. Kotler, P., Kartajaya, H., Setiawan, I. (2017). *Marketing 4.0: Moving from Traditional to Digital*. New Jersey: Wiley.
35. Kotler, P., Kartajaya, H., Setiawan, I. (2024). *Marketing 6.0: The Future Is Immersive*. New Jersey: Wiley.
36. Kotler, P., Kumar, V. (2024). *Transformative Marketing: Combining New Age Technologies and Human Insights*. Cham: Springer International Publishing AG.
37. Kumar, M., Choubey, V.K. (2023). Sustainable Performance Assessment towards Sustainable Consumption and Production: Evidence from the Indian Dairy Industry. *Sustainability*, 15(15), 11555. <https://doi.org/10.3390/su151511555>
38. Ladybird (2025a). *Fruvita*. <https://www.biedronka.pl/pl/fruvita>
39. Ladybird (2025b). *Fruvita Pure*. <https://www.biedronka.pl/pl/fruvita-pure>
40. Ladybird (2025c). *Milky Valley*. <https://www.biedronka.pl/pl/mleczna-dolina>
41. Ladybird (2025d). *GoVege*. <https://www.biedronka.pl/pl/go-vege>

42. Lee, J., Cho, M. (2019). New insights into socially responsible consumers: The role of personal values. *International Journal of Consumer Studies*, 43(2), 123-133. <https://doi.org/10.1111/ijcs.12491>
43. Lidl (2025a). *Pilos*. <https://www.lidl.pl/c/pilos/s10015077>
44. Lidl (2025b). *Plant-based products*. <https://www.lidl.pl/c/produkty-roslinne/s10033872>
45. Lima, P.A.B., Falguera, F.P.S., Silva, H.M.R.D., Maciel, S., Mariano, E.B., Elgaaied-Gambier, L. (2024). From green advertising to sustainable behaviour: A systematic literature review through the lens of value-belief-norm framework. *International Journal of Advertising*, 43(1), 53-96. <https://doi.org/10.1080/02650487.2023.2199668>
46. Listonic Ads (2024a). *Ranking of yogurt brands - which yogurts do Poles buy most often?* <https://ads.listonic.com/aktualnosci/jogurty-ranking/>
47. Listonic Ads (2024b). *Private label Ranking: Lidl and Biedronka 2024*. <https://ads.listonic.com/raport/ranking-marek-wlasnych-2024/>
48. Nestorowicz, R., Rogala, A., Jerzyk, E. (2024). Enhancing sustainable food consumption by the IoF. In: A. Rogala, R. Nestorowicz, E. Jerzyk, *Internet of Things in the Food Industry: Challenges and Opportunities for the Internet of Food Things* (pp. 145-159). Routledge. <https://doi.org/10.4324/9781003401421-14>
49. NielsenIQ (2022). *The changing story of sustainability*. <https://nielseniq.com/global/en/landing-page/the-changing-story-of-sustainability/>
50. Olsen, J., Atkin, T., Thach, L. (2016). *Marketing by What Matters: Using Schwartz's Theory of Basic Values to Identify Wine Consumer Segments*. 9th International Conference of the AWBR (2016), Adelaide, Australia.
51. Osburg, V.-S., Akhtar, P., Yoganathan, V., McLeay, F. (2019). The influence of contrasting values on consumer receptiveness to ethical information and ethical choices. *Journal of Business Research*, 104, 366-379. <https://doi.org/10.1016/j.jbusres.2019.07.022>
52. Pankowiak, N. (2024). Vegetable drinks-Sales of the category in shops are on the rise. *Market Monitoring Centre*. <https://www.cmr.com.pl/2024/08/napoje-roslinne-sprzedaz-w-sklepach-dane/>
53. Peattie, K., Crane, A. (2005). Green marketing: Legend, myth, farce or prophesy? *Qualitative Market Research: An International Journal*, 8(4), 357-370. 10.1108/13522750510619733
54. Peterson, C.B., Mitloehner, F.M. (2021). Sustainability of the Dairy Industry: Emissions and Mitigation Opportunities. *Frontiers in Animal Science*, 2, 760310. <https://doi.org/10.3389/fanim.2021.760310>
55. Piatnica (2025a). *Piatnica*. <https://piatnica.com.pl/>
56. Piatnica (2025b). *Vegetable Piatnica*. <https://piatnica.com.pl/produkty/piatnica-roslinna/>
57. Pocol, C.B., Marinescu, V., Amuza, A., Cadar, R.-L., Rodideal, A.A. (2020). Sustainable vs. Unsustainable Food Consumption Behaviour: A Study among Students from Romania, Bulgaria and Moldova. *Sustainability*, 12(11), 4699. <https://doi.org/10.3390/su12114699>

58. Próchniak, P., Próchniak, A., Ossowski, A., Cieśluk, M., Suchecka, D.J. (2025). Generational Egoism: Concept and Measurement. *Psychology Research and Behavior Management*, 2091-2105.
59. Puska, P. (2019). Does Organic Food Consumption Signal Prosociality? An Application of Schwartz's Value Theory. *Journal of Food Products Marketing*, 25(2), 207-231. <https://doi.org/10.1080/10454446.2018.1522286>
60. Randall, T., Cousins, A.L., Neilson, L., Price, M., Hardman, C.A., Wilkinson, L.L. (2024). Sustainable food consumption across Western and Non-Western cultures: A scoping review considering the theory of planned behaviour. *Food Quality and Preference*, 114, 105086. <https://doi.org/10.1016/j.foodqual.2023.105086>
61. Rogala, A. (2011). Przekazy reklamowe a kompetencje komunikacyjne odbiorców. In: B. Pilarczyk (ed.), *Komunikacja rynkowa. Strategie i instrumenty*. Poznań: Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, 208, 233-243.
62. Schwartz, S.H. (2012). An Overview of the Schwartz Theory of Basic Values. *Online Readings in Psychology and Culture*, 2(1). 10.9707/2307-0919.1116
63. Schwartz, S.H., Cieciuch, J., Vecchione, M., Davidov, E., Fischer, R., Beierlein, C., Ramos, A., Verkasalo, M., Lönnqvist, J.-E., Demirutku, K., Dirilen-Gumus, O., Konty, M. (2012). Refining the theory of basic individual values. *Journal of Personality and Social Psychology*, 103(4), 663-688. <https://doi.org/10.1037/a0029393>
64. Sihvonen, J., Luomala, H. (2017). Hear what I appreciate: Activation of consumption motives for healthier food choices across different value segments. *The International Review of Retail, Distribution and Consumer Research*, 27(5), 502-514. <https://doi.org/10.1080/09593969.2017.1383290>
65. Taufique, K.M.R. (2022). Integrating environmental values and emotion in green marketing communications inducing sustainable consumer behaviour. *Journal of Marketing Communications*, 28(3), 272-290. <https://doi.org/10.1080/13527266.2020.1866645>
66. Vergura, D.T., Zerbini, C., Luceri, B., Palladino, R. (2023). Investigating sustainable consumption behaviors: a bibliometric analysis. *British Food Journal*, 125(13), 253-276. <https://doi.org/10.1108/BFJ-06-2022-0491>
67. White, K., Habib, R., Hardisty, D.J. (2019). How to SHIFT consumer behaviours to be more sustainable: A literature review and guiding framework. *Journal of Marketing*, 83(3), 22-49. <https://doi.org/10.1177/0022242919825649>
68. Wulandari, D.K., Putri, K.Y.S. (2023). Contemporary Hedonism: An Exploration of Consumer Lifestyles and Pleasure in Global Culture. *International Journal of Social Sciences & Humanities*, 8(2), 179-187. <https://doi.org/10.58885/ijssh.v08i2.179.dw>
69. Zott (2025). *Zott Protein*. <https://www2.zott-dairy.com/pl/nasze-marki/marki/mm/zott-protein-263/>

FINANCING NUCLEAR ENERGY THROUGH SOVEREIGN GREEN BONDS: POLAND'S PATHWAY TO AFFORDABLE DECARBONISATION

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Purpose: The paper analyses how sovereign green bond financing could influence the affordability of Poland's nuclear energy programme. It examines whether green-labelled debt, through reduced yields ("greenium"), can lower the cost of capital for state-backed nuclear investments consistent with EU sustainable finance regulations.

Design/methodology/approach: A desk-based scenario analysis integrates international cost benchmarks for nuclear power (OECD/IEA & NEA, 2020) with Poland's sovereign yield curve and empirically observed greenium ranges. Levelised cost of electricity (LCOE) is modelled under alternative financing conditions, assuming sovereign guarantees for the PEJ special purpose vehicle. The analysis reflects the June 2025 Sovereign Green Bond Framework, which does not explicitly include nuclear among eligible categories.

Findings: The baseline LCOE for nuclear in Poland is estimated at €60/MWh under a 4.5% real WACC (Weighted Average Cost of Capital). LCOE increases by nearly €45/MWh between 3% and 10% WACC, confirming high sensitivity to financing costs. A greenium of 3-36 basis points would reduce LCOE by $\leq$ €1.5/MWh but yield fiscal savings of €250-600 million for a €10 billion sovereign issue.

Research limitations/implications: Results are illustrative, not predictive. They rely on international benchmarks and assume sovereign-backed financing. Future work should link financial modelling with power-system integration and domestic regulatory factors.

Practical implications: Green bonds could modestly reduce Poland's financing costs and signal alignment with EU sustainable finance standards, but they cannot substitute for broader credit enhancement or policy stability.

Social implications: By integrating nuclear investment within sustainable finance frameworks, Poland could strengthen public credibility in its low-carbon transition while maintaining fiscal prudence.

Originality/value: The study bridges sustainable finance and nuclear economics, demonstrating how sovereign bond structures can marginally improve affordability and credibility in coal-dependent economies pursuing decarbonisation.

Keywords: nuclear finance; green bonds; levelised cost of electricity; Poland; sustainable finance taxonomy.

Category of the paper: Research paper.

1. Introduction

Poland's energy system remains one of the most coal-dependent in the European Union. In 2017, coal accounted for about 79% of electricity generation (Helgilibrary, 2025), and although this share has since declined to 60% in 2023 (IEA, 2023b), coal still dominates the national mix. This dependence contributes to some of the highest carbon intensity levels in Europe and exposes Poland to political and economic pressures to decarbonise. In response, the government has identified nuclear power as a central element of its long-term energy strategy. The *Polish Nuclear Power Programme* (PNP), adopted in 2020 by the Ministry of Climate and Environment, sets out plans to construct 6-9 GW of nuclear capacity by 2043, with the first reactor scheduled for 2033 (PNP, 2020). Though more recent news suggests this date to be delayed by 2036 (WNA, 2025).

Financing these programmes is among the biggest challenges energy transition in the world and Poland is no different. Nuclear plants require very large upfront capital investments and long lead-times for construction, although their fuel and operating costs are relatively low once in operation¹. *In Poland, the first nuclear power plant is currently estimated to cost PLN 150 billion (roughly €34.6 billion) with alternate figures around USD 37-40 billion, depending on supplier and scope* (bneIntellinews, 2024). Construction is expected to begin in the mid-2020s, but commissioning may not occur until 2033–2036 or even 2040 in some forecasts. Delays of several years are already flagged by OECD and independent analyses as likely, which thereby increase financing costs (Lewandowska, 2025). Operating cost estimates are lower in comparison to fossil fuel plants, especially once fuel and carbon costs are internalized, but achieving cost-competitiveness depends heavily on achieving high utilization (capacity factors near 90%) and managing regulatory, construction, and cost-overrun risks (Göke et al., 2023).

The financing of Poland's nuclear programme is widely recognised as one of the most significant challenges in the country's energy transition. Official estimates place the cost of the first plants at PLN 115-150 billion ($\approx$ USD 25-40 billion)², underscoring the scale of upfront capital requirements. International benchmarks published by the OECD/IEA/NEA (2020) indicate overnight costs for nuclear construction ranging from USD 2156 to 6920 per kW, reflecting the diversity of project outcomes across countries. Once operational, nuclear plants exhibit relatively low fuel and operating costs, but the economics of new build are highly

¹ It is agreed that “low operating cost” depends on many specific parameters: maintenance, waste management, staffing, regulatory compliance, etc. The evidence indicates that over the long term, nuclear can be cost-competitive but is not cost-free or trivial.

² One government-source media article quotes a cost estimate of PLN 115 billion ($\approx$ EUR 26.5 billion) for Poland's first nuclear power plant (Olbryt, 2025; Rogers, 2024). Another source places the estimate at PLN 150 billion ($\approx$ €34.6 billion) per an official proxy from PEJ (PNB - Polish News Bulletin, 2024). The variation arises from differences in assumed scope (plant core cost vs full infrastructure), inclusion or exclusion of financing costs, contingencies, and fluctuations in exchange and inflation rates.

sensitive to financing conditions. Illustrative data from Lazard's Levelized Cost of Energy v18 (2025), based on U.S. experience, show that nuclear LCOE increases steeply with higher discount rates—from approximately USD 115/MWh at a 4.2 WACC to over USD 240/MWh at 10% WACC. These values are derived from U.S. benchmarks (Vogtle plant)³ and should be treated as illustrative only. In the Polish context, where financing costs reflect higher country and project risk, actual WACC values could be higher, implying even greater sensitivity of nuclear LCOE to capital costs. This highlights how financing terms exert a disproportionate influence on overall affordability, a factor particularly relevant for Poland as it seeks to mobilise capital for large-scale nuclear deployment.

Poland intends to implement its nuclear programme through a state-owned Special Purpose Vehicle (SPV), the PEJ. Initially 100% government-owned, PEJ is expected to be partially privatised to a 51% state stake as private investors are gradually introduced. This ownership model underscores the importance of sovereign-backed financing, including the potential issuance of government bonds, guarantees, and green-labelled debt instruments. The policy environment is also shaped by the European Union's sustainable finance taxonomy, which since 2022 has recognised nuclear energy as a transitional activity, thereby enabling its inclusion in sustainable finance frameworks (Commission Delegated Regulation (EU) 2022/1214, 2022). At the same time, investor perceptions under environmental, social, and governance (ESG) criteria remain divided, underscoring the importance of labelling, external verification, and market confidence.

Against this backdrop, this paper asks: To what extent can nuclear energy contribute to Poland's long-term decarbonisation goals, and how do sovereign bond yields and financing mechanisms — including the greenium⁴ — shape its affordability? To answer this question, the analysis pursues three objectives: first, to evaluate nuclear cost benchmarks under standard international assumptions; second, to model financing scenarios using Poland's sovereign bond yields and empirical estimates of the greenium, defined as the yield differential between green and conventional bonds; and third, to assess the implications of these financing outcomes for the affordability of nuclear power within Poland's decarbonisation strategy.

The contribution of this paper is twofold. Conceptually, it integrates insights from sustainable finance into the debate on nuclear power, treating financing conditions as a strategic lever comparable to technology choice or vendor selection. Empirically, it applies international cost benchmarks and evidence on green bond markets to the Polish context, quantifying the

³ Poland's first nuclear power plant at Lubiatowo-Kopalino will be developed by Westinghouse and Bechtel in partnership with PEJ, based on the AP1000 reactor design (Westinghouse, 2022). Same technology deployed at Vogtle Unit 3 and 4 in Georgia, USA, which forms a benchmark for LCOE calculations. The Vogtle case is therefore useful for ILLUSTRATIVE purposes in showing financial sensibility and cost dynamics, but its U.S. – specific context (regulations, financial structure and supply chains) means that results should not be read as directly transferable to the Polish programme.

⁴ The sovereign-level greenium (i.e. a yield discount on green bonds relative to conventional sovereign bonds) has been estimated in recent studies to average about 4 basis points in advanced economies and around 11 basis points in emerging markets, which include many Central and Eastern European countries (Ando et al., 2023).

potential cost implications of alternative financing scenarios. The remainder of the paper is structured as follows: Section 2 outlines the methodology; Section 3 presents the results; Section 4 discusses financial and policy implications; and Section 5 offers conclusions.

2. Methods

2.1. Study design and scope

This study is a desk-based scenario analysis that integrates (1) international cost benchmarks for building a new nuclear power plant (OECD/IEA & NEA, 2020), (2) a financing model that maps Poland's sovereign borrowing costs to project WACC5. Under an explicit assumption of sovereign support (e.g., guarantees/capital injections) for the state-backed SPV (Wisława-Bąk, 2025), and (3) empirically observed “greenium” effects in bond markets – typically 4 bps in advanced economies and 11 bps in emerging markets (Ando et al., 2023). The method quantifies how financing terms propagate into the levelised cost of electricity (LCOE). Poland's June 2025 Sovereign Green Bond Framework (Ministry of Finance, 2025; Reuters, 2025), was updated in line with the ICMA 2021 Green Bond Principles but does not explicitly include nuclear energy among eligible categories. Therefore, green-label effects are modelled illustratively—consistent with EU taxonomy provisions that recognise nuclear as a transitional activity (Commission Delegated Regulation (EU) 2022/1214, 2022) – rather than as commitments under the present framework. Results are illustrative rather than predictive and are used to assess affordability implications within Poland's decarbonisation strategy.

2.2. Data sources and inclusion criteria

Cost benchmarks. The primary engineering-economic reference is the OECD/IEA/NEA Projected Costs of Generating Electricity from 2020, which reports overnight capital cost (OCC) ranges for large reactors of USD 2156-6920/kW ($\approx$ EUR 2000-6440 per kW at 2025 October exchange rates), under standard evaluation settings for discount rate, capacity factor and plant life. To capture the financing gradient, the analysis applies the WACC-LCOE sensitivity for nuclear reported in LCOE v18 (2025), where nuclear costs rise from about USD115/MWh ($\approx$ EUR 107/MWh) at a 4.2% WACC to more than USD 240/MWh ($\approx$ EUR 223/MWh) at 10% WACC.

⁵ This assumption reflects the Polish government's decision to finance the initial stages of the nuclear programme through the state-owned SPV *PEJ*. The law of **13 July 2023** provides for PLN 60.2 billion of budget funding for 2025-2030, and the Ministry of Finance has confirmed that the State Treasury may provide guarantees or capital injections. These measures imply that project debt would be priced off the sovereign yield curve rather than purely corporate spreads.

For financing inputs, the sovereign borrowing costs are anchored in Poland's government bond yield curve (10-30-year maturities), sourced from the National Bank of Poland's auction data. The post-2018 period is used to represent current market conditions and plausible ranges. For point estimates, the 30-year tenor (e.g. 2047 bonds yielding ~5.6% in 2025 auctions) (National Bank of Poland (NBP), 2025) is taken as the baseline, consistent with the long asset life of nuclear plants, while recognising that liquidity at ultra-long maturities is limited and often requires curve interpolation.

As for the “greenium” — the yield differential between green and conventional bonds — is parameterised using ranges reported in both sovereign and corporate studies. The most comprehensive cross-country evidence remains the IMF by (Ando et al., 2023), which estimates an average premium of about 4 basis points in advanced economies and 11 basis points in emerging markets. More recent work for the euro area by the Banque de France (Descombes, Szczerbowicz, 2024) suggests that the effect may even be slightly negative (≈ -3 bps on average), indicating that the greenium is neither stable nor guaranteed. Corporate and municipal bond markets show similar variability, with most studies finding modest premia in the low single digits (Caramichael, Rapp, 2024; Malich et al., 2024), while a subset report negligible or statistically insignificant differences (Berdiev, 2025; Dragotto et al., 2025). “Dark green” bonds with strong external validation tend to capture somewhat larger but still small premia (Dorfleitner et al., 2022). Taken together, this literature justifies treating the greenium in the modelling as a range — potentially positive, negligible, or slightly negative — rather than a fixed value.

The sources are included if they (1) provide transparent methodologies that allow replication or scrutiny of assumptions; (2) report numerical ranges directly usable in constructing financing scenarios; and (3) are recognised in the literature, typically through multilateral institutions, central banks, or peer-reviewed research. Market commentary, consultancy reports, and unaudited data releases are excluded, unless they provide unique contextual information on Poland's nuclear programme, in which case they are cited descriptively but not used in the core calculations.

2.3. Cost and financing model

2.3.1. LCOE framework

This formulation follows the standard LCOE approach applied by OECD/IEA/NEA and Lazard, using a capital recovery factor to annualise capital costs and adding operating and fuel components. The contribution of this study does not lie in modifying the LCOE equation itself, but in how financing terms are parameterised: sovereign bond yields from Poland's debt market and empirically observed greenium effects are explicitly mapped into the WACC, creating scenario-based estimates tailored to the Polish nuclear programme.

For technology $LCOE_i$ ⁶, the LCOE formula (1) is:

$$LCOE_i = \frac{CRF(r,n) \times TCC + FOM + VOM + Fuel + Backend}{CF \times 8760} \quad (1)$$

where:

$CRF(r, n) = \frac{r(1+r)^n}{(1+r)^n - 1}$ is the capital recovery factor,

r is the real weighted average cost of capital WACC,

n is plant economic life (in years),

TCC is the total capital construction cost at the commercial operation date (COD), including the overnight construction cost (OCC) plus interest during construction (IDC) and contingency allowances,

FOM/VOM are fixed/variable O&M (operations and maintenance costs) (\$/kW-yr; \$/MWh), Fuel and Backend include front-end fuel cycle, waste, and decommissioning annualisations respectively.

CF is capacity factor (fraction of hours per year the plant operates) 8760 = hours per year.

Relation to OECD/IEA/NEA methodology

The OECD/IEA/NEA (2020) – Projected Costs of Generating Electricity defines LCOE using a full discounted-cash-flow (DCF) formulation, in which lifetime costs and electricity output are discounted year by year and expressed as present values. The above formulation (1) of CRF expression is the closed-form special case of that DCF framework under the following assumptions: (a) capital costs are aggregated into a single all-in amount at COD ($TCC = OCC + IDC$); (b) O&M, fuel, and backend costs remain constant in real terms; and (c) annual electricity generation is constant at the chosen capacity factor. This simplification maintains mathematical consistency with the OECD approach while allowing transparent and replicable sensitivity analysis focused on financing effects.

Treatment of capital costs

Following OECD/IEA/NEA (2020), a seven-year linear construction schedule is assumed for nuclear plants. Interest during construction is estimated as the following formula (2):

$$IDC = OCC \times r \times \frac{d}{2} \quad (2)$$

where d = construction duration (7 years) (OECD/IEA & NEA, 2020, p. 38).

Under typical nuclear financing conditions ($r = 5 - 7\%$), this yields an uplift of roughly 18-25% above OCC, consistent with OECD and NEA statements that IDC adds 15-30% to overnight costs for long-lead technologies such as nuclear. Incorporating IDC in this way produces a total capital construction cost (TCC) comparable to the “investment cost” definition used in OECD/IEA/NEA tables and to the “all-in” capital values underlying LCOE analyses.

⁶ “i” stands for Nuclear Energy

Consistency with Lazard

LCOE studies adopt the same CRF-based structure, annualising capital costs using a fixed WACC and adding operating and fuel components per unit of output (MWh). Employing this form ensures comparability with both Lazard and OECD/IEA/NEA benchmarks.

Parameter variation

Technical parameters ($CF, FOM, VOM, Fuel, Backend$) are fixed within literature median ranges (e.g., $CF = 85 - 90 \%$, $n = 60$ years), while the financing parameter r (WACC) is varied to isolate financing effects. Capital cost scenarios (low, central, high) are produced using the OECD/IEA/NEA nuclear cost range adjusted to TCC values.

2.3.2. WACC construction and mapping from yields

Project WACC is built via a standard weighted average formula (3):

$$WACC = \frac{E}{D+E} R_e + \frac{D}{D+E} R_d (1 - \tau) \quad (3)$$

where:

D and E denote the market values of debt and equity, respectively,

R_d is the cost of debt,

R_e is the cost of equity,

τ is the corporate income tax rate.

The base case assumes a capital structure of 70% debt and 30% equity, reflecting financing practices of large, sovereign-supported or export-credit-agency (ECA)-backed nuclear projects. The assumption lies within the empirical range reported by the OECD-NEA which documents debt-to-equity ratios of 80:20 for Barakah (UAE) and Paks II (Hungary), 98:2 (expected) for Dukovany 5 (Czechia), and 75:25 for Olkiluoto 3 (Finland) (OECD & NEA, 2024).

These projects share common features with Poland's PEJ programme: sovereign ownership of the project company, reliance on government or ECA-backed debt, and limited private equity exposure.

For the SPV model adopted in Poland, the cost of debt R_d is anchored in the yield of long-dated Polish government bonds, adjusted for two possible effects:

1. a greenium, representing yield reductions on labelled green or sustainability bonds (Section 2.4); and
2. ECA concessionality, where Export Credit Agencies such as U.S. EXIM or KEXIM provide loans, guarantees, or insurance for nuclear export projects. Their sovereign backing allows borrowers to access credit at below-market spreads—effectively a concessional reduction in the cost of debt.

The cost of equity R_e is modelled as a spread of +200-400 basis points over R_d , consistent with returns typically required by regulated or contracted utility assets (IEA, 2023b). This is a modelling assumption, not a fixed empirical constant, but it aligns with observed patterns across power-sector projects in the IEA Cost of Capital Observatory (IEA, 2023a), which shows

equity returns generally exceeding debt by several percentage points in both advanced and emerging markets. Comparable differentials are found in regulated or sovereign-backed infrastructure finance, including the Hinkley Point C (UK) and Barakah (UAE) projects. The corporate tax rate is fixed at $\tau = 19\%$, Poland's statutory rate, and applied only to the debt component.

2.3.3. Mapping yields to real WACC

Because sovereign yields are quoted in nominal terms while levelised-cost models operate in real prices, nominal rates are converted using the Fisher relation equation (4):

$$r_{real} = \frac{1+r_{nominal}}{1+\pi} - 1 \quad (4)$$

where:

π is the long-term inflation anchor.

The National Bank of Poland's inflation target of 2.5 % is adopted as π .

the exact formulation is used rather than the approximation $r_{real} \approx r_{nominal} - \pi$ to maintain consistency with OECD, IMF and IEA practice.

All WACC and LCOE results are expressed in real €/MWh, allowing direct comparison with the Projected Costs of Generating Electricity (2020) and with the IEA Cost of Capital Observatory (2023a), which reports capital costs and LCOEs in constant-price terms. The Observatory further shows that financing costs account for roughly 25-30% of LCOE in advanced economies and around 50% in many emerging markets—underscoring the sensitivity of capital-intensive technologies such as nuclear power to financing conditions.

2.4. Scenario design

Scenarios are constructed along three independent axes to quantify how capital intensity, financing conditions and operational performance interact in determining LCOE outcomes.

- a. Capital cost (OCC) – Three cost levels are taken from the OECD/IEA/NEA Projected Costs of Generating Electricity (2020) database:
 1. Low – lower-quartile overnight capital cost (fleet or replication case).
 2. Central – median benchmark.
 3. High – upper-quartile cost reflecting first-of-a-kind (FOAK) or schedule-risk premiums.
- b. Financing (WACC) – Each case maps Poland's long-term sovereign yield (30-year point) to the cost of debt (R_d), with a capital structure of $D/E = 70/30$ and an equity spread of +300 bps in the base case. Alternative financing scenarios introduce green-label effects as yield reductions on R_d ("greenium"), drawn from recent empirical studies:
 1. 3 bps – conservative market average.
 2. 5 bps – externally verified "dark green" bonds.

3. 15-20 bps – typical range in broad bond-market samples.
4. 24-36 bps – labelled vs unlabeled spreads reported in selected studies (Ando et al., 2023; IEA, 2024).

For each differential, R_d and hence WACC are recomputed, and the resulting LCOE is evaluated. In addition, a sensitivity grid spanning real discount rates from 3 % to 10 % in 1-percentage-point steps reproduces the gradient approach used in LCOE v18 and earlier editions.

- c. Operating performance (CF) – Capacity-factor assumptions follow international practice for baseload technologies: 85% and 90%, consistent with OECD/IEA/NEA conventions. Each $(OCC, WACC, CF)$ combination yields a distinct LCOE point. Scenario matrices are presented in Section 3 as heat-maps and tables, highlighting financing-driven cost deltas and the relative magnitude of green-label effects.

2.5. Sovereign green bond savings arithmetic

For an illustrative €10 billion 30-year sovereign issue dedicated to nuclear CAPEX (consistent with large-unit tranche sizing), annual interest-cost savings formula (5) from a greenium g (in basis points (bp)) is:

$$\text{Annual Savings (€m)} = \frac{g}{10,000} \times N_m \quad (5)$$

where N_m is the notional amount in € million.

For $N_m = 10,000$ (€ 10 billion), this simplifies to formula:

$$\text{Annual Savings (€m)} = g \quad (6)$$

(e.g., 5 bps $\Rightarrow$ €5 m/yr).

A simple undiscounted lifetime saving is $30 \times g$ (€m). Where a present value is reported, as in the formula (7):

$$PV \text{ Savings} = \sum_{t=1}^T \frac{\frac{g}{10,000} N_m}{(1+r_{disc})^t} \quad (7)$$

with r_{disc} set to the corresponding sovereign yield (consistency with issuer funding costs) and T is the maturity in years⁷.

For a 30-year bond discounted at $r_{disc} = 4.5\%$, the implied annuity factor is approximately 16.27, which reproduces all PV values reported in Table 5.

These bond-level savings are then propagated into the WACC (Section 2.3.2) and hence the LCOE via the CRF, allowing a direct link: greenium $\rightarrow$ cheaper debt $\rightarrow$ lower WACC $\rightarrow$ lower LCOE.

Contextually as the formula explains (8):

$$\text{greenium} \Rightarrow R_d \downarrow \Rightarrow WACC \downarrow \Rightarrow CRF \downarrow \Rightarrow LCOE \downarrow \quad (8)$$

⁷ In numerical illustrations $N_m = €10,000$ million (€10 billion), $T = 30$ years, and r_{disc} is the real sovereign yield. The summation index t runs from 1 to T . The summation and annuity-factor forms of equation (6) are algebraically identical.

2.6. Consistency checks and validation

To ensure the robustness and internal coherence of the modelling framework, the results were subjected to a series of validation and consistency checks consistent with international methodological guidance. The approach follows the validation principles outlined in the OECD/IEA/NEA “Projected Costs of Generating Electricity” (2020), which emphasises benchmarking of levelised cost estimates across countries and technologies to ensure methodological comparability and transparency. In this study, model outputs were cross-checked against the reference LCOE ranges reported for nuclear power under comparable discount-rate and capacity-factor assumptions, confirming that the baseline values remain within the internationally observed cost bands.

Gradient and sensitivity checks were further applied to verify the expected monotonic relationship between the WACC and the LCOE, ensuring that the magnitude of change ($\Delta\text{LCOE}/\Delta\text{WACC}$) was consistent with both the direction and scale reported in the OECD/IEA/NEA analysis (2020). In addition, a back-solving test was performed using the CRF to confirm that the implied cost differentials correspond to the observed WACC variations.

Finally, the results were compared against independent methodological standards established in “A Manual for the Economic Evaluation of Energy Efficiency and Renewable Energy Technologies” (Short et al., 1995), which stress that economic evaluation of energy systems must incorporate verification of parameter sensitivity and alignment of base-case assumptions with recognised financing norms. This multi-stage validation procedure ensures that the model not only maintains internal numerical consistency but also conforms to accepted international practice in LCOE analysis.

2.7. Limitations

Several limitations should be acknowledged regarding the interpretation and transferability of the results. First, while the OECD/IEA/NEA OCC ranges and Lazard-derived WACC sensitivities provide internationally recognised benchmarks, their direct application to the Polish context may be constrained by domestic supply-chain characteristics, regulatory factors, and project-specific schedule risks. Second, the assumed greenium values are inherently sample and period dependent, implying that realised yield differentials for Polish sovereign green issuance could vary above or below the illustrative ranges applied here.

Third, the financing framework assumes full sovereign backing through guarantees or export credit agency (ECA) wraps; any deviation from this assumption would increase the effective cost of debt (R_e). Fourth, non-capital cost components, such as operations, maintenance, and fuel costs, were held constant to isolate the marginal impact of financing conditions. Consequently, the analysis does not capture future variability in back-end or fuel-cycle costs. Finally, the nominal programme size of €10 billion was adopted as an illustrative scaling convention; in practice, national nuclear financing is expected to proceed through multiple tranches and heterogeneous instruments.

2.8. Replicability statement

All equations are provided; inputs are standard (yield points, OCC ranges, operating parameters). A reader can reproduce every table by applying Sections 2.3-2.5 with the same parameter values. Where ranges are reported (e.g., 15-20 bps), both endpoints are calculated and shown.

3. Results

3.1. Baseline LCOE levels

Table 1 presents LCOE values for nuclear power in Poland under the central overnight capital cost (OCC) case and capacity factor of 90%. The baseline financing scenario assumes a real WACC of 4.5%, corresponding to Poland's long-term sovereign yield without greenium adjustment. For comparison, results are also shown across the sensitivity range of 3-10% WACC.

Table 1.

Baseline LCOE for central OCC and CF = 90% (real €/MWh)

Real WACC %	LCOE (€/MWh)
3.0	51.4
4.0	57.1
4.5 (base)	60.0
5.0	63.1
6.0	69.4
7.0	75.9
8.0	82.6
10.0	96.2

Note. Values in real €/MWh.

The results show that the baseline cost of nuclear electricity in Poland—about €60/MWh at a 4.5% real WACC—falls within the range of international benchmarks reported by OECD/IEA/NEA (2020). The steep increase from €51/MWh at 3% WACC to €96/MWh at 10% WACC underscores the dominant role of financing terms in determining overall affordability. This gradient is further analysed in Section 3.2.

3.2. Sensitivity to financing costs (WACC gradient)

The relationship between financing conditions and nuclear generation costs is summarised in Table 2, which presents the sensitivity of the LCOE to changes in the WACC under alternative OCC scenarios. The results show how even moderate increases in WACC produce substantial rises in LCOE, reflecting the capital-intensive nature of nuclear power.

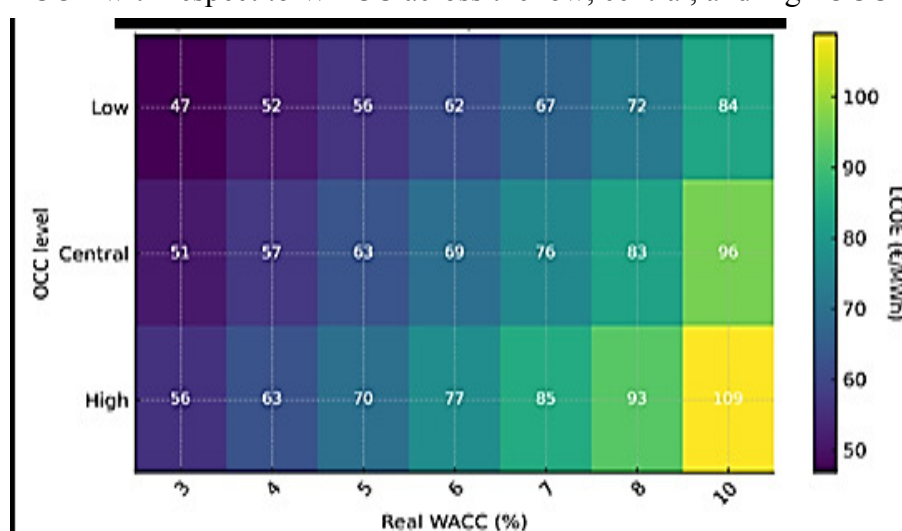
Table 2.*LCOE sensitivity to WACC for OCC scenarios (CF = 90%; real €/MWh)*

Real WACC %	3	4	5	6	7	8	10
OCC: Low	46.8	51.5	56.4	61.5	66.9	72.3	83.5
OCC: Central	51.4	57.1	63.1	69.4	75.9	82.6	96.2
OCC: High	56.0	62.7	69.8	77.2	84.9	92.8	108.9

Note: (for both tables 2&3). Inputs: plant life 60 years; FOM €120/kW·yr; VOM €2/MWh; fuel €7/MWh; backend €2/MWh. OCC sets: Low €4500/kW; Central €5500 /kW; High €6500/kW. Values are in real €/MWh.

Across all OCC scenarios, the results confirm a near-linear relationship between WACC and LCOE. Each one-percentage-point increase in the real discount rate raises the LCOE by roughly €6-8/MWh in the central cost case, underscoring the high financial leverage of nuclear investments.

Figure 1 visualises these results as a two-dimensional heat map, highlighting the steep gradient of LCOE with respect to WACC across the low, central, and high OCC cases.

**Figure 1.** Heatmap of LCOE vs WACC and OCC (CF = 90%).

The heat map in Figure 1 confirms the steep cost gradient observed numerically in Table 2. Nuclear LCOE rises sharply once the real WACC exceeds about 6%, while cost differences between the low and high capital-cost cases remain roughly parallel across the financing range. This consistency supports the robustness of the model and provides the baseline against which the impact of green-label financing is examined in Section 3.3.

To test the influence of operating performance, Table 3 extends the analysis to a lower capacity factor of 85 %, illustrating how reduced utilisation amplifies the cost impact of higher WACC.

Table 3.*LCOE sensitivity to WACC for OCC scenarios (CF = 85 %; real €/MWh).*

Real WACC %	3	4	5	6	7	8	10
OCC: Low	49.0	53.8	59.0	64.5	70.2	75.9	87.8
OCC: Central	53.8	59.8	66.1	72.8	79.7	86.8	101.2
OCC: High	58.7	65.7	73.2	81.1	89.3	97.6	114.7

Note: (for both tables 2&3). Inputs: plant life 60 years; FOM €120/kW·yr; VOM €2/MWh; fuel €7/MWh; backend €2/MWh. OCC sets: Low €4500/kW; Central €5500 /kW; High €6500/kW. Values are in real €/MWh.

The 5-percentage-point reduction in capacity factor increases LCOE by about €3-5/MWh across all WACC values, confirming that while financing dominates total cost, operational efficiency remains an important secondary driver. This completes the base-case sensitivity analysis and provides the reference point for assessing the impact of green-label financing in Section 3.3.

3.3. Greenium Scenarios (central OCC, CF = 90%)

The potential impact of green-label financing on nuclear affordability is illustrated in Table 4, which quantifies LCOE reductions arising from various *greenium* levels. Each scenario converts a yield differential into an adjusted real WACC, showing the marginal—but measurable—effect of cheaper debt on generation cost.

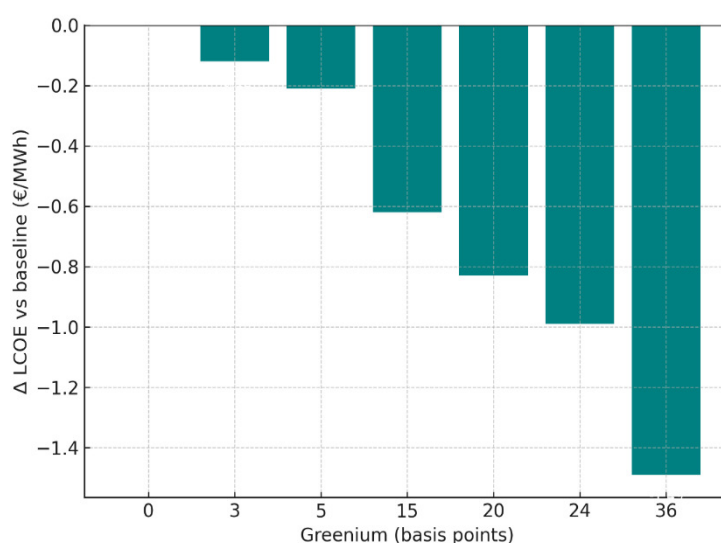
Table 4.

LCOE impact of greenium via WACC mapping (real terms) Greenium scenarios (central OCC, CF = 90%)

Greenium (bps)	Δ Rd (bps)	Real WACC (%)	LCOE (€/MWh)	Δ LCOE vs baseline (€/MWh)
0	0	4.500	60.00	0.00
3	-2.1	4.479	59.88	-0.12
5	-3.5	4.465	59.79	-0.21
15	-10.5	4.395	59.38	-0.62
20	-14.0	4.360	59.17	-0.83
24	-16.8	4.332	59.01	-0.99
36	-25.2	4.248	58.51	-1.49

Note: WACC reduction $\approx (D/(D+E)) \times g = 0.70 \times g$ bps. Baseline (no greenium) equals the 3.1 central case: €60.00/MWh at 4.5% real WACC. Values rounded to 0.01 €/MWh.

As shown in Figure 2 below, the relationship between LCOE and greenium is nearly linear at small yield differentials but flattens for larger values, indicating diminishing marginal cost benefits from additional greenium gains.



Note: Sovereign green bond savings (€10bn, 30-year, real).

Figure 2. *LCOE reductions under alternative greenium assumptions (central OCC, CF = 90%).*

The patterns in Figure 2 provide the empirical bridge to Section 3.4, which assesses these same financing differentials from the perspective of the sovereign issuer rather than the project company.

3.4. Sovereign green bond savings (€10 bn, 30 year, real)

Building on the project-level results in Section 3.3, this subsection evaluates the same financing differentials from the perspective of the sovereign issuer. The fiscal implications of green-labelled issuance are summarised in Table 5, which converts each assumed *greenium* into annual, undiscounted, and present-value interest-cost savings for a notional € 10 billion 30-year bond, directly linked to the financing assumptions outlined in Section 2.5.

Table 5.

Interest-cost savings from greenium (issuer perspective) as Sovereign green bond savings (€10bn, 30-year, real)

Greenium (bps)	Annual saving (€/yr)	Lifetime undiscounted (€m)	PV saving at $r_{disc} = 4.5\%$ (€m)
3	3	90	48.8
5	5	150	81.3
15	15	450	243.9
20	20	600	325.2
24	24	720	390.2
36	36	1,080	585.3

Note. Annual saving = g (€/yr) on €10bn notional. PV uses annuity factor for 30 years at 4.5% (~16.27).

These results indicate that even modest *greenium* levels can yield meaningful fiscal benefits at the sovereign scale: a 15-20 bp differential corresponds to discounted savings of roughly €250-325 million, while the most optimistic 36 bp case exceeds €580 million. The next subsection (Section 3.5) verifies the internal consistency of these calculations.

3.5. Model validation and consistency checks

The results were subjected to internal validation following the procedures described in Methods (§2.6). The gradient check confirmed that the relationship between WACC and LCOE behaves as expected and is consistent with international benchmarks. In the central OCC case, the LCOE increases from €51/MWh at a 3% WACC to €96/MWh at 10% WACC, corresponding to a difference of approximately €45/MWh. This gradient aligns closely with the range reported in Lazard (2025), where nuclear LCOE rises by roughly 60-100 USD/MWh between comparable financing assumptions (4-10% WACC).

A back-solve validation was also conducted: for selected scenarios, the implied WACC differences reverse-calculated from the CRF reproduced the input deltas to within rounding error, confirming internal numerical consistency of the model. Moreover, the absolute LCOE values across OCC and capacity factor cases remain within the benchmark ranges documented by the OECD/IEA/NEA (2020) when evaluated at their standard discount rates, supporting the external validity of the results.

4. Discussion

4.1. Baseline cost position

The baseline estimate of €60/MWh for nuclear electricity in Poland, derived under central overnight capital cost assumptions and a real WACC of 4.5%, places nuclear broadly within the competitive range of low-carbon generation technologies. While this value is higher than the short-run marginal cost of existing coal assets, it is comparable to the projected costs of new renewable and gas-fired generation once system integration and carbon pricing are accounted for. The result underscores the central role of financing conditions in shaping nuclear competitiveness: with technical parameters held constant, the baseline outcome reflects primarily the sovereign cost of capital. This indicates that nuclear deployment in Poland is not constrained by intrinsic technology costs but rather by the ability to secure favourable financing. Importantly, the baseline scenario provides a reference against which the impact of financing innovations, such as green bond issuance, can be assessed.

4.2. Financing sensitivity and WACC gradient

The results highlight the exceptional sensitivity of nuclear costs to the weighted average cost of capital. Across the central overnight capital cost scenario, LCOE increases by approximately €45/MWh between 3% and 10% WACC, a gradient fully consistent with international benchmarks such as Lazard's estimates (2025) and the OECD/IEA/NEA (2020) cost ranges. This steep profile illustrates that financing terms exert a far greater influence on project viability than variations in operating or fuel costs, which remain relatively minor contributors to total generation cost. For policymakers, this reinforces the notion that nuclear energy is uniquely exposed to sovereign credit conditions and risk perceptions in capital markets. In practical terms, even modest changes in the discount rate translate into double-digit changes in the delivered cost of electricity, implying that financial structuring is as decisive as technological efficiency in determining overall competitiveness.

4.3. Effect of greenium on project economics

The introduction of a greenium produces only modest reductions in LCOE at the plant level, with the most optimistic scenario yielding a saving of just under €1.5/MWh relative to the baseline (Section 3.3). While this appears limited when viewed in isolation, the effect scales with system size. Applied across several gigawatts of capacity, even a €1/MWh reduction corresponds to hundreds of millions of euros in avoided lifetime costs for the Polish nuclear fleet.

These magnitudes are consistent with empirical evidence on green-labelled bonds, which typically report yield premia in the range of 3-5 basis points, with larger spreads being exceptional and context-dependent (Ando et al., 2023). The findings therefore suggest that

while the greenium alone will not transform project-level economics, it can nonetheless deliver non-trivial system-wide savings and contribute to lowering perceived financial risk in capital markets, an effect that may indirectly improve financing access and cost over time.

4.4. Sovereign green bond implications

From the perspective of the sovereign issuer, the interest-cost savings from green-labelled debt are more pronounced than the marginal LCOE effects. A €10 billion 30-year bond could generate discounted savings of roughly €250-600 million under plausible greenium ranges (Section 3.4). Although this represents only a small share of total programme expenditure—expected to exceed €60 billion (PNP, 2020; bne Intellinews, 2024)—the fiscal significance remains substantial.

Reduced financing charges directly ease budgetary pressure, improve debt sustainability, and can enhance investor confidence in long-term transition instruments. In addition, sovereign issuance of nuclear-linked green bonds would carry a signalling effect: it would demonstrate compliance with EU sustainable finance taxonomy provisions that recognise nuclear energy as a transitional activity (Commission Delegated Regulation (EU) 2022/1214, 2022) and reinforce perceptions of policy stability. In this sense, the sovereign benefit extends beyond numerical savings, positioning nuclear as an investable component of Poland's decarbonisation strategy and aligning public-sector finance with broader ESG market expectations.

4.5. Policy and strategic relevance

Taken together, the results indicate that green bond financing offers meaningful—but not transformative—benefits for nuclear deployment in Poland. The dominant driver of competitiveness remains the overall cost of capital, which depends on sovereign creditworthiness, market risk perception, and the institutional design of the financing framework. Within this context, green-labelled instruments should be regarded as a complementary tool, not a substitute for comprehensive financing reforms or sovereign credit enhancement.

Again, it must be highlighted that Poland's principal value lies in signalling compliance with the EU Sustainable Finance Taxonomy (Commission Delegated Regulation (EU) 2022/1214, 2022), broadening the investor base, and marginally reducing borrowing costs when deployed at scale. For Poland—a country seeking simultaneously to exit coal dependence and strengthen energy security—these characteristics carry significant strategic relevance. By integrating nuclear investment within sustainable finance frameworks, policymakers can enhance both the credibility and the affordability of the programme while setting a precedent for other carbon-intensive economies pursuing nuclear power as part of their decarbonisation pathways.

4.6. Limitations and future research

The analysis presented here is based on standardised international cost benchmarks and stylised financing assumptions rather than project-specific Polish data. While this ensures comparability with OECD and IEA studies, it necessarily abstracts from domestic construction risks, regulatory features, and market conditions that could materially influence realised costs.

A further limitation concerns the stability of the greenium itself: empirical evidence indicates that the yield differential varies across issuers, market cycles, and regulatory environments, raising uncertainty over its persistence across a multi-decade investment horizon.

Moreover, the analysis isolates financing effects from broader system-integration dynamics, including grid reinforcement, balancing requirements, and interactions with variable renewables. Future research should therefore link financial modelling with power-system simulations to capture the full implications of nuclear deployment under alternative financing structures. Comparative work across Central and Eastern European economies would also help assess the general applicability of sovereign and green-bond mechanisms in coal-dependent transition contexts.

5. Summary

This paper has examined the cost implications of financing Poland's planned nuclear programme through sovereign green bonds. Drawing on OECD/IEA/NEA benchmarks, the baseline LCOE for nuclear power was estimated at € 60/MWh under central capital cost assumptions and a 4.5% real WACC, broadly consistent with international ranges. The results confirm the exceptional sensitivity of nuclear costs to financing conditions, with LCOE increasing by almost €45/MWh between 3% and 10% WACC.

The analysis of greenium effects indicates that while reductions in project-level LCOE are modest ($\leq$ €1.5/MWh), the scale of national investment amplifies their fiscal significance, generating system-level savings of several hundred million euros. From a sovereign perspective, the issuance of a € 10 billion green bond could yield discounted savings of €250-600 million, while simultaneously signalling compliance with the EU sustainable finance taxonomy.

Overall, green bonds should be viewed as a complementary tool within a broader nuclear financing strategy. Their value lies not in transforming nuclear economics but in marginally improving affordability, diversifying the investor base, and enhancing policy credibility. Future research should link financial modelling with system-level energy analysis to capture the wider implications of green-labelled financing for decarbonisation pathways in coal-dependent economies.

References

1. Ando, S., Fu, C., Roch, F.R., Wiriadinata, U. (2023). How Large is the Sovereign Greenium? *IMF Working Papers, I*. 10.2139/ssrn.4427184
2. Berdiev, U. (2025). What shapes greenium in bond markets? Evidence from Japan. *Economic Modelling, 151*, 107159. 10.1016/j.econmod.2025.107159
3. bneIntellinews (2024, Apr 23). Poland's first nuclear plant may carry €35bn price tag. *Energy Monitor Worldwide (Amman, Jordan)* <https://www.intellinews.com/poland-s-first-nuclear-plant-may-carry-35bn-price-tag-321833/>
4. Caramichael, J., Rapp, A.C. (2024). The green corporate bond issuance premium. *Journal of Banking & Finance, 162*, 107126. 10.1016/j.jbankfin.2024.107126
5. Commission Delegated Regulation (EU) 2022/1214. (2022). *European Commission. (2022). Commission Delegated Regulation (EU) 2022/1214 of 9 March 2022 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives, and amending Commission Delegated Regulation (EU) 2021/2139*. Official Journal of the European Union.
6. Descombes, T., Szczerbowicz, U. (2024). *Do green sovereign bonds benefit from a green premium?* Banque De France.
7. Dorfleitner, G., Utz, S., Zhang, R. (2022). The pricing of green bonds: external reviews and the shades of green. *Review of Managerial Science, 16*(3), 797-834. 10.1007/s11846-021-00458-9
8. Dragotto, M., Dufour, A., Varotto, S. (2025). Greenium fluctuations and climate awareness in the corporate bond market. *International Review of Financial Analysis, 105*, 104281. 10.1016/j.irfa.2025.104281
9. Göke, L., Wimmers, A., von Hirschhausen, C. (2023). *Flexible nuclear power and fluctuating renewables? A techno-economic analysis for decarbonized energy systems*. 10.48550/arxiv.2302.14515
10. Helgilibrary (2025). *Electricity Production from Coal Sources (As % of Total) in Poland*. Retrieved from: <https://www.helgilibrary.com/indicators/electricity-production-from-coal-sources-as-of-total/poland/>?, 9.09.2025.
11. IEA (2023a). *Cost of Capital Observatory*. Washington: International Energy Agency. Retrieved from Publicly Available Content Database: <https://www.proquest.com/docview/3147080665>
12. IEA (2023b). *Sources of electricity generation*. Retrieved from: <https://www.iea.org/countries/poland/electricity>, 9.09.2025.

13. IEA (2024). *World Energy Outlook 2024*.
14. LAZARD , & LCOE+ (2025). *A Lazard's levelized cost of energy analysis*. <https://www.lazard.com/news-announcements/lazard-releases-2025-levelized-cost-of-energyplus-report-pr/>
15. Lewandowska, N. (2025, Feb 4). OECD warns of delays in construction of nuclear power plants in Poland. *PAP Market Insider*, <https://www.proquest.com/docview/3163140340>
16. Malich, J., Petrovich, M., Ridley, M., Husi, A. (2024). *Is Greenium evaporating in USD Corporate Bonds?* <https://www.msci.com/research-and-insights/blog-post/is-greenium-evaporating-in-usd-corporate-bonds?>
17. Ministry of Finance (2025). *Sovereign Green Bond Framework*. Republic of Poland, Ministry of Finance.
18. National Bank of Poland (NBP) (2025). *Informacja o oprocentowaniu rządowych papierów wartościowych (krótko- i długoterminowych) na rynku pierwotnym w 2025 r.*
19. OECD/IEA & NEA (2020). *Projected Costs of Generating Electricity*.
20. OECD, & NEA (2024). *Effective Frameworks and Strategies for Financing Nuclear New Build*. OECD.
21. Olbryt, A. (2025, Mar 13). Poland likely to see first electricity from first nuclear unit flowing in 2036. *PAP Market Insider*, <https://www.proquest.com/docview/3176605432>
22. PNB - Polish News Bulletin (2024, Jun 14). Poland's first nuclear power plant. *PNB - Polish News Bulletin*, <https://tvpworld.com/77065045/polands-first-nuclear-power-plant-to-cost-approximately-eur-346-bn-official>
23. PNP (2020). *The_Polish_Nuclear_Power_Programme_(PPEJ)_2020*. Ministry of Climate.
24. Reuters (2025, June 26). Poland updates green bond framework ahead of possible first issuance in six years. <https://www.reuters.com/sustainability/boards-policy-regulation/poland-updates-green-bond-framework-ahead-possible-first-issuance-six-years-2025-06-26/>
25. Rogers, D. (2024, Apr 23). Poland's first nuclear plant may carry €35bn price tag. *Energy Monitor Worldwide* <https://www.globalconstructionreview.com/price-tag-for-polands-first-nuclear-plant-may-reach-37bn/?>
26. Short, W., Packey, D.J., Holt, T. (1995). *A Manual for the Economic Evaluation of Energy Efficiency and Renewable Energy Technologies*. National Renewable Energy Laboratory (U.S.). 10.2172/35391, <https://digital.library.unt.edu/ark:/67531/metadc678552/>
27. Westinghouse (2022, Nov 4). Westinghouse Selected For Poland's New Nuclear Power Program. *Targeted News Service*, <https://www.proquest.com/docview/2731810674>
28. Wisława-Bąk, P. (2025, March 25). Polish president signs bill on state aid for nuclear plant. *PAP English News Service*, <https://www.proquest.com/docview/3180887785>
29. WNA (2025, 19 June). *Nuclear Power in Poland*. Retrieved from: <https://world-nuclear.org/information-library/country-profiles/countries-o-s/poland?>, 30/08/2025.

SYSTEM CONTROL'S MECHANICS OF A RELIABLE MOBILE ROBOT OPERATION WITH REGARDS TO OBSTACLES

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Purpose: The paper is devoted to the development of an algorithm for automatic path planning of a mobile robot (MR) to a given target point, taking into account the occurrence of obstacles on its way. The advantages of using MR in manufacturing, such as increased productivity, reduced costs, improved safety and flexibility, are discussed. State-of-the-art path planning methods including graph search, random sampling and intelligent bionic algorithms are discussed.

Design/methodology/approach: Special attention is given to the problem of planning safe paths in the presence of information scarcity and obstacles. The results of MP path planning modelling are presented, confirming the effectiveness of the proposed solutions. Laser range finders have been proposed to improve the safety of MR traffic. The main criteria for selecting a laser rangefinder - distance, weight, reliability, cost - are defined.

Findings: Path planning for MR and collision avoidance remains a topical issue and requires further research, especially in the context of integrating MR with other automated process systems and improving their reliability and safety.

Research limitations/implications: The research focused on modern technological processes that require a high degree of automation to increase efficiency, reduce costs and improve product quality. One of the key areas of development was the use of mobile robots (MRs) capable of performing a wide range of tasks, from transporting materials to performing complex manufacturing operations. This article deals with research on route planning for MRs, taking into account the presence of obstacles, such as people in the path.

Practical implications: For obstacle detection the VL53L1X laser rangefinder based on the principle of time-of-flight (ToF) measurement from the ST FlightSense product family with the parameters; distance measurement range up to 4 m, measurement frequency up to 50 Hz, independence from the obstacle color and surface reflection properties was selected. It is recommended to install 3 laser rangefinders to realize the collision detection and automatic evasion system.

Social implications: For reliable operation in a social environment, 3 laser rangefinders were chosen to implement the collision detection system and automatic evasive maneuver.

Originality/value: An original mechanics of control system for reliable operation of a mobile robot with regard to obstacles is proposed.

Keywords. Path planning, automation, mobile robot, obstacles, modelling.

Category of the paper: Case study.

1. Introduction

Modern technological processes require a high degree of automation to increase efficiency, reduce costs and improve product quality. One of the key areas of automation development is the use of mobile robots (MRs) capable of performing a wide range of tasks, from transporting materials to performing complex manufacturing operations. This paper considers path planning for MRs, taking into account the occurrence of obstacles such as people in the path.

The advantages of using MRs in manufacturing processes are:

1. Increased productivity. MRs can work around the clock without interruption, which significantly increases the productivity of the enterprise. They are also able to perform tasks faster and more accurately than humans, especially in monotonous and repetitive operations.
2. Cost reduction. The use of MRs reduces labour costs as they replace human labour. In addition, MRs require less maintenance and repair costs compared to traditional production lines.
3. Improved safety. MRs can perform dangerous and complex operations, reducing the risk of injury to workers. This is especially important in industries that require handling heavy loads or hazardous materials.
4. Flexibility and adaptability. Modern MRs are highly flexible and can easily adapt to changes in the production environment. They can be reprogrammed to perform new tasks, making them versatile tools for a variety of industries.
5. Integration with other systems. MRs can be integrated with other automated systems such as Manufacturing Execution Systems (MES) to create fully automated production lines.

The aim of the work is to develop an algorithm for automatic planning of the MR path to a given target point with constant scanning of obstacles on the path and taking measures when obstacles are detected (stopping the MR, giving sound and light signals or avoiding the obstacle).

2. Literature review on the topic of mobile robots path planning for unexpected obstacles

A good review of path planning methods for MR navigation in a dense environment is presented in Mammadova, Alieva (2022, pp. 156-165.), where MR path planning methods, their advantages and disadvantages are discussed. In Rego, Voronov (2023, pp. 264-274) the problem of MP navigation with limited information about the environment is solved. An algorithm for finding a path to the target with a minimum number of turns is described. The idea of the algorithm is based on the bug family of reactive navigation algorithms. MR memorises obstacle boundaries and calculates the turn angle depending on the environment. The difference from bug algorithms is that the robot does not move "along the obstacle", but turns only in a limited number of cases. The results of testing the algorithm on simulated polygons are presented. The efficiency is evaluated by comparing the minimum possible number of turns with the number of turns in the trajectory obtained with the algorithm.

The review article (Gazieva, 2024, pp. 73-76) is devoted to path planning methods for MR in an obstacle-ridden environment. The paper discusses various approaches to solving this problem, ranging from classical methods such as graph-based methods, cellular networks and potential field methods to modern intelligent algorithms, which are of most interest for real-world applications. The paper also discusses the applicability of these methods in different types of environments. In Yuditsev (2019, pp. 163-186), control problems in planning safe trajectories of a group of MRs are solved.

In recent years, MRs have been widely used in automated warehouses (Wen, 2022, pp. 1095-1105). When a MR operates in a warehouse, it must first accurately perceive the environment and then construct a map to navigate through. A global dynamic path planning method, which includes an improved A* algorithm, is developed to solve the MP path planning problem. Firstly, the distance information between nodes is integrated into a heuristic function with exponential decay function as coefficients to accelerate the global optimisation search speed and improve the efficiency of path planning; secondly, the planned path is smoothed and optimised by combining the gradient descent method; finally, the A* algorithm can perform global dynamic path planning.

In Farhud (2021, pp. 99-114), a deep learning artificial neural network is used for collision-free path planning. In Bizhanova, Salykova, Moldamurat, Ivanova (2023, pp. 339-346) methods for planning and controlling the motion of a mobile robot in an uncertain environment with stationary and moving obstacles, including random changes in the velocity vectors of moving obstacles, are considered. The methods of MP motion planning under uncertainty are analysed. The authors propose a solution in which the operation of MR using simulation modelling under uncertainty will be successful. In Barashkov (2020, pp. 51-58) the developed algorithm combining the merits of the beetle algorithm and potential fields methodology is proposed.

In Krenicky et al. (2022) the problem of MR path planning between two given points with static obstacles is solved using an integrated approach based on graph theory methods, including Voronoi diagram, visibility graph and Dijkstra's algorithm. Optimisation of the MP path length was implemented and the computational complexity of visibility graph construction was significantly reduced.

In Koshman, Bykov, Leonard, Shurygin (2024, pp. 65-71) research was carried out on MP motion planning with displacement of the potential field centre of a static obstacle, which makes it possible to exclude the possibility of oscillations of the MP centre of mass. In Sága, Bednár, Vasko (2011, pp. 269-274), an algorithm for scheduling operations in a group of autonomous MRs to eliminate the consequences of fires or emergencies was proposed.

In Pavlov (2021, pp. 38-59) algorithms for MP trajectory planning with lower computational complexity are investigated. In Li, Liu, Wang, Zhang (2021, pp. 7-10) the topical issues in the field of building an intelligent system for MP trajectory planning by means of a neural network are considered. In He, Fan, Mu, Wang (2024, pp. 63-70) a solution to the problem of insufficient performance and accuracy of real-time MP trajectory tracking is proposed by implementing a system combining machine vision and laser radar. In Mikheev, Svyatov, Lapshov (2020, pp. 70-79) a software system for determining the probability of collision of MRs with obstacles is proposed.

The analysis of the above sources shows that the topic of MR path planning and obstacle collision avoidance is very relevant and requires further research.

3. Development of a mobile robot path planning model

Several key aspects have been taken into account while creating the MP path planning model in MATLAB software product:

1. Kinematic and dynamic models of the robot: a description of the robot's motion considering its kinematics and dynamics.
2. Motion control algorithms: an algorithm for path planning and motor control of the robot.
3. Feedback and error correction: processing sensor data and correcting the path if necessary.

The MR has two drive wheels and two passive support rollers at the front and rear of the platform (differential drive). Its motion can be described by the following equations:

$$\frac{dx}{dt} = V \cos(\theta)$$

$$\frac{dy}{dt} = V \sin(\theta)$$

$$\frac{dx}{dt} = V \cos(\theta)$$

where x , y are the coordinates of MR on the plane, θ is the angle of orientation of MR relative to the x -axis, v is the linear velocity of MP, ω is the angular velocity relative to the centre of rotation of MR.

Laser range finders or lidars are one of the most common types of sensors used for obstacle detection and evasion. Lidars provide highly accurate measurements and are capable of operating in a variety of lighting and weather conditions. The use of lidars in MR significantly improves driving safety. The main criteria when choosing a laser rangefinder are distance, weight, reliability, and cost.

In works Jianing, Wei, Wei et al. (2021, pp. 1484-1491), Kuric et al. (2021), D'Arco, Fratelli, Graber et al. (2024, pp. 49-56), Majko et al. (2022), Qazizada, Pivarciová (2018, pp. 141-152), Nikitin, Yu (2024, pp. 137-149) a solution for obstacle detection, evasion, the problem of insufficient performance and accuracy of MR trajectory tracking in real time by implementing systems on laser radar or lidar has been proposed.

The VL53L1X laser rangefinder is selected for obstacle detection. The VL53L1X is a modern laser sensor based on the time-of-flight (ToF) principle from the ST FlightSense product family. It is a fast, miniaturised ToF sensor with a range of up to 4 m and a measurement frequency of up to 50 Hz. Unlike conventional IR sensors, the VL53L1X uses ST's latest-generation ToF technology, which allows absolute distance measurement independent of obstacle colour and surface reflectance.

The distance measurement module based on the VL53L1X laser rangefinder is shown in Fig. 1.



Figure 1. Laser rangefinder VL53L1X.

Application features of the VL53L1X laser rangefinder:

- fully integrated miniature module (25 mm * 10 mm),
- emitter: invisible infrared laser with a wavelength of 940 nm (laser safety class 1),
- SPAD (single photon avalanche diode) receiver array with integrated lens,
- low power consumption microcontroller,

- sensor field of view (FoV): 27° ,
- I2C interface (up to 400 kHz).

To implement the collision detection and automatic evasion system, 3 laser rangefinders are required. The first rangefinder is located directly on the MR's course to detect and automatically evade head-on collisions with other MRs, people, technological equipment, or to maintain a specified distance in the keel of the group control. The second rangefinder is positioned to the left at a 30° degree angle from the centreline of the MR to detect an obstacle and determine if it can be avoided. The third rangefinder is positioned to the right at an angle of 30° degrees from the centreline of the MR to detect the obstacle and determine if it can be avoided. If there is no possibility to avoid the obstacle, the MR stops and gives sound and light signals.

The results of simulation of MP motion with obstacle detection and avoidance in MATLAB software are shown in Fig. 2.

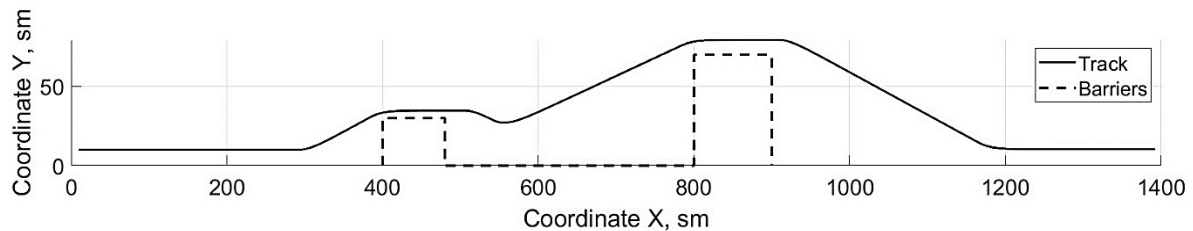


Figure 2. MP motion simulation process with detection in MATLAB software.

The essence of the algorithm is to detect an obstacle, measure the distance to it, calculate the angle of rotation of the MR to avoid the obstacle. After avoiding the obstacle, the MR returns to the calculated trajectory.

Here is a complete overview of algorithm development in MATLAB:

```
clear; clear global; clc
global vg hzv hz0 xv yv tzv tz0 xvl xvs yvs xvs1
hz0=10; hzv=5;
xc0=10; yc0=hz0; xc=xc0; yc=yc0; vg=10; tz0=0;
sd01=80; sd02=100; tzv=15*pi/180;
xv=400; xvl=xv+sd01; xvs=xv+400; xvs1=xvs+sd02; yv=70; yvs=50;
T=0:0.05:140; te0=0.0; A0=[te0; xc0; yc0; 0; 0; yc0];
options=odeset('RelTol',1*10e-4); [T,A]=ode45('Jump', [T], A0, options);
for i=1:size(T); H(i)=A(i,3);
    if (A(i,2)>=xv)&(A(i,2)<=xvl); A(i,6)=yv+hzv; H(i)=A(i,3)-yv;
end
    if (A(i,2)>=xvs)&(A(i,2)<=xvs1); A(i,6)=yvs+hzv; H(i)=A(i,3)-yvs;
end;
end
subplot(3,1,1); hold on; Fl_Tetta=plot (A(:,2),A(:,3),'-k')
D_Tetta=plot ([xv xv xvl xvl xvs xvs xvs1 xvs1],[0 yv yv 0 0 yvs yvs 0],'--k');
```

```

set( D_Tetta, 'LineWidth', 2 ); set( Fl_Tetta, 'LineWidth', 2 );
hold off; grid; xlabel('Coordinate X, sm'); ylabel('Coordinate Y, sm');
legend('Track','Barriers')
function F=Jump(t,x)
global vg hzv hz0 xv yv tzv tz0 xv1 xvs yvs xvs1
ot=2; A1t=4; A2t=4; lo=1; la=0; Log0=0; Log2=0; Log4=0; Logs0=0; Logs2=0;
Log1=0; Logs1=0; Duv=ot*vg*cos(tzv); Duvs=ot*vg*cos(0-x(1)); xt0=(yv+hzv-
x(3))/tan(tzv)+Duv;
xts0=(yvs+hzv-x(3))/tan(tzv)+Duvs; xts00=(yvs+hzv-hz0)/tan(tzv)+Duvs;
if (xv<x(2))&(x(2)<xv1); Log1=1; end;
if (xvs<x(2))&(x(2)<xvs1); Logs1=1; end
if or((x(2)<=xv-xt0),(x(2)>=xv1+xt0)); Log0=1; end
if or((x(2)<=xvs-xts0),(x(2)>=xvs1+xts0)); Logs0=1; end
if (xv-xt0<x(2))&(x(2)<xv-Duv); Log2=1; end
if (xv1-xt0<x(2))&(x(2)<xv1-Duv); Log2=-1; end
if (xvs-xts0<x(2))&(x(2)<xvs-Duvs); Logs2=1; end
if (xvs1+xts0<x(2))&(x(2)<xvs1-Duvs); Logs2=-1; end
if (x(2)<xvs-Duvs)&(x(2)>xvs-xts00); lo=0; la=1; end
tzad=(tz0)*Log1+(abs(asin((hz0-x(3))))*sign(hz0-x(3)))*Log0+(tzv*Log2);
tzads=(tz0)*Logs1+(abs(asin((hz0-x(3))))*sign(hz0-x(3)))*Logs0+(tzv*Logs2);
tzaa=atan((yvs+hzv-x(3))/(xvs-Duvs-x(2)));
Fey=max(tzad,tzads)*lo+max(tzaa,tzads)*la;
if abs(Fey)>=tzv; Fey=tzv*sign(Fey); end
if x(2)>xvs1+xts00; Fey=0; end
F=[ x(4); vg*cos(x(1)); vg*sin(x(1)); x(5); ot^3*(Fey-x(1))-x(5)*A1t*ot-
x(4)*A2t*ot^2; 0];
End

```

4. Conclusion

The implementation of MR in manufacturing contributes to a significant increase in productivity, cost reduction, improved safety and flexibility of production processes. There are various path planning methods for MRs, including graph search algorithms, random sampling, and intelligent bionic algorithms. Each of these methods has its own advantages and limitations that need to be considered when selecting an approach for a particular task.

The developed algorithms were tested by means of modelling, which allowed to confirm their efficiency. To improve the safety of MR movement, it is proposed to use laser rangefinders, the determining parameters of which are distance, mass, reliability, and cost.

For obstacle detection the VL53L1X laser rangefinder based on the principle of time-of-flight (ToF) measurement from the ST FlightSense product family with the parameters; distance measurement range up to 4 m, measurement frequency up to 50 Hz, independence from the obstacle colour and surface reflection properties was selected. It is recommended to install 3 laser rangefinders to realise the collision detection and automatic evasion system. The topic of MR path planning and collision avoidance remains topical and requires further research, especially in the context of MR integration with other automated technological systems and increasing their reliability and safety.

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References

1. Barashkov, A.A. (2020). Field bug algorithm in the problem of local motion planning for mobile robots. *Journal of Advanced Research in Technical Science*, No. 19, pp. 51-58. DOI: 10.26160/2474-5901-2020-19-51-58
2. Bizhanova, O., Salykova, O., Moldamurat, H., Ivanova, I. (2023). Methods of planning the trajectory of a mobile robot in conditions of uncertainty. *Bulletin of the Kazakh Academy of Transport and Communications named after M. Tynyshpayev*, No. 6(129), pp. 339-346. DOI: 10.52167/1609-1817-2023-129-6-339-346

3. D'Arco, M., Fratelli, L., Graber, G. et al. (2024). Detection and Tracking of Moving Objects Using a Roadside LiDAR System. *IEEE Instrumentation & Measurement Magazine*, no. 27, pp. 49-56.
4. Farhud, A.K. (2021). Control of a mobile robot using a neural network for motion planning in an unmapped environment with obstacles. *Izvestia YuFU. Technical Sciences*, No. 6(223), pp. 99-114. DOI: 10.18522/2311-3103-2021-6-99-114
5. Gazieva, L.R. (2024). Review of methods for planning the path of a mobile robot in an environment with obstacles. *Trends in Science and Education*, No. 110-117, pp. 73-76. DOI: 10.18411/trnio-06-2024-931
6. He, B., Fan, C., Mu, X., Wang, R. (2024). Mobile robot tracking system based on machine vision and laser radar. *Bulletin of the Pacific State University*, No. 2(73), pp. 63-70. DOI: 10.38161/1996-3440-2024-2-63-70
7. Jianing, L., Wei, Z., Wei, S. et al. (2021). High precision positioning algorithm based on two-dimensional code vision and laser radar fusion. *Computer Applications*, No. 41, pp. 1484-1491.
8. Koshman, A.M., Bykov, A.S., Leonard, A.V., Shurygin, V.A. (2024). Motion planning of a mobile robot with displacement of the initial potential field centre of a static obstacle. *Izvestiya Volgogradskogo Gosudarstvennogo Tekhnicheskogo Universiteta*, No. 4(287), pp. 65-71. DOI: 10.35211/1990-5297-2024-4-287-65-71
9. Krenicky, T. et al. (2022). Model-based design of induction motor control system in MATLAB. *Applied Sciences-Basel*, Vol. 12, Iss. 23, DOI: 10.3390/app122311957
10. Kuric, I. et al. (2021). Industrial robot positioning performance measured on inclined and parallel planes by double ballbar. *Applied Sciences-Basel*, Vol. 11, Iss. 4, DOI: 10.3390/app11041777
11. Li, C., Liu, X., Wang, J., Zhang, S. (2021). Trajectory planning of a mobile robot using a neural system. *World of Modern Science*, No. 4(68), pp. 7-10.
12. Majko, J. et al. (2022). Tensile properties of additively manufactured thermoplastic composites reinforced with chopped carbon fibre. *Materials*, Vol. 15, Iss. 12. DOI: 10.3390/ma15124224
13. Mammadova, T.A.K., Alieva, N.R.K. (2022). Path planning of a mobile robot in dynamic environments: a review. *Infinite Light in Science*, No. 6-6, pp. 156-165.
14. Mikheev, A.V., Svyatov, Y.A., Lapshov, V.G. (2020). Tronin Software tools for the analysis of mobile robot motion trajectory features using neural networks with attention. *Automation of Control Processes*, No. 3(61), pp. 70-79. DOI: 10.35752/1991-2927-2020-3-61-70-79.
15. Nikitin, Yu. (2024). *UAV control system with obstacle detection and automatic collision avoidance functions*. International Student Scientific Conference: Mechatronics, production technologies, digital enterprise: latest success, challenges and trends. 16.05.2024, pp. 137-149. ISBN 978-80-87583-51-7

16. Pavlov, A.S. (2021). Methodology of planning the trajectory of a group of mobile robots in an unknown closed environment with obstacles. *Control, Communication and Security Systems*, No. 3, pp. 38-59. DOI: 10.24412/2410-9916-2021-3-38-59
17. Qazizada, M.E., Pivarciová, E (2018). Reliability of parallel and serial centrifugal pumps for dewatering in mining process. *Acta Montanistica Slovaca*, 23(2), pp. 141-152.
18. Rego, G.E., Voronov, R.V. (2023). Algorithm of the dynamic path planning for the autonomous mobile robot with the minimum number of turns in the unknown environment. *Vestnik of Saint-Petersburg University. Applied mathematics. Informatics. Control processes*, Vol. 19, No. 2, pp. 264-274. DOI: 10.21638/11701/spbu10.2023.211
19. Sága, M., Bednár, R., Vasko, M. (2011). Contribution to modal and spectral interval finite element analysis. *Vibration Problems ICOVP*, Vol. 139, pp. 269-274. DOI10.1007/978-94-007-2069-5_37
20. Wen, I. (2022). Research of the trajectory planning algorithms for mobile robots. *Sustainable Development Issues of Society*, No. 8, pp. 1095-1105.
21. Yudintsev, B.S. (2019). Synthesis of the neural network system of trajectory planning for a group of mobile robots. *Control, Communication and Security Systems*, No. 4, pp. 163-186. DOI: 10.24411/2410-9916-2019-10406.

CONNECTED OR DISCONNECTED? EXPLORING GEN Z STUDENTS' COMMUNICATION STYLES IN NEGOTIATION CONTEXTS

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Purpose: This study examines the declared behaviors and self-awareness of Generation Z students in face-to-face and online negotiations, exploring how digital environments shape their negotiation dynamics.

Design/methodology/approach: The study draws on 214 survey responses from bachelor's and master's students collected in 2024 via Microsoft Forms. Using K-means cluster analysis, it identifies patterns in Gen Z's negotiation behaviors based on 27 Likert-scale items comparing face-to-face and online interactions, with a focus on factors influencing satisfaction and the role of nonverbal versus written communication.

Findings: The results reveal a marked preference for short-term communication orientation among Gen Z students, accompanied by a strong focus on practical interpersonal skills, including active listening and eye contact. No significant gender differences were identified, which may reflect the broader influence of diversity and inclusion policies.

Research limitations/implications: The research sample was limited to students of SGH Warsaw School of Economics, including Erasmus+ participants, which narrows the scope of generalization. The lack of longitudinal data restricted the ability to capture changes in negotiation skills over time. However, these constraints highlight opportunities for future studies with more diverse and repeated samples.

Practical and social implications: Despite its limitations, the study offers valuable insights into Gen Z's communication orientations as they enter the labor market. The findings can inform educators and trainers in designing more tailored negotiation programs, while also indicating that diversity and inclusion policies may already be shaping communication dynamics in positive ways.

Originality/value: The study advances understanding of how digital communication contexts and generational traits shape negotiation behavior, offering empirical insight into Gen Z's distinct interaction patterns. The paper is addressed to educators, trainers, and HR professionals, as the findings offer practical guidance for developing targeted negotiation training for the emerging workforce.

Keywords: Generation Z, negotiation behavior, communication skills, Face-to-face communication, diversity and inclusion.

Category of the paper: Research paper.

1. Introduction

In today's digitalized ecosystem individuals smoothly navigate across multiple communication channels (e-mail, messaging apps, video calls) often switching between them during interactions (Leonardi et al., 2012; Maude, 2014; Munkejord, n.d.). This shift is particularly evident in negotiations processes, which are no longer limited to F2F settings. Modern negotiation process often begins with online requests for proposals, proceeds through online communication and may finish either online or at a F2F negotiation meeting. Popularization of Internet use in negotiations triggered scientific research on the topic. Despite the growing number of studies focusing on the influence of communication medium on the negotiation process (Geiger, Laubert, 2018; Purdy et al., 2000), outcome and negotiators' satisfaction (Geiger, 2014; Kazemitabar et al., 2024; Kiruthika et al., 2020; Sheffield, 1995) several aspects remain underexplored due to the continuous advancement and integration of new technologies.

The current study focuses on digital versus F2F negotiation processes, especially within a semi-structured negotiation context, such as project collaborations or academic assignments, where participants have preliminary information and engage in goal-oriented discussions. In this environment, the negotiation process includes offer exchanges, verification and eventual selection, sometimes before the active dialogue begins. Understanding how communication mode shapes behavior and perceptions in such a hybrid environment is critical as more interactions move online.

The advent of digital technology has revolutionized communication, especially for Generation Z (Gen Z - born between the mid-1990s and early 2010s), who have grown up in a highly connected world. Gen Z's digital fluency, preference for instant communication, and familiarity with virtual interactions distinguish them from earlier generations. This demographic exhibits unique negotiation behaviors that warrant closer examination. Literature on Gen Z's communication patterns highlights their comfort with asynchronous tools, multimedia messaging, and reduced tolerance for ambiguity or delayed feedback (Turner, 2015; Seemiller, Grace, 2016), but how these traits translate into negotiation behavior remains unclear.

The primary aim of this study is to investigate the declared behaviors and self-awareness of Gen Z students in F2F and online negotiations. As digital natives, Gen Z's approach to negotiations may differ significantly between F2F and online interactions. This research seeks to uncover how digital environments influence their interactions dynamics. To address this,

the study applies K-means cluster analysis and unsupervised machine learning technique, to identify distinct patterns and groupings within Gen Z's negotiation behaviors. The research explores various factors influencing negotiation satisfaction, such as communication style, negotiation preparation, and cultural influences. Particular attention is paid to nonverbal communication in F2F context versus written communication and tool-assisted interactions with implications for both theory and practice. The findings of this study contribute to a better understanding of how communication channels and generational characteristics shape negotiation processes. By comparing F2F and online negotiation behaviors, insights into the strengths and weaknesses of each approach for Gen Z have been gained. This knowledge can help to design more effective negotiation strategies and training programs tailored to unique characteristics of the said generation. Furthermore, the research contributes to the broader discourse on how technology shapes interpersonal interactions and decision-making processes in professional settings.

2. Literature review

Paper Gen Z, iGeneration or iGen, post-millennials, Digital Natives and Facebook-generation (Sghari et al., 2023) is a cohort of individuals born between 1996 and 2010 (Gao, 2023), with the oldest members entering the workforce in 2017 (Chen, Ha, 2023). Gen Z officially surpassed the Baby Boomers in the US labor market in 2024 and is expected to represent 30% of the global workforce by 2030 (Dokoupilová et al., 2024). As the first generation to grow up entirely in a digitally connected world, Gen Z became a puzzling generation to discover and in consequence, a topic of scientific research due to their distinctive behaviors, values, and communication styles (Chen, Ha, 2023).

Initially, research on Gen Z concentrated on its educational experience, which posed challenges to traditional educational systems (Cilliers, 2017; Schwieger, Ladwig, 2018; Seemiller, Grace, 2016). Studies indicate that Gen Z differs from previous generations and requires more personalized approach in education and favors applied learning (Chardonnens, 2025; Shaker, 2025). While innovative entrepreneurial and passionate, they also demonstrate a tendency towards skepticism and require frequent feedback and instant gratification due to the information overload and shortened attention span. They are comfortable with multitasking, use of digital tools for earning income. As born and grown up “with a smartphone in their hands”, Gen Z desires technology and visual media to be integrated in educational settings (Demir, Sönmez, 2021). This reliance on technology for communication and learning may be interpreted through media synchronicity theory (Dennis et al., 2008) explaining how different media support varying levels of synchronicity and shared understanding. Gen Z's preference for interactive and visual communication tools aligns with media that allow rapid feedback and

real-time collaboration. Furthermore, the research suggests Gen Z exhibits a preference for individualism in terms of learning, communication, and interpersonal interaction (Pichler et al., 2021). Working in groups is perceived as challenging and problematic for this generation as they are more likely than previous ones to believe that “group projects bring out the worse in people”. They do not accept free riding and emphasize learning experience the most (Schlee et al., 2020).

Aside from educational sphere, scholars examined the issues Gen Z’s workplace expectations, in particular their job satisfaction, motivation, values, and communication styles (Dokoupilová et al., 2024; Lim, Lianto, 2024; Münz, Mascena, 2024). Research results show that technology plays a central role in the lives of Gen Z, from socializing to schoolwork, entertainment to exercise, relaxation to reference. This may influence their ability to effectively communicate and interact with others. Gen Z relies heavily on text message communication and digital platforms, what may hinder the development of their interpersonal skills such as listening, asking questions, or interrupting in a manner that respects others. They tend to rely on technology for communication, even in situations where it may not be suitable (Raslie, 2021; Schroth, 2019). As employees, Gen Z expects frequent interactions with supervisors, regular feedback about their performance, and also values F2F interactions. In regard to training, this generation is very tech-savvy but may require assistance when it comes to customer-facing roles (Asare, 2018; Irini, Racolța-Paina, 2021). This links to the social exchange theory (Blau, 1964) suggesting that Gen Z’s desire for constant feedback and reciprocal communication reflects their orientation toward fairness, trust, and balanced social relationships in professional environments.

Gen Z is more diverse and open to diversity what distinguishes it from previous generations and makes them particularly inclined toward inclusive organizational cultures (Irini, Racolța-Paina, 2021; Pichler et al., 2021). Communication has emerged as a defining characteristic of Gen Z, both as a strength and challenge. As digital natives who have grown up in a hyper-connected world, Gen Z’s communication is influenced by their comfort with technology, social media, and rapid information exchange. Researchers have noted that Gen Z tends to prioritize brevity, directness, and visual communication, with a strong preference for digital platforms such as messaging apps, social media, and video-based interactions (Raslie, 2021; Schwieger, Ladwig, 2018). Gen Z relay heavily on social media platforms as they become the primary arena for connecting with friends, family, and the wider world (Peredy et al., 2024). They strategically segment their use of digital platforms based on audience and purpose: Snapchat for peers, Facebook for family, and other platforms for learning, personal empowerment and entertainment. These distinctions in the use of social media platforms prove unique ways that Gen Z is using technology to communicate (Janssen, Carradini, 2021). According to media synchronicity theory, such platform differentiation illustrates Gen Z’s ability to match the medium to the message and the level of immediacy required, enhancing communication efficiency and satisfaction. While they embrace technology, they are also aware

of its drawbacks, including overuse, blurred boundaries between personal and professional life, and concerns over authenticity. They recognize the importance of self-regulation and differentiated communication across contexts (Janssen, Carradini, 2021).

However, recent research underscores a growing concern regarding Gen Z's communication skills. A 2024 study conducted in Canada involving over 1,500 respondents indicated that more than a half believed that social skills had decreased and 25% noticed the deterioration in verbal communication skills (Segal, 2024). This trend has been associated with the reduction of interpersonal contacts during the pandemic and the growing maturity of Gen Z. Reduction of physical contact, focus on privacy and striving for acceptance in social media, addiction to online information, isolation and loneliness, digital bulimia, loss of authenticity were identified as barriers to building social competences necessary in F2F communication (Peredy et al., 2024). These interpersonal challenges are visible in negotiation contexts, where active listening, emotional intelligence, eye contact and ability to interpret the body language are critical. It is also well established that the medium of communication plays a crucial role. Logsdon and Patterson (2010) highlight that digital communication can reduce empathy and moral awareness, increasing the likelihood of deception in interaction. Online communication can facilitate unethical behavior due to anonymity and weak social ties what gives a space for dishonest practices. Moral intensity (defined by magnitude of consequences and perceived social consensus) has been shown to influence ethical behavior in online interactions. This aligns with social exchange theory, as reduced social presence and weaker relational bonds in digital communication may lower perceived social costs of unethical behavior, encouraging strategic information withholding or distortion during negotiation. These findings demonstrate that Gen Z represents a unique blend of digital fluency, multitasking abilities, and value-driven decision-making what influence their communication skills and work attitudes.

Despite a growing number of research on Gen Z's communication and workplace integration, little is known about their negotiation behaviors, particularly in digital context. This study aims to explore the negotiation behavior of Gen Z with a focus on their use of digital versus F2F negotiation channels. In particular, the study addresses the following research questions:

1. How do Gen Z students perceive and prefer negotiation methods (online vs. face-to-face) in future business and professional communication contexts?
2. What role does gender play in shaping Gen Z students' preferences for negotiation communication styles as they prepare for professional careers?
3. How do age variations within Gen Z students influence their negotiation communication preferences and strategies for future workplace interactions?
4. To what extent do regional or cultural backgrounds affect Gen Z students' anticipated negotiation communication approaches in global professional environments?

5. How do communication competencies such as active listening, emotional regulation, and nonverbal behaviors correlate with Gen Z students' preferred negotiation methods in preparation for business careers?
6. What is the relationship between Gen Z students' negotiation method preferences and their attitudes toward ethical communication practices, including fairness and manipulation, in future professional negotiations?

These questions emphasize students' preparation for professional roles and the pedagogical implications for communication education in business contexts. This study offers valuable insights into the evolving communication preferences and competencies of emerging professionals, highlighting how educational strategies can better prepare them for effective negotiation in diverse business environments. By exploring the intersection of negotiation methods and communication skills among future workforce members, the research contributes to advancing pedagogical approaches that align with contemporary and future workplace demands.

3. Methods

In this section, the dataset is presented, followed by descriptive statistics including gender, age, region of origin, and academic discipline of responders. The variables used in the analysis are then introduced. Finally, the statistical methods employed in the study are described.

3.1. Dataset

The dataset consists of responses from an anonymous survey conducted among bachelor and master students via Microsoft Forms in the spring and autumn of 2024, gathering a total of 214 responses. The survey includes 27 questions, with the majority of them using a Likert scale ranging from 1 to 5, apart from basic demographic questions. The primary focus of the survey is a comparison between online and F2F interactions among Gen Z students. This dataset offers valuable insights into the preferences and priorities of Gen Z in both educational and professional contexts.

3.2. Descriptive statistics

The dataset shows an almost equal gender distribution, with 47% male and 53% female respondents. This balance enhances representativeness and reduces potential bias, supporting more accurate and generalizable conclusions across genders (Figure 1).

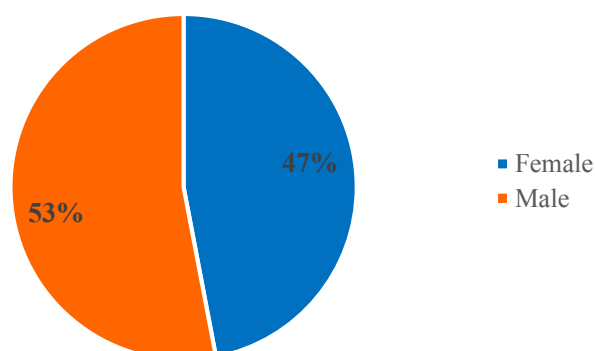


Figure 1. Gender distribution.

Source: Authors' elaboration.

The sample demonstrates an almost even distribution across the four age groups, which reflects the inclusion of both bachelor's and master's students in the study (Figure 1).

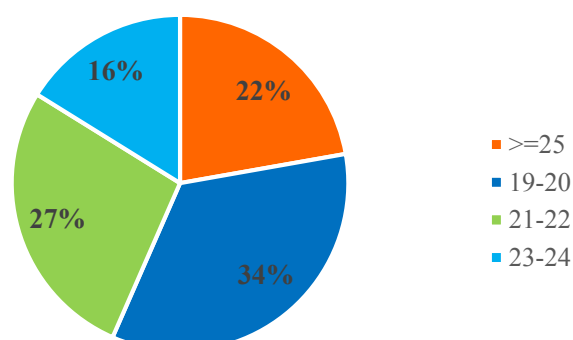


Figure 2. Age distribution.

Source: Authors' elaboration.

Achieving such balance across undergraduate and graduate cohorts strengthens the analysis by ensuring that the viewpoints of students at different stages of their academic journey are proportionally represented. This balanced structure supports more reliable comparisons across age categories. The distribution of participants across world regions, following the regional classification used by the World Bank for the 2025 fiscal year (World Bank, 2024) is illustrated in Figure 3.

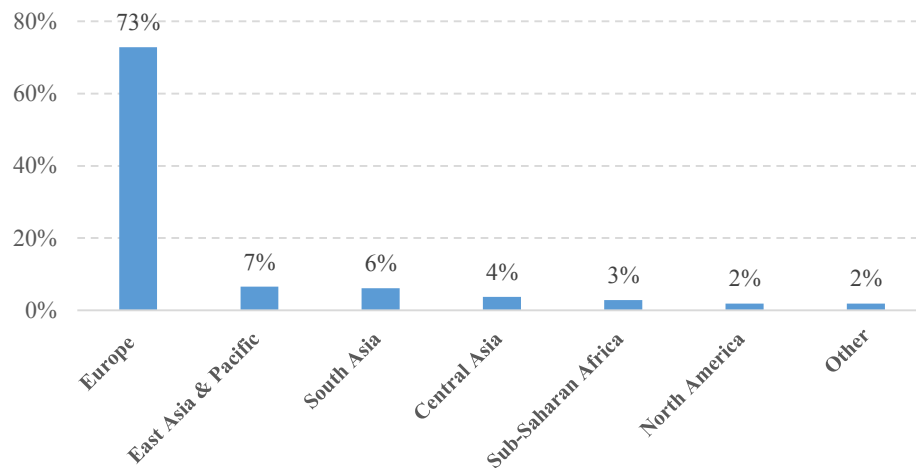


Figure 3. Region distribution.

Source: Authors' elaboration.

The majority of respondents (73%) originate from Europe, indicating a strong representation from this region. East Asia & Pacific and South Asia account for 7% and 6% of the sample respectively, followed by Central Asia with 4% and Sub-Saharan Africa with 3%. North America forms the smallest group, contributing just 2% of the total responses. This distribution clearly shows the dominance of European participants in the dataset, while other regions contribute smaller yet meaningful proportions to the overall geographic diversity of the sample.

The distribution of respondents across academic disciplines shows a clear concentration in business-related fields. Business Administration students form the largest segment at 44%, indicating a strong representation from this discipline. They are followed by Finance & Accounting students, who make up 21%, and Management students at 16%. Marketing accounts for 8% of the sample, while the remaining 10% consists of students from various other fields (Figure 4).

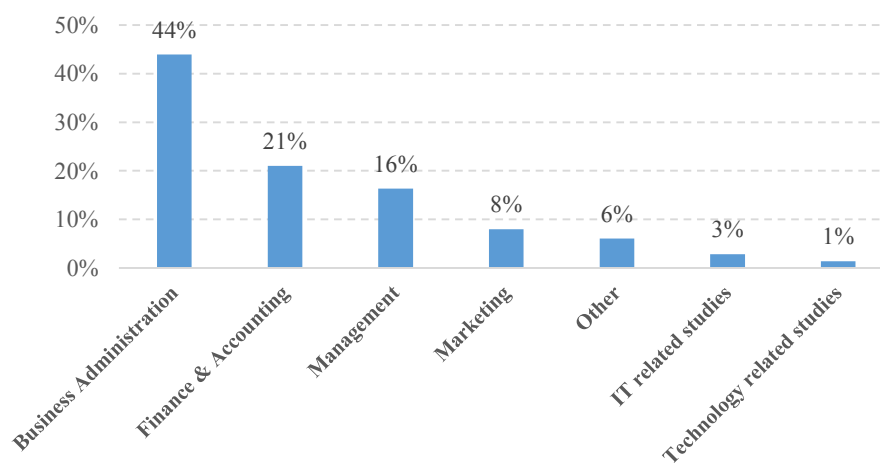


Figure 4. Major distribution.

Source: Authors' elaboration.

The major distribution highlights the predominance of Business Administration within the sample, while other fields account for comparatively smaller portions of the respondent population. The employment status of 214 respondents in relation to their field of study is presented in Figure 5.

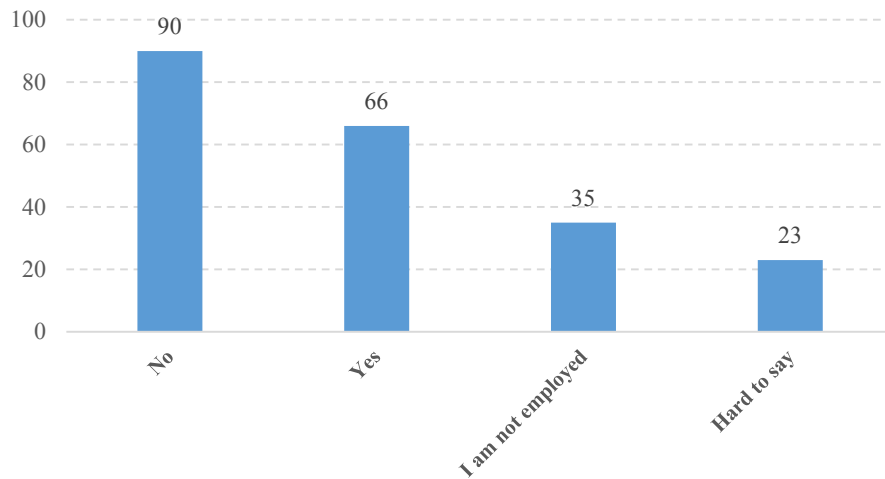


Figure 5. Employed in jobs related to education (number of respondents).

Source: Authors' elaboration.

A majority of 90 out of 214 respondents (42% of total) do not work in a profession related to their education. Meanwhile, 66 respondents are employed in a field aligned with their studies (31% of total sample). Additionally, 35 respondents are not employed, and 23 are unsure how to categorize their employment in relation to their education. Figure 5 reveals that a significant portion of respondents work outside their field of study.

3.3. Variables selection

Following an extensive review of communication literature, key variables related to interpersonal and digital communication were selected to explore their impact on negotiation behaviors:

- *Onlinenegosat* which is the response to the question: How satisfied are you with your online negotiations' skills? (Likert scale, see details in Appendix A).
- *F2Fnegosat* which is the response to the question: How satisfied are you with your on-site (Face-To- Face) negotiations skills? (Likert scale, see details in Appendix A).
- *Emotions* which is the response to the statement: I am very good at controlling my emotions (Likert scale, see details in Appendix A).
- *Pointofview* which is the response to the statement: During negotiations I can see things from the other party's point of view (Likert scale, see details in Appendix A).
- *Listening* which is the response to the statement: I prefer speaking rather than listening to other party (Likert scale, see details in Appendix A).

- *Sayingno* which is the response to the statement: I feel comfortable saying "no" to other party (Likert scale, see details in Appendix A).
- *Eyecontact* which is the response to the statement: When listening to other party, I maintain eye contact (Likert scale, see details in Appendix A).
- *Worstofpeople* which is the response to the statement: I tend to assume the worst of people (Likert scale, see details in Appendix A).
- *Bodylanguage* which is the response to the statement: I am very good at adjusting my body language during negotiations (Likert scale, see details in Appendix A).
- *Playdirty* which is the response to the statement: I am willing to play dirty in order to get my way (Likert scale, see details in Appendix A).

The full version of the questionnaire with scale of responses is available in Appendix A.

3.4. Statistical analysis

The primary goal of analysis was to extract tangible information from the collected data. Due to the fact that data are collected in categories, the meaningful grouping technique was data clustering with a goal to group the data objects whose characteristics and attributes are similar within a cluster and significantly different compared to another group of objects. Despite the fact that K-means algorithm was discovered in 1950s/1960s, it still remains the most popular and straightforward clustering algorithm (Ikotun et al., 2023; Jain, 2010; Sinaga, Yang, 2020). K-means clustering is a technique used to group objects into K distinct categories based on a set of features. This grouping is achieved by minimizing the sum of the squared distances between each object and its corresponding cluster. The K-means algorithm follows these steps: (1) selecting the center of the K-th cluster either randomly or using specific heuristics; (2) assigning each datapoint to the cluster that minimizes the distance between the datapoint and the cluster center; (3) recalculating the cluster centroids by averaging all the datapoints within each cluster; and (4) repeating steps 2 and 3 until the algorithm converges (Hartigan, Wong, 1979).

4. Results

In this section, two K-means clustering results for 214 observations are presented to highlight the differences in negotiation profiles between F2F and online negotiations.

Table 1 illustrates the respondents' satisfaction with F2F versus online negotiations. Out of the total respondents, 60 students (approximately 28%) rated their satisfaction with F2F negotiations higher than online. Meanwhile, 93 respondents (43%) rated their satisfaction with both F2F and online negotiations equally. On the other hand, 61 students (around 29%) reported higher satisfaction with online negotiations compared to F2F.

Table 1.

Number of responders (n) with higher self-assessment of satisfaction with F2F vs online negotiations

Self-assessment	n
F2F better	60
Online better	61
no difference	93

Source: Authors' elaboration.

Table 1 highlights the diverse self-assessment among respondents regarding negotiation satisfaction. Based on these results, a decision was made to divide the observations into three clusters. This approach allows for a more comprehensive analysis by grouping respondents according to their satisfaction levels with F2F versus online negotiations. The clustering will help identify distinct patterns and define negotiation profile among the different respondent groups.

The division of 214 observations into 3 clusters shows no association with the declared region of origin or gender (Appendix B and C). The results of the principal component analysis, when segmented by clusters and by region or gender, did not reveal any relationship between these factors in the studied sample for F2F negotiations. There are no significant differences in the self-assessment of negotiation skills between genders, both in online and F2F negotiations (Table 2).

Table 2.

Results of self-assessment of online and F2F negotiation skills among genders

Group	Average Online	Average F2F
Female	3,55	3,51
Male	3,46	3,49
Total	3,50	3,50

Source: Authors' elaboration.

The difference of 0.1 p between women and men in the case of online negotiations is not significant, although it requires investigation in further research. The questionnaire also included another gender, but the respondents did not check this box. Therefore, it is not taken into account. Variables such as BATNA (Best Alternative to a Negotiated Agreement), negotiation style, or ESG (Environmental, Social, Governance) from Appendix A were not included in the clustering process because the article primarily focuses on communication, cultural, and demographic aspects.

There are no significant differences in the self-assessment of negotiation skills between age groups in online negotiations (Table 3). However, in the case of F2F negotiations, an upward trend is observed – self-assessment of F2F negotiation skills increases with age. In the case of online negotiations, the trend is not clear.

Table 3.*Results of self-assessment of online and F2F negotiation skills among various age groups*

Group	Average Online	Average F2F
19-20	3,55	3,34
21-22	3,40	3,34
23-24	3,57	3,69
>=25	3,50	3,79
Total	3,50	3,50

Source: Authors' elaboration.

What is noteworthy is the decrease in self-assessment among the 21-22 age group compared to the 19-20 group by more than 0.15 points. This is followed by an increase of 0.17 points in the 23-24 age group compared to the 21-22 group in terms of negotiation skills self-assessment.

The characteristics of three clusters based on respondents' self-assessments related to online negotiations is presented in Table 4.

Table 4.*Results of K-mean clustering for 11 characteristics and online negotiation satisfaction*

Feature	Cluster 1	Cluster 2	Cluster 3
onlinenegosat	3,83	3,76	3,12
emotions	3,92	4,37	3,52
pointofview	3,67	4,27	3,70
listening	3,50	2,67	2,35
sayingno	3,85	3,76	2,88
eyecontact	4,06	4,59	3,72
worstofpeople	3,48	2,34	2,50
bodylanguage	3,73	3,91	2,73
playdirty	3,83	2,13	2,08

Source: Authors' elaboration.

Cluster 1 is characterized by the highest self-rated satisfaction with online negotiations. However, it shows average scores in emotional control, maintaining every contact during listening, and adapting body language during negotiations in comparison to all three clusters. Cluster 1 also has the lowest self-ratings in respecting others' point of view, struggles with listening to other part, tends to assume the worst about others, and willingness to play dirty in order to get own way. Cluster 2 demonstrates average satisfaction with online negotiations but stands out with the highest self-assessments in emotional control, understanding other perspectives, reluctant to assume the worst of people, adapting body language, and maintaining eye contact during listening. Cluster 3 reports the lowest satisfaction with online negotiations and rates themselves the lowest in emotional control, felling comfortable saying "no" to other party, lowest score in maintaining eye contact during listening and adapting body language during negotiations. However, respondents in this cluster have very high self-assessments in listening more than talking and strive to "play fair" in order to persuade others to their point of view.

The results of the online negotiation assessments are not conclusive, as a high self-rating of online negotiations (Cluster 1) does not correlate with high ratings in other characteristics. On the other hand, an average satisfaction rating with online negotiations (Cluster 2) is

associated with the highest scores in emotional control, understanding the other party's perspective, and maintaining eye contact.

The results for F2F negotiations are more consistent (Table 5).

Table 5.

Results of K-mean clustering for 11 characteristics and F2F negotiation satisfaction

Feature	Cluster 1	Cluster 2	Cluster 3
onlinenegosat	3,88	3,82	2,95
emotions	4,24	3,88	3,59
pointofview	4,19	3,75	3,67
listening	2,67	3,45	2,36
sayingno	3,65	3,88	2,88
eyecontact	4,59	4,06	3,64
worstofpeople	2,33	3,43	2,56
bodylanguage	3,92	3,76	2,60
playdirty	2,00	3,94	2,14

Source: Authors' elaboration.

Table 5 shows that cluster 1 not only has the highest self-assessed satisfaction with F2F negotiations, but also scores the highest in most characteristics, such as emotional control, understanding the other party's perspective, maintaining eye contact while listening, not assuming the worst about others, effectively adapting body language during negotiations and no willingness to play dirty in order to get own way. Cluster 2, with an average satisfaction rating for F2F negotiations, also shows average scores across most parameters. However, it scores the lowest in playing fair to persuade the other side. Additionally, respondents in Cluster 2 tend to assume the worst about others and often talk more than they listen. Cluster 3 consists of individuals who rate themselves the lowest in satisfaction with F2F negotiations. Similarly, they gave the lowest ratings to their abilities in emotional control, maintaining eye contact, and adapting body language. Interestingly, like in the online negotiation results, Cluster 3 rated themselves highest in listening skills.

Table 5 demonstrates that the satisfaction profile in Cluster 1 (the highest self-assessment) for F2F versus online negotiations presented in Table 4 is significantly different. It is evident that in Cluster 1, those with the highest F2F ratings have much better abilities in understanding other perspectives, maintaining eye contact, and not assuming the worst about others compared to online negotiation profile in Cluster 1.

5. Discussion

The research was conducted among students at the SGH Warsaw School of Economics, some of whom participated in Negotiation Techniques classes and international students from Europe are participants of the Erasmus + exchange. This also means that these are selected students both in terms of grades and social behavior. Therefore, the conclusions are also

burdened with the above factor. Next, it should be considered that management-related courses dominate in the study population. The above courses teach subjects related to communication, ethics, and social responsibility, among others. However, despite the inclusion of ethical issues and social responsibility in the course, unethical tactics based on manipulation are still preferred by the surveyed students, especially in the case of online negotiations. More than 70 percent of the students surveyed are already working, which means that they are in contact with negotiations in a business environment. When it comes to comparing negotiation skills in age groups, one can notice generally lower scores in the case of people who prefer F2F negotiations from the youngest age groups. This score in this group clearly increases in the subsequent age groups. In the case of people who prefer online negotiations, such a trend is not visible.

The analysis of the survey results did not confirm that there were any significant differences in the preferences of Gen Z students in choosing the type of negotiation based on gender and age. The country of origin also did not differentiate the answers. The analysis of the metrics showed that the majority of respondents came from European countries. Therefore, free access to travel opportunities and the participation of Erasmus+ students in the survey meant that no significant differences in the statements were noted. In connection with the above, the authors focused on finding answers to the last 2 questions: is there a correlation between the chosen method of negotiation and effective communication and does a specific method of communication affect the tendency to manipulation. Based on the literature review, it was found that effective communication consists of a certain number of factors. After the analysis, several that were repeated most often were selected and included in the questionnaire. These were: listening, emotional control, body language control, eye contact, considering other viewpoints, ability to say "no"). Four of them were non-verbal behaviors and two - verbal. In turn, 2 areas were selected for the analysis regarding the use of manipulation techniques: engaging in unfair practices, assuming the worst in others.

As a result of further analyses, it was decided to use the K-means clustering algorithm, distinguishing groups depending on the preferred type of negotiation: F2F and/or online. The analysis noted that in the case of age within the F2F group there is a noticeable "jump" in the assessment of negotiation skills. It concerns second-cycle students (master's studies), where the number of professional experiences is higher than in the case of first-cycle students. In the groups preferring online and F2F negotiations, 3 clusters were distinguished: 1 - declaring the highest satisfaction, 2 - with average satisfaction and 3 - with the lowest satisfaction with negotiations. In the case of online negotiations, the differences between clusters occur especially in the case of listening, the ability to say "no", tends to assume the worst about others and the tendency to "play dirty" (the highest in 1, the lowest in 3). In cluster 2, the highest rated skills compared to the other clusters are self-assessment in emotional control, understanding other perspectives, reluctant to assume the worst of people, adapting body language, and maintaining eye contact during listening. Although the tendency to play dirty and perceive people as untrustworthy is not rated above 4 points in each of the clusters, such a tendency is

clearly visible in the case of cluster no. 1, with the highest level of online satisfaction. It is interesting that such a tendency goes hand in hand with maintaining eye contact (manipulating without "blinking"). It should be added, however, that maintaining eye contact was rated quite high in all clusters. The above results do not allow for an unequivocal statement that respondents who prefer online negotiations, depending on the level of satisfaction, have specific communication competences in their own assessment.

In turn, in the groups that prefer F2F negotiations, the distribution of statements is different compared to the online group. Cluster 2 can be distinguished, with an average level of satisfaction. In this case, relatively high listening skills (compared to the other clusters) go hand in hand with "dirty play" and lack of trust in others. Importantly, manipulative behaviors appear to be rooted in perceptions of negotiation as a win-lose scenario (Maude, 2014). This perspective motivates participants to seek advantages via techniques that create information asymmetry and psychological pressure (Lewicki, Robinson, 1998; Malutan, 2025). Similarly, agency theory in economics explains manipulation through information asymmetry when agents may engage in hidden actions or withhold important knowledge from principals (Arrow, 1971; Eisenhardt, 1989; Thaler, 2018). In negotiations, such behaviors enable the accumulation of benefits in the hands of one party, consistent with behavioral economic principles (Brdulak, 2021). Moreover, in Cluster 2, the highest ratings were given to the skills of maintaining eye contact, similarly to the online group. This may mean that the difference between the distinguished groups does not affect the assessment of eye contact as an important negotiation competence. This is also evidenced by the similar level of assessment of body language by both groups, although in the case of F2F negotiations, the cluster with the lowest level of satisfaction (no. 3) also rated this competence the lowest.

Among the limitations of the study, one should mention the selection of the research group. The respondents were students of SGH Warsaw School of economics, partly from the Erasmus+ exchange program. Therefore, the research results can only be interpreted for the above group. One key limitation of the study is the homogeneity of the sample, as it was drawn exclusively from a single university. Moreover, the absence of panel data or multiple time points prevented the measurement of progress in both face-to-face and online negotiations following training. Nonetheless, the article has many positive aspects and its innovative focus on Gen Z provides essential insights into individuals entering the labor market.

6. Conclusions

Brdulak (2008) underlines the importance of both short- and long-term orientations in communication as key elements of negotiation models. This seems particularly relevant for Gen Z, whose communication style is often focused on immediate outcomes and short-term

benefits. The study did not show significant gender differences in self-assessed negotiation skills, which may suggest that ongoing diversity, equality, and inclusion initiatives in universities and workplaces have helped reduce perceived disparities. Although recent political developments in the United States may slow the public promotion of DEI policies (Panjwani, 2025), it is unlikely that organizations will abandon the practices they have already adopted. Many appear to be waiting for clearer policy directions before adjusting their public stance.

Active listening, often described as core negotiation competence, also proved relevant for recognizing manipulative behavior. Among participants who preferred F2F negotiations, better listening skills were linked to greater awareness of potential “dirty play”. In the online group, a similar tendency appeared among respondents who rated their negotiation competences and the role of eye contact highly, even in settings where visual cues are limited. This suggests that, despite the constraints of online communication, Gen Z negotiators still value and consciously use non-verbal elements such as eye contact to build influence and trust.

Respondents who preferred online negotiations tended to rate their overall negotiation competences slightly higher than those who favored F2F interactions. This may be because online negotiations, while more accessible and less stressful, do not require the same degree of emotional control or adaptability as direct encounters. F2F negotiations demand stronger preparation, greater personal resilience, and the ability to manage tension. As Brdulak (2000) notes, coping effectively with negotiation stress requires the ability to step back and view the situation from a broader perspective, a skill that often develops with experience.

Despite being educated in communication, ethics, and social responsibility, the surveyed students still demonstrated a pragmatic approach to negotiation, with acceptance of manipulative tactics, especially online. At the same time, consistent emphasis on listening and eye contact indicates that Gen Z negotiators do not reject traditional interpersonal competencies but adapt them to hybrid forms of negotiation. Finally, manipulative behaviors in negotiations appear theoretically supported by both negotiation and agency theory. Viewing negotiations as win–lose situations motivates the use of tactics that exploit information asymmetry and psychological leverage. This aligns with the agency theory concepts of moral hazard and adverse selection, offering a behavioral economic explanation for why negotiators may strategically withhold or distort information to maximize benefits.

References

1. Arrow, K.J. (1971). *Essays in the theory of risk-bearing*. Markham Publishing Co. Chicago.
2. Asare, J.G. (2018). How Generation Z Will Impact Your Workplace. *Forbes*. <https://www.forbes.com/sites/janicegassam/2018/12/26/how-the-newest-generation-generation-z-will-impact-your-workplace/>, 26.02.2025.

3. Blau, P.M. (1964). Justice in Social Exchange. *Sociological Inquiry*, 34, pp. 193-206. <http://dx.doi.org/10.1111/j.1475-682X.1964.tb00583.x>
4. Brdulak, H., Brdulak, J. (2000). *Negocjacje handlowe*. Warszawa: PWE.
5. Brdulak, H. (2008). Rola komunikowania w kulturze organizacyjnej korporacji międzynarodowych. *Zeszyty Naukowe*. Szkoła Główna Handlowa, Kolegium Gospodarki Światowej, pp. 98-117.
6. Brdulak, H. (2021). Koncepcja krajowego operatora logistycznego w kontekście makroekonomicznym i społecznym. In: L. Reszka, M. Chaberek (Eds.), *Rozwój funkcji logistycznych w Grupie PKP: Przesłanki i uwarunkowania* (pp. 93-110). Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.
7. Chardonens, S. (2025). Adapting educational practices for Generation Z: integrating metacognitive strategies and artificial intelligence. *Frontiers in Education*, 10. <https://doi.org/10.3389/educ.2025.1504726>
8. Chen, P., Ha, L. (2023). Gen Z's social media use and global communication. *Online Media and Global Communication*, 2, pp. 301-303. <https://doi.org/10.1515/omgc-2023-2006>
9. Cilliers, E.J. (2017). The challenge of teaching Generation Z people. *International Journal of Social Sciences*, 3, pp. 188-198. <https://doi.org/10.20319/pijss.2017.31.188198>
10. DemiR, B., Sönmez, G. (2021). Generation Z students' expectations from English language instruction. *Dil ve Dilbilimi Çalışmaları Dergisi*, 17, pp. 683-701. <https://doi.org/10.17263/jlls.903536>
11. Dennis, A.R., Fuller, R.M., Valacich, J.S. (2008). Media, tasks, and communication processes: A theory of media synchronicity. *Management Information Systems Quarterly*, 32(3), pp. 575-600, <https://doi.org/10.2307/25148857>
12. Dokoupilová, L., Cogiel, A., Fero, M. (2024). Values as motivating factors for representatives of Generation Z in the Czech Republic and Slovakia within the European context. *Frontiers in Psychology*, 15. <https://doi.org/10.3389/fpsyg.2024.1404354>
13. Eisenhardt, K.M. (1989). Agency theory: An assessment and review. *Academy of Management Review*, 14(1), pp. 57-74.
14. Gao, M.H. (2023). From the Traditionalists to GenZ: conceptualizing intergenerational communication and media preferences in the USA. *Online Media and Global Communication*, 2, pp. 422-445. <https://doi.org/10.1515/omgc-2023-0011>
15. Geiger, I. (2014). Media Effects on the Formation of Negotiator Satisfaction: The Example of Face-to-Face and Text Based Electronically Mediated Negotiations. *Group Decision and Negotiation*, 23, pp. 735-763. <https://doi.org/10.1007/s10726-012-9317-3>
16. Geiger, I., Laubert, C. (2018). Situational strategic versus personal influences on negotiation medium choice: Media synchronicity theory and affect for communication channel. *International Journal of Conflict Management*, 29, pp. 398-423. <https://doi.org/10.1108/IJCMA-06-2017-0054>

17. Hartigan, J.A., Wong, M.A. (1979). Algorithm AS 136: A K-Means Clustering Algorithm. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 28, pp. 100-108. <https://doi.org/10.2307/2346830>.
18. Ikotun, A.M., Ezugwu, A.E., Abualigah, L., Abuhaija, B., Heming, J. (2023). K-means clustering algorithms: A comprehensive review, variants analysis, and advances in the era of big data. *Information Sciences*, 622, pp. 178-210. <https://doi.org/10.1016/j.ins.2022.11.139>
19. Irini, R.-D., Racolța-Paina, N. (2021). Generation Z in the Workplace through the Lenses of Human Resource Professionals - A Qualitative Study. *Quality - Access to Success* 22(183), pp. 78-85.
20. Jain, A.K. (2010). Data clustering: 50 years beyond K-means. *Pattern Recognition Letters. Award winning papers from the 19th International Conference on Pattern Recognition (ICPR)*, 31, pp. 651-666. <https://doi.org/10.1016/j.patrec.2009.09.011>
21. Janssen, D., Carradini, S. (2021). Generation Z Workplace Communication Habits and Expectations. *IEEE Transactions on Professional Communication*, 64, pp. 137-153. <https://doi.org/10.1109/TPC.2021.3069288>
22. Kazemitabar, M., Mirzapour, H., Akhshi, M., Vatankhah, M., Hatami, J., Doleck, T. (2024). Power of nonverbal behavior in online business negotiations: understanding trust, honesty, satisfaction, and beyond. *Interactive Learning Environments*, 32, pp. 1442-1459. <https://doi.org/10.1080/10494820.2022.2121728>
23. Kiruthika, U., Somasundaram, T.S., Raja, S.K.S. (2020). Lifecycle Model of a Negotiation Agent: A Survey of Automated Negotiation Techniques. *Group Decision and Negotiation*, 29, pp. 1239-1262. <https://doi.org/10.1007/s10726-020-09704-z>
24. Leonardi, P.M., Neeley, T.B., Gerber, E.M. (2012). How managers use multiple media: Discrepant events, power, and timing in redundant communication. *Organization Science*, 23, pp. 98-117. <https://doi.org/10.1287/orsc.1110.0638>.
25. Lewicki, R.J., Robinson, R.J. (1998). Ethical and unethical bargaining tactics: An empirical study. *Journal of Business Ethics*, 17(6), pp. 665-682.
26. Lim, A.T., Lianto, L. (2024). Ethical Leadership in the Eyes of Gen Z: A Literature Review. *FIRM Journal of Management Studies*, 9. <https://doi.org/10.33021/firm.v9i1.5059>
27. Malutan, D. (2025). Manipulation in Negotiations: The Hidden Costs of the “Easy” Victory, *Journal of Research and Innovation for Sustainable Society (JRISS)*, Vol. 7, Iss. 1, pp. 212-221. Thoht Publishing House, DOI: 10.33727/JRISS.2025.1.22:212-221
28. Maude, B. (2014). *International Business Negotiation: Principles and Practice*. 2014th edition. Houndmills, Basingstoke, Hampshire New York: Palgrave MacMillan.
29. Munkejord, K. (n.d.). Multiple Media Use in Organizations: Identifying Practices Leading to an Alignment Paradox. *Journal of Information, Information Technology, and Organizations (Years 1-3)*, 2, pp. 095-118.

30. Münz, C., de Mascena, K.M.C. (2024). Work values and attitudes toward the technology of Generation Z in Brazil and Germany. *Internext*, 19. <https://doi.org/10.18568/internext.v19i1.773>.
31. Panjwani, H. (2025). *Details about Trump's executive orders around DEI are causing confusion*. AP News, <https://apnews.com/article/trump-dei-businesses-diversity-05fb71a91cab7e3bbe8729f6bdeb4983>, 26.02.2025.
32. Peredy, Z., Vigh, L., Quingyu, W., Muiy, J. (2024). Analysing Generation Z Communication Attitudes, Values and Norms. *Acta Periodica*, 30, pp. 4-19. <https://doi.org/10.47273/AP.2024.30.4-19>
33. Pichler, S., Kohli, C., Granitz, N. (2021). DITTO for Gen Z: A framework for leveraging the uniqueness of the new generation. *Business Horizons*, 64, pp. 599-610. <https://doi.org/10.1016/j.bushor.2021.02.021>
34. Purdy, J.M., Nye, P., Balakrishnan, P.V. (Sundar) (2000). The impact of communication media on negotiation outcomes. *International Journal of Conflict Management*, 11, pp. 162-187. <https://doi.org/10.1108/eb022839>
35. Raslie, H. (2021). Gen Y and Gen Z Communication Style. *Studies of Applied Economics*, 39. <https://doi.org/10.25115/eea.v39i1.4268>
36. Schlee, R.P., Eveland, V.B., Harich, K.R. (2020). From Millennials to Gen Z: Changes in student attitudes about group projects. *Journal of Education for Business*, 95, pp. 139-147. <https://doi.org/10.1080/08832323.2019.1622501>
37. Schroth, H. (2019). Are You Ready for Gen Z in the Workplace? *California Management Review*, 61, pp. 5-18. <https://doi.org/10.1177/0008125619841006>
38. Schwieger, D., Ladwig, C. (2018). Reaching and retaining the next generation: Adapting to the expectations of Gen Z in the classroom. *Information Systems Education Journal*, 16, pp. 45-54.
39. Seemiller, C., Grace, M. (2016). *Generation Z Goes to College*. New Jersey: John Wiley & Sons.
40. Segal, E. (2024). *Why The Social and Verbal Skills of Some Gen Z Workers Have Declined*. <https://www.forbes.com/sites/edwardsegal/2024/06/16/why-the-social-and-verbal-skills-of-some-gen-z-workers-have-declined/>, 26.02.2025.
41. Sghari, A., Chtourou, W., Ghattas, S. (2023). Decoding Gen Z employee profiles: revealing work values. *Recherches en Sciences de Gestion*, 159, pp. 267-294. <https://doi.org/10.3917/resg.159.0267>
42. Shaker, H. (2025). Teaching the Digital Natives: Examining the Learning Needs and Preferences of Gen Z Learners in Higher Education. *Transcultural Journal of Humanities and Social Sciences*, 6, pp. 214-242. <https://doi.org/10.21608/tjhss.2025.346098.1303>
43. Sheffield, J. (1995). The effect of communication medium on negotiation performance. *Group Decision and Negotiation*, 4, pp. 159-179. <https://doi.org/10.1007/BF01410100>

44. Sinaga, K.P., Yang, M.S. (2020). Unsupervised K-Means Clustering Algorithm. *IEEE Access*, 8, pp. 80716-80727. <https://doi.org/10.1109/ACCESS.2020.2988796>
45. Thaler, R.H. (2018). *Zachowania niepoprawne: Tworzenie ekonomii behawioralnej* (eng. *Misbehaving*). Poznań: Publ. Media Rodzina.
46. World Bank (2024). *World Bank Country and Lending Groups*. <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>, 09.06.2024).

Abbreviations

F2F: face-to-face (in-person).

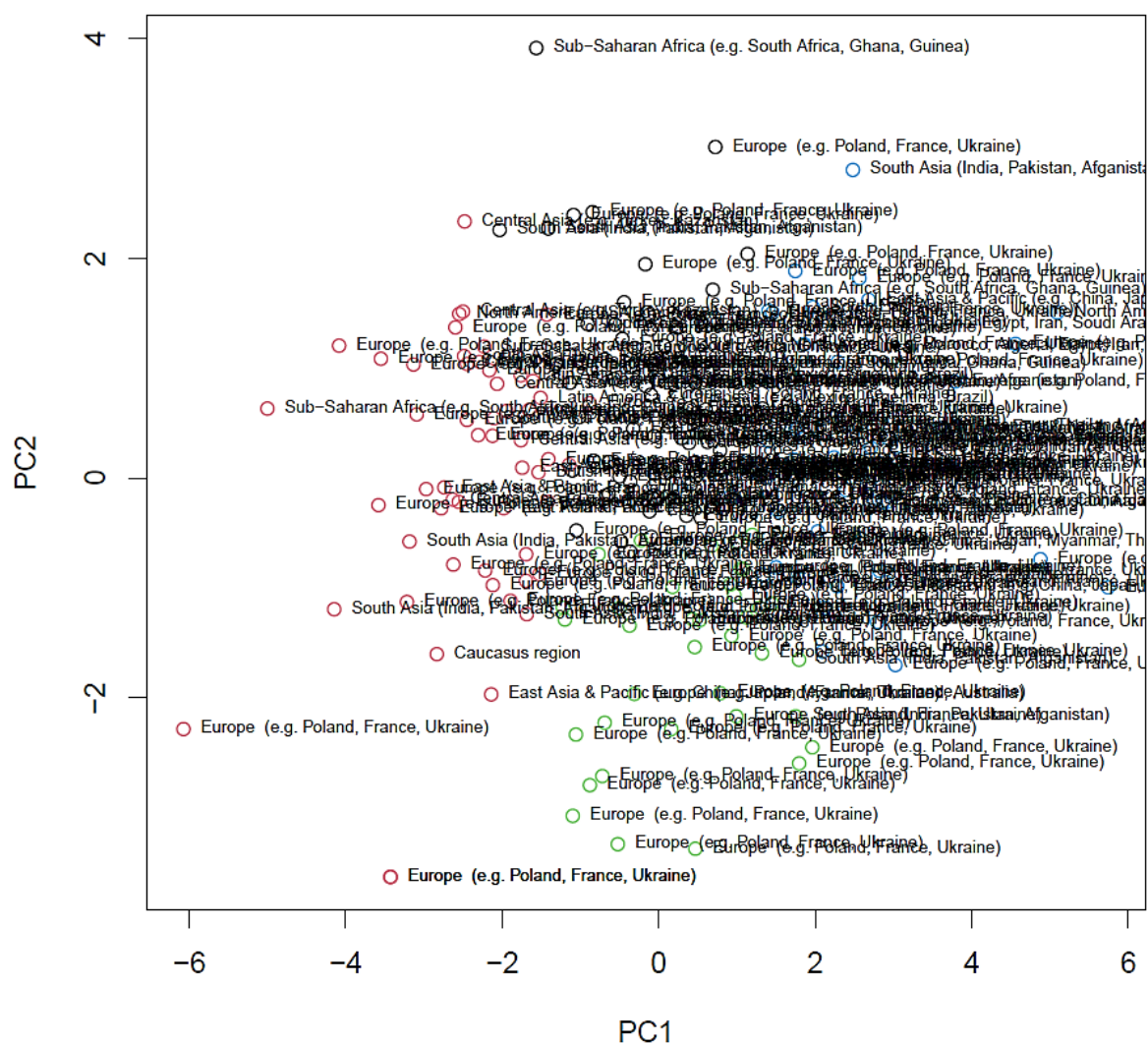
Gen Z: Generation Z (born between the mid-1990s and early 2010s).

Appendix A – Questionnaire

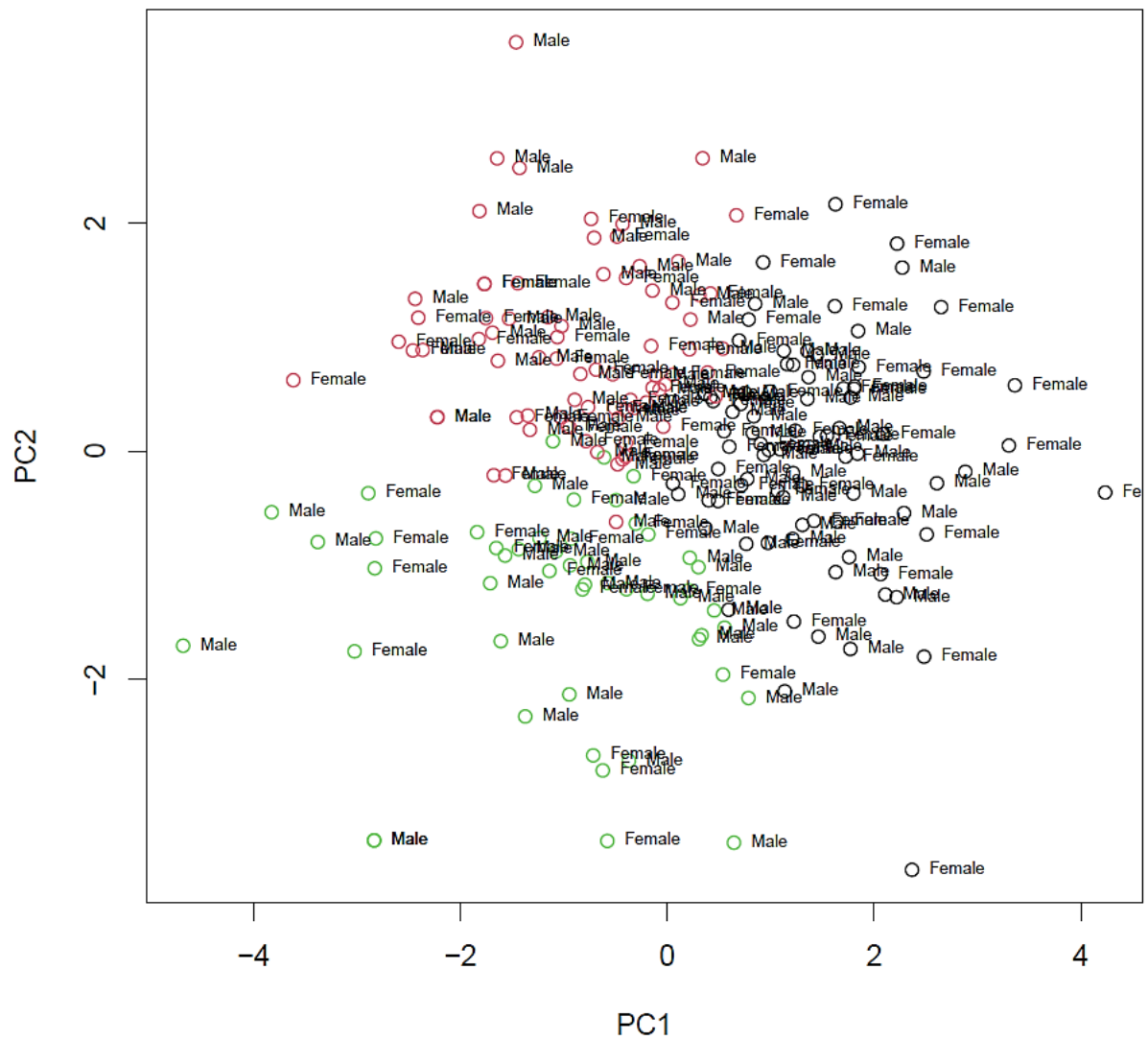
Questions	Variable	Scale
What is your gender?	sex	Male, Female; Other
What is your age?	age	19-20 years old; 21-22 years old; 23-24 years old; >=25 years old
Please select your region (if other please type country):	region	Europe (e.g. Poland, France, Ukraine) North America (USA, Canada) Latin America & Caribbean (e.g. Mexico, Argentina, Brazil) Middle East & North Africa (e.g. Marocco, Algeria, Egypt, Iran, Soudi Arabia) South Asia (India, Pakistan, Afganistan) Central Asia (e.g. Turkey, Kazahstan) East Asia & Pacific (e.g. China, Japan, Myanmar, Thailand, Australia) Sub-Saharan Africa (e.g. South Africa, Ghana, Guinea)
Which of the following majors is the most similar to yours?	study	Finance & Accounting Business Administration Business Administration Law Management Technology related studies IT related studies Social Science Medicine & Health Other
Are you currently employed in job related with your education?	eduemployed	Yes No Hard to say I am not employed
Please select type of your negotiations experience:	negoexp	Private Business Both
How satisfied are you with your online negotiations skills?	negosat	1 - very dissatisfied; 2 - dissatisfied; 3 - neither satisfied nor dissatisfied; 4 - satisfied 5 - very satisfied
How satisfied are you with your on-site (Face-To- Face) negotiations skills?	F2Fnegosat	1 - very dissatisfied; 2 - dissatisfied; 3 - neither satisfied nor dissatisfied; 4 - satisfied 5 - very satisfied
How comfortable are you during negotiations with party from other country?	country	1 - very uncomfortable; 2 - uncomfortable; 3 - neither uncomfortable nor comfortable; 4 - comfortable, 5 - very comfortable
How comfortable are you during negotiations with party older than you?	older	1 - very uncomfortable; 2 - uncomfortable; 3 - neither uncomfortable nor comfortable; 4 - comfortable, 5 - very comfortable
How comfortable are you during negotiations with party of different gender than you?	gender	1 - very uncomfortable; 2 - uncomfortable; 3 - neither uncomfortable nor comfortable; 4 - comfortable, 5 - very comfortable
I am very good at controlling my emotions.	emotions	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
During negotiations I can see things from the other party's point of view.	pointofview	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I prefer speaking rather than listening to other party.	listening	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I feel comfortable saying "no" to other party.	sayingno	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always

When listening to other party, I maintain eye contact.	eyecontact	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I tend to assume the worst of people.	worstofpeople	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I am comfortable with a conflict situation in negotiations.	conflict	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I am very good at adjusting my body language during negotiations.	bodylanguage	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I prefer to use the same negotiation style for every negotiation situation.	negostyle	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I carefully prepare my negotiations, including BATNAs.	BATNA	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I find it easy to convince people to see/do things my way.	myway	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
I am willing to play dirty in order to get my way	playdirty	1 - never; 2 - rarely; 3 - sometimes; 4 - often, 5 - always
Are you familiar with Sustainable Development Goals (SDGs)?	SDG	Yes No
Are you familiar with Environmental, Social and Governance (ESG) metrics?	ESG	Yes No
Which dimension in your opinion is influencing the negotiations the most?	ESGimpact	Environmental dimension (e.g. reduction impact on the planet) Governance dimension (e.g. ensure executives uphold stakeholders rights and interest) Social dimension (e.g. health, human and labor rights, fair wages, working conditions) None of the above
Which of the following do you think is the most important when choosing your future job? (please select max 3)	jobpreference	Work/life Balance ESG activity of employer Job Duties & Projects Health Insurance & Wellness Benefits Salary Career Growth Opportunities Investment and Financial Planning Benefits Diversity, Equity, and Inclusion at workplace Flexible working hours

Appendix B – Principal component analysis for F2F clustering results segmented by regions of origin



Appendix C – Principal component analysis for F2F clustering results segmented by sex



PROACTIVITY AND ADAPTATION TO WORK: VALIDATION OF THE PROACTIVE WORK ADAPTATION QUESTIONNAIRE (PWAQ)

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Purpose: This study describes the preliminary validation of the Proactive Work Adaptation Questionnaire (PWAQ), which is a new method designed to assess an individual's proactive adaptation to work in practice. The PWAQ measures the tendency to self-start the action and change the environment to fulfill one's goals while adapting to work.

Design/methodology/approach: The study was conducted with a group of 220 employees to test the psychometric properties of the instrument, specifically its reliability and validity. The exploratory factor analysis showed a three-factor structure. The external relevance showed positive correlations between each factor and other individual difference factors, i.e., proactive personality and self-efficacy beliefs. As expected, proactive adaptation was related to motivation to work.

Practical implications: The validation results found the PWAQ a valid and reliable measure for evaluating proactivity in the work adaptation process.

Originality/value: PWAQ is a promising tool for analyzing the newcomers' ability to act proactively in new and challenging professional conditions, which might be useful during the onboarding process.

Keywords: work adaptation, proactive coping, proactive work adaptation, organizational newcomers, proactive adaptation scale.

Category of the paper: Research paper.

1. Introduction

Nowadays, employees change their place of employment at least once in 10 years. High occupational mobility occurs mainly among younger employees who enter a new organization, on average, every two years (European Foundation..., 2006). According to worldwide predictions (Bauer, Erdogan, 2011), individuals change their place of employment an average of ten times over 20 years. A strong intention to change work is found among newly

hired employees. Some new employees (4%) leave immediately after a bad first day at work, while 22% resign within the first 45 days. One of the reasons for employee turnover is poor adaptation to the new workplace, which results in a lack of commitment to the job or even a desire to change it. In accordance, increasing job mobility results in frequent entering a new organization, and thus, effective adaptation to a new workplace gains more and more importance.

Adaptation to the workplace is understood as the actions the employee takes to recognize their role in the organization, establish relationships within the team, acquire the skills necessary to perform job duties and build identification with the organization. Failure in adaptation might lead a person to face admonishment and even exclusion from the group (Schein, 2004). Therefore, effective adaptation to the new workplace is becoming a significant issue, and skillful management of introducing new employees to the organization seems to be the main task of human resource management. Employees' skills are improved and optimized through human resources development (HRD) procedures, which should be carried out for the organization's and individuals' benefits (Swanson, 2001; Greenan, 2023). Thus, HRD merges individual and group, as well as focuses on the integrity of work processes and the organization as a whole.

According to the former view on new employees, they were considered submissive individuals, passively adapting to the environment under the influence of organizational trends. However, according to a more contemporary concept of the protean career (Hall, 2004; Tamontseva, Akkermans, 2024), employees are characterized by increasing responsibility for their professional development. Currently, employees are perceived as active participants in their adaptation process (De Vos et al., 2009). Therefore, the importance of individual proactivity is higher (Griffin et al., 2007). The proactivity of individuals means that they show proactive behaviors such as direct inquiry, feedback seeking, networking, negotiating job tasks, etc. (Cooper-Thomas et al., 2014) that lead them to better adaptation outcomes. Based on the assumption that entering the new organization states a time of coping with both anticipated and occurring stressors, proactive coping should help in this process. This period has been considered crucial for the adjustment of newcomers (Saks et al., 2007), and proactive behavior is seen as one of the key techniques to enhance orientation at work. A range of research on proactivity suggests positive effects on a variety of adaptation outcomes (Greenglass, Fiksenbaum, 2009; Thomas et al., 2010), such as job performance and job satisfaction (Seibert et al., 2001; Wanberg, Kammeyer-Mueller, 2000). Drawing from the Human Resource Development approach (HRD; McLean, McLean, 2001; Swanson, 2001), research is needed to explore the role of organizational factors in shaping employees' abilities to engage in proactive coping behaviors. For example, organizational culture, leadership styles, and training opportunities may all play a role in facilitating or hindering employees' proactive coping efforts. In the following, we introduce the validation of the new scale PWAQ to measure proactive coping at work that is tailored to broad organizational requirements.

In this paper, we report the results of a validation of the new measure, i.e., the PWAQ. It was designed to assess an individual's proactive coping during adaptation to work. The instrument was developed to fill the gap between research and practice (Danquah et al., 2022), particularly to provide scholars and practitioners with a short and reliable tool to assess the proactive behaviors of new employees in the organizational setting. From a practical standpoint, addressing this research gap could have important implications for HRD professionals seeking to promote employees' well-being and resilience in the face of workplace stressors (Torraco, Lundgren, 2020) and to enhance their learning attitudes (Park et al., 2018). By better understanding how individuals develop and sustain proactive coping strategies, organizations can design more effective interventions and support systems to help employees thrive in their work environments.

2. Theoretical background

In this study, we emphasize the role of proactive behavior in work adaptation in a sample of newly employed workers. In relation to the HRD approach (McLean, McLean, 2001; Swanson, 2001), and proactive coping theory (Aspinwall, Taylor, 1997; Schwarzer, Taubert, 2002), we analyzed the method of assessing proactive behavior in the adaptation process to a new workplace. Studies on HRD (Greenan, 2023; Park et al., 2018; Torraco, Lundgren, 2020) consider HRD a development process involving proactive and systematic strategies undertaken to improve performance and to reach both individual and organizational long-term goals. Based on the above, we underline that recognizing the individual capability already at the organizational entrance phase will lead to better workplace adaptation, higher learning attitudes and, as a result, performance improvement in the long run.

In this paper, we discuss the theoretical background and the validation process of the PWAQ, a short scale to measure the components of proactive adaptation. Based on the assumption of the existence of potential stages of adaptation to work, such as role clarification, adaptation, and adjustment (Nicholson, 1984; Ślebarska, Flakus, 2021), as well as the concept of proactive coping, we specified three aspects of proactive adaptation to work (i.e., taking initiative, constructing opportunities and recognizing/gathering resources).

2.1. Newcomer adaptation to work

The dynamics of the labor market, increasing complexity, and often unclear tasks imposed on employees generate a demand for quickly "adaptable" workers (de Stobbeleir et al., 2010). Human adaptability is generally defined as the ability to change behavior, feelings, and thoughts to adapt to new circumstances (Fugate et al., 2004). Research on adaptability focuses on the stable personal resources that influence how employees adapt to changes in their work

environment (Fugate, Kinicki, 2008). In the past, the adaptation process was recognized as based on adaptive capacity described in terms of career opportunities in planning, exploration and decision-making (Savickas, 1997). Most recent research, however, emphasizes the role of personal initiative and proactivity in understanding employee behavior (Frese, 2008; Seibert et al., 2001). According to this concept, individuals who can adapt aim at preparing for specific or anticipated threats or changes in advance rather than waiting until a change or requirement becomes a fact (Aspinwall, Taylor, 1997). The above conceptualization of adaptive capacity is based on active adaptation and proactivity at work (Ashford, Black, 1996).

The task of a new employee is to learn and understand the vision, goals, and activities of the organization, as well as the generally accepted canon of behavior that includes the norms and customs of the workplace. Acquiring the information necessary to perform job duties efficiently is a part of successful adaptation to a new workplace. According to the adaptive performance model (Pulakos et al., 2000), there are eight dimensions of adaptive performance, including handling emergencies or crisis situations, handling work stress, solving problems creatively, dealing with uncertain or unpredictable work situations, learning new tasks, technologies and procedures, demonstrating interpersonal adaptability, demonstrating cultural adaptability and demonstrating physically oriented adaptability. On the one hand, such adaptive behaviors are a human disposition. On the other hand, they can be effectively shaped through training.

Existing research (Greenan, 2023; Danquah et al., 2022) emphasizes the importance of HRD in organizations by arguing that investing in employees' development is crucial for enhancing job performance and productivity, but also for fostering employee satisfaction and engagement. The need for organizations to align their HRD strategies with their overall business objectives to ensure that employees are equipped with the necessary skills and knowledge to contribute effectively to the organization's success has been highlighted (Greenan, 2023; Hirudayaraj, Matić, 2021). Hence, continuous learning and skill development in a permanently evolving work environment becomes crucial (Torraco, Lundgren, 2020).

2.2. Proactive adaptation

Current research emphasizes the importance of proactivity in understanding employee behavior (Seibert et al., 2001). According to this approach, adaptable individuals do not wait for a specific change or threat to occur, but they rather prepare for it in advance (Aspinwall, Taylor, 1997). Adaptation includes planning, setting long-term goals, dealing with potential stressors, expanding available resources, and self-development, which corresponds to the theory of proactive coping. In contrast to past research approaches, new employees are currently perceived as active individuals involved in an individual adaptation process based on proactive patterns (De Vos et al., 2009).

Proactive adaptation is defined as the activity of newly hired workers, such as taking initiative in learning. Proactivity is treated as an element even more important than the support received by those employed to work in a new organization, such as feedback or advice given by superiors (Savickas, 1997). Proactive coping is understood as a person's ability to analyze a situation to recognize possible difficulties and see them as an opportunity/challenge. A proactively coping individual can recognize their own and environmental resources and skillfully use them in overcoming challenges. Thus, proactive coping should play an important role in the adaptation process, leading to positive results by reducing the negative aspects of the transition from outside the organization to a given workplace. Continuous development and a strong focus on refreshing employee skills give rise to the need for a proactive employee who is characterized by motivation for change, tolerance of uncertainty, ability to anticipate future tasks and creation of their future (Frese, 2008; Ślebarska et al., 2019). For new employees, adaptive activities and proactivity become particularly important. Adaptable individuals do not wait for a particular change or threat to occur, but they prepare for it adequately in advance. The importance of personal initiative and proactive action is visible at this point (Ślebarska et al., 2019).

Proactive behavior is related to solving a problem in advance, i.e., before it occurs (Grant, Ashford, 2008). A proactive individual takes control of a situation rather than waiting passively for it to develop. The individual treats difficulties as a challenge and tries to change them instead of adjusting to the patterns. The actions taken by a proactive worker involve positive assessment of events, identification, and gathering of one's resources, establishing short- and long-term goals, developing an action plan, and creating a plan to deal with possible obstacles (Schwarzer, Taubert, 2002). Increasing the number of proactive coping activities makes new employees feel comfortable in the new organization. Their satisfaction increases, which can favor a better understanding of their job responsibilities or the hierarchy and mission of a particular organization.

3. Methodology

Based on the theoretical framework outlined above and a literature review on work adaptation, we developed PWAQ, a short-scale diagnosing proactive adaptation to work. Below, we present the construction and validation process of the PWAQ.

3.1. Preliminary scale development

Based on psychometric standards (Hornowska, 2007), a procedure for constructing the measurement tool with further steps was proposed. First, the aim of the measurement was defined, namely the identification of the strengths and weaknesses of proactive coping in the

employee's adaptation to work. Next, the measured trait was explained in direct relation to the concept of proactive coping proposed by Aspinwall and Taylor (1997). Deriving from the theory of proactive coping, an initial set of the items was prepared with the determination of their format (number of items, response scale, form of statements and responses). Drawing on the extensive literature on indicators of proactive coping (Aspinwall, Taylor, 1997; Ślebarska et al., 2019), a pool of test items included 38% more items than the final version of the tool. All the items were checked for linguistic correctness (grammatical and stylistic correctness), as well as comprehensibility for the potential audience. The content relevance analysis of the items was conducted to evaluate the relevance of specific statements with the measured competence in relation to the adopted concept of proactive coping. In the final stage, a key was developed to assess the responses. For this purpose, a pilot study was conducted on a group of 86 employees. The level of attractiveness of the initial version of the tool for the study participants was checked on a group of 14 working psychology students.

To ensure the content validity of the PWAQ, three different groups of Subject Matter Experts (SMEs) reviewed the items. The items were evaluated by competent judges (work and organizational psychologists, fourth-year psychology students, and practicing psychologists). The judges were provided with the definitions of the dimensions, according to which they evaluated each item assigned to each dimension, as instructed ("Determine the level to which each statement reflects proactive coping in adapting to work"). The assessment was performed by indicating the value on a five-point scale (1 - the minimum value; the statement completely fails to address the assumed dimension; 5 - the maximum value - the statement fully addresses the assumed dimension). The opinions of the competent judges resulted in preparing a set of 24 questionnaire items.

The following instruction was developed for the questionnaire: "Listed below are a number of behaviors that people undertake when starting new tasks at work. Using the scale, determine how often you undertake such behaviors"). The respondents were asked to answer according to the adopted five-point scale (1 - very rarely, 2 - rarely, 3 - sometimes, 4 - often, 5 - very often), which made it possible to determine the severity of the measured feature. The response scale allowed the determination of the obtained results on the continuum of the trait, thus making it possible to notice the change in the level of proactive coping in the process of adaptation to work.

3.2. Sample and procedure

The tool was used in a study that was conducted on a group of 220 individuals aged 22-70 years ($M = 30.39$, $SD = 10.08$) who were differentiated in terms of education and occupation. Individuals with higher education (46.36) and secondary education (35.9%) were predominant. The category of job declared by the respondents included professional/technical (29.5%), managerial (13.64%), sales (24.09%), Office/Clerical (25%), Craft/Operatives (1.36%),

Laborers (0.91%) and Service Workers (5.45%). Overall, 70.9% of the sample were women. The participants were asked about their form of work (68.18% - face-to-face work in their workplace; 10.45% - remote work, 21.36% - hybrid work, which is a blend of in-office and remote work).

The study was conducted online using the Microsoft Forms platform. The online survey was aimed at employed adults. The study included 220 respondents who answered all the questions included in the survey. The individuals were informed of the voluntary nature of participation in the study and anonymity of data collection, i.e., collective data analysis without any possibility of recognizing the individual participant. They were informed that there were no wrong answers and that all their opinions were important. The respondents were also informed about the aim of the study, i.e., investigating the strategies of work adaptation. No written informed consent was obtained because all the participants were volunteers. Before participation, they provided oral consent to participate in the study and were informed about the possibility of withdrawing from the study at any time. The study received approval from the Research Ethics Committee (decision no. KEUS.58/10.2020).

4. Results

4.1. Factor analysis

Factor analysis using the principal component method with Oblimin rotation was used to select the dimensions of the questionnaire. The obtained Kaiser-Meyer-Olkin (KMO) value (0.853) and Bartlett's sphericity test result ($p = 0.001$) were satisfactory. The analysis of the shape of the scree plot (Figure 1) showed three factors that had an eigenvalue greater than 1. The theoretical assumption of the three dimensions (taking initiative, constructing opportunities and recognizing/gathering resources) was confirmed. The three-factor structure explained 54.9% of the variance. The final version of the questionnaire included items with factor loadings greater than 0.40 and with the predominant saturation of one factor (Table 1).

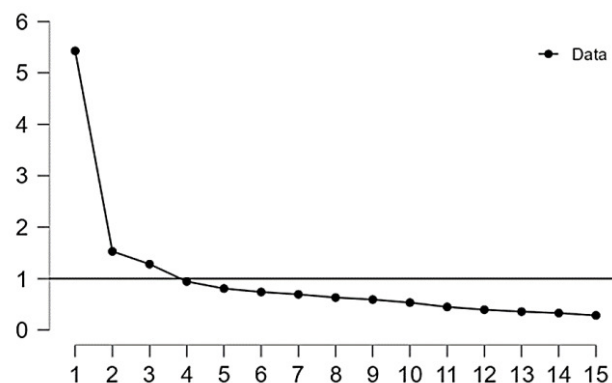


Figure 1. Scree plot for the factor analysis of the preliminary version of the questionnaire.

Table 1.
The content of the selected factors

	Factor 1	Factor 2	Factor 3
1. I am aware of my competencies and their limitations when determining my future tasks with my superior.	0.490		0.264
2. I take the initiative in defining my role in the workplace.	0.518	0.489	-0.241
3. When taking on team tasks, I am aware of my strengths and weaknesses.	0.679		
4. I can identify which of my colleagues has the right competencies to help me in the case of difficulties.	0.733		
5. I take the initiative in making contacts at work.	0.733	0.137	-0.359
6. When I need support, I ask for it.	0.764	-0.151	
7. I know which of my colleagues can be recommended for cooperation to increase the chances in the face of the need to complete a task urgently.	0.436		0.334
8. I determine where I can get adequate support at work and ask for it in the case of difficulties.	0.533		0.286
9. I actively co-create my professional goals in the organization so as to realize my potential.	0.171	0.641	
10. I search for the ways to improve my work on my own.		0.744	
11. Even in challenging work situations, I recognize potential opportunities.	-0.132	0.801	0.160
12. In each task, I look for the ways to develop my skills.		0.781	
13. Before taking on a task, I prepare to overcome potential difficulties.			0.832
14. When starting a new task, I find out where I can get support if I have some doubts.	0.452	-0.112	0.518
15. I prepare in advance to overcome potential difficulties.	-0.128	0.285	0.724

Note. Factor loadings for a given dimension are in bold.

Factor 1 – Initiative (8 items; $\alpha = 0.81$): a high score on this dimension indicated a higher tendency to take the initiative when adapting to work, while a low score indicated low self-initiative in taking steps to adapt to work.

Factor 2 – Constructing opportunities (4 items; $\alpha = 0.78$): a high score indicated a greater ability to analyze the situation to recognize possible difficulties and view them in terms of an opportunity/challenge, while a low score on this dimension meant less ability to treat tasks in terms of an opportunity/challenge and more ability to see them in terms of harm/loss.

Factor 3 – Recognizing/gathering resources (3 items; $\alpha = 0.69$): a high score on this dimension indicated a greater ability to recognize one's resources and those of the environment and to skillfully use them in overcoming difficulties, while a low score indicated a lower ability to recognize and accumulate internal as well as external resources.

Descriptive statistics for all items in the questionnaire are given in Table 2. As the results show, all items in the questionnaire were characterized by a left-skewed distribution, with the skewness coefficient for most items (13 out of 15) not exceeding the absolute value of 1. Based on the results, it was assumed that the distribution was not shifted from the classical normal distribution. The statistics for kurtosis showed the predominance of values below 3, which indicated a platykurtic distribution of the results.

Table 2.
Descriptive statistics for the PWAQ items

Item content	Minimum	Maximum	Mean	SD	Skewness SD = 0.164	Kurtosis SD = 0.327
I am aware of my competencies and their limitations when determining my future tasks with my superior.	1	5	3.741	0.902	-0.932	0.850
I take the initiative in defining my role in the workplace.	1	5	3.768	0.982	-0.273	-0.736
When taking on team tasks, I am aware of my strengths and weaknesses.	1	5	3.818	0.898	-0.650	0.737
I can identify which of my colleagues has the right competencies to help me in the case of difficulties.	1	5	4.114	0.897	-1.481	3.840
I take the initiative in making contacts at work.	1	5	3.673	0.980	-0.553	-0.373
When I need support, I ask for it.	1	5	3.741	0.902	-0.604	-0.055
I know which of my colleagues can be recommended for cooperation to increase the chances in the face of the need to complete a task urgently.	1	5	3.768	0.982	-0.941	0.782
I determine where I can get adequate support at work and ask for it in case of difficulties.	1	5	3.818	0.898	-0.875	1.528
I actively co-create my professional goals in the organization so as to realize my potential.	1	5	4.114	0.897	-0.402	-0.524
I search for the ways to improve my work on my own.	1	5	3.673	0.980	-0.990	1.380
Even in challenging work situations, I recognize potential opportunities.	1	5	3.741	0.902	-0.443	-0.158
In each task, I search for the ways to develop my skills.	1	5	3.768	0.982	-0.455	-0.398
Before taking on a task, I prepare to overcome potential difficulties.	1	5	3.818	0.898	-0.587	0.227
When starting a new task, I find out where I can get support if I have some doubts.	1	5	4.114	0.897	-1.069	0.972
I prepare in advance to overcome potential difficulties.	1	5	3.673	0.980	-0.302	-0.645

Next, the discriminatory power of the questionnaire items was checked to determine how the collected items affected the overall score of the trait measured by the tool (Mahmood, Miller, 2022). The correlation of the items assigned to a particular scale with the score on each scale was analyzed. Correlations of individual items with the score of the scale to which they were assigned showed statistical significance at $p < 0.01$. Correlation values ranged from $r = 0.62$ to $r = 0.82$. The analysis showed good discriminatory power. The intercorrelations between all three scales were $r = 0.544$ (scale 1 and scale 2), $r = 0.535$ (scale 1 and scale 3),

and $r = 0.480$ (scale 2 and scale 3). All scales were significantly correlated at $p < 0.01$ and the relationships were positive and moderate. On this basis, it seemed reasonable to adopt a summary approach to the results obtained in all scales (the total score of the questionnaire). Summing the results could provide a basis for estimating the overall generalized ability to proactively adapt to work.

In order to analyze the psychometric properties of the scale, the exploratory analysis was extended with the structural equation method using the AMOS 29.0 program. The analysis was performed on the raw data matrix using the generalized least squares estimates (GLSE). Assumptions for GLSE were checked by calculating the normality of the distribution of variables and multivariate normality. The calculated indices obtained the values that allowed us to assume that the distributions of the observational variables and their overall multivariate distribution did not deviate significantly from the normal distribution. Finally, a model assuming model fit with three latent variables was tested.

The identification of factors with the exploratory analysis is understood by the fact that a certain set of factors characterizing a non-measurable variable was previously assumed based on literature and research (Ślebarska et al., 2019). The aim of the exploratory analysis was to examine the accuracy of the scale model with the three latent variables and to estimate the factor loadings obtained in the main study for each scale item. To obtain psychometric characteristics of the PWAQ, the root mean square error of approximation (RMSEA) was used. When the RMSEA is calculated, there is no comparison between the estimated model and the baseline model. The lower the value of the RMSEA calculated from the model is, the better the model fit. It is assumed (Kline, 2005) that for a value of RMSEA less than 0.1, the model is fitted to the data. However, the cutoff is sometimes established at 0.05 (Konarski, 2009).

In the case of the exploratory analysis, the hypothesis was formulated that the model was a good fit and the discrepancies between the theoretical variance-covariance matrix from the model and the observed variance-covariance matrix were insignificant. We used the maximum likelihood method in modeling and the following parameters of the estimated model were obtained for the questionnaire. The estimated model of the PWAQ was compared with the values of the independence model and the saturated model.

Assessing the quality of the PWAQ model, it was found that the FMIN value was 1.09, which was closer to the value of the saturated model, while the CMIN value was 239.12, which with 87 degrees of freedom gave the significance level of 0.000. Hoelter's N for the confidence interval of 95% showed a value of 101 and the CMIN/DF value was 2.74 (not exceeding the critical value). It should be considered a better fit of the analyzed model to the saturated model compared to the independence model (Figure 2).

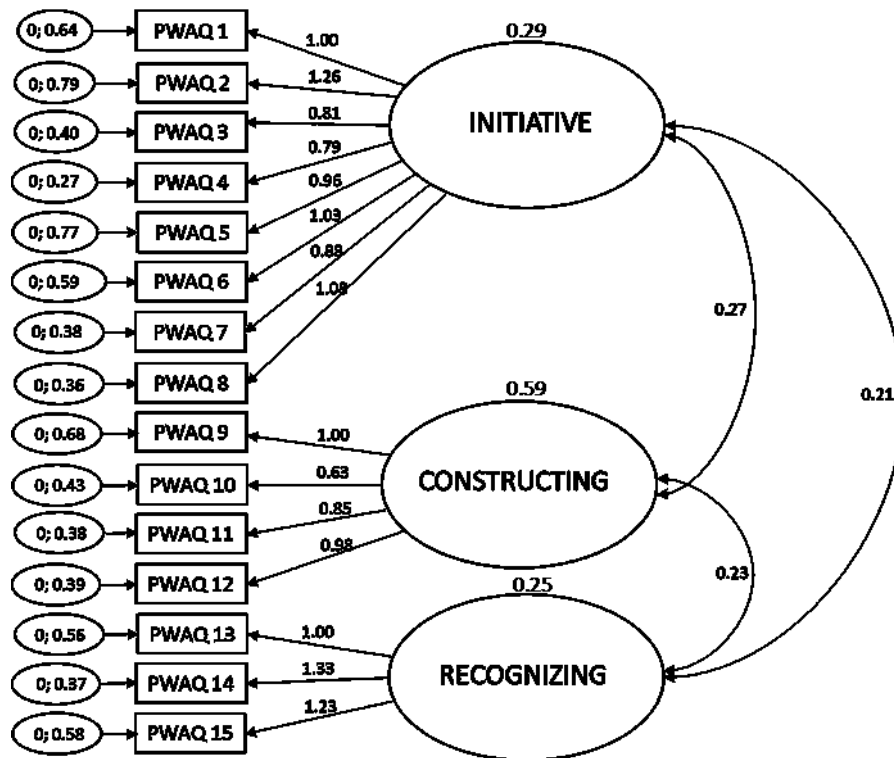


Figure 2. The path diagram of the PWAQ with three latent variables.

In the case of the PWAQ, the value of RMSEA showed the cutoff of model fit in relation to the population (0.08; Konarski, 2009). The PNFI and PCFI were 0.65 and 0.7, respectively. The values of the Akaike information criteria (AIC) showed fit to the saturated model. Additionally, the ECVI and MECVI criteria showed fit to the saturated model. The following parameters of selected quality measures were obtained in the analysis of the PWAQ scale: CMIN = 239.12; $p = 0.000$; $DF = 87$, and $CMIN/DF = 2.74$.

4.2. External validity test

Measuring the external validity of the PWAQ included three measures. The selected scales are conceptually related to proactive behavior, including at the time of adaptation to work.

Proactive Personality was assessed with the 6-item scale. This study was based on the shortened version of PPS (cf. PPS; Bateman, Crant, 1993; Parker, Sprigg, 1999; Polish version: Adamek, 2019). The scale was translated into Polish via the back-translation procedure. A sample question was “If I believe in an idea, no obstacle will prevent me from making it happen”. The response options for all items ranged from 1 (not at all true) to 4 (exactly true). Higher scores indicated higher levels of proactivity. Cronbach's alpha was $\alpha = 0.70$.

Self-efficacy was assessed using the 10-item Polish version of the General Self-Efficacy Scale (GSES; Schwarzer et al., 2008). A sample item was “I can always manage to solve difficult problems if I try hard enough.” The response options for all items ranged from 1 = (not at all true) to 4 (exactly true). Higher scores indicated higher levels of general self-efficacy. Cronbach's alpha was $\alpha = 0.89$.

Work Motivation was assessed using the 6-item Polish version of the Work Extrinsic and Intrinsic Motivation Scale (WEIMS-6; Tremblay et al., 2009; Polish version: Chrupała-Pniak, Grabowski, 2016). WEIMS-PL consists of the following six subscales: amotivation (AMO), external regulation (EXT), introjected regulation (INTRO), identified regulation (IDEN), integrated regulation (INTEG), and intrinsic motivation (IM). Each subscale comprises three items answered on a 7-point Likert scale.

Table 3.

Descriptive statistics of the selected variables

	<i>M</i>	<i>SD</i>	<i>N</i>
Initiative	31.60	4.68	220
Constructing opportunities	15.05	2.99	220
Recognizing and gathering resources	11.60	2.17	220
Result-Total	58.25	8.22	220
Proactive personality	22.22	3.27	220
Excessive expectations	2.56	1.64	220
Income	4.47	1.81	220
Willingness to be very good at work	5.05	1.59	220
Willingness to achieve professional goals	4.42	1.95	220
Identification with work	4.24	1.94	220
Satisfaction from the challenges	4.85	1.83	220
Self-efficacy	32.28	5.71	220

Table 4.

Relationships of proactive behaviors at work with proactive personality, intrinsic/extrinsic motivation indicators and self-efficacy

		Proactive personality	Excessive expectations	Income	Willingness to be very good at work	Willingness to achieve professional goals	Identification with work	Satisfaction from the challenges	Self-efficacy
Initiative	<i>r</i>	.323**	-.274**	.046	.204**	.139*	.147*	.231**	.380**
	<i>p</i>	.000	.000	.494	.002	.040	.029	.001	.000
Constructing Opportunities	<i>r</i>	.383**	-.218**	-.038	.435**	.381**	.450**	.530**	.525**
	<i>p</i>	.000	.001	.575	.000	.000	.000	.000	.000
Recognizing and gathering resources	<i>r</i>	.230**	-.141*	-.011	.206**	.219**	.235**	.229**	.337**
	<i>p</i>	.001	.037	.866	.002	.001	.000	.001	.000
PWAQ – total	<i>r</i>	.384**	-.273**	.010	.329**	.276**	.310**	.385**	.497**
	<i>p</i>	.000	.000	.889	.000	.000	.000	.000	.000

Table 3 and 4 shows significant correlations between the scales, the total score and other variables. All the dimensions of proactive actions during adaptation to work showed a positive correlation with proactive personality, self-efficacy and intrinsic motivation to work. As shown in Table 4, individuals with higher initiative, creating a favorable situation (constructing opportunities) and inclined to recognize and gather their own and environmental resources did not perceive work to be too demanding. Instead, they strove to achieve excellence (desire to be

good at work). Constructing opportunities and recognizing/gathering resources were additionally associated with a stronger desire to achieve occupational goals, identify with work, and were also related to satisfaction with challenges. None of the dimensions in the questionnaire was significantly associated with job-related income.

5. Discussion

The results of the structural research of the method for diagnosing proactive coping in the process of adaptation to work confirmed the theoretical assumptions based on the analysis of the literature (Frese et al., 2016; Ślebarska et al., 2019). Organizational newcomers are currently expected to perform proactive behaviors during their organizational socialization and work adaptation process (Gruman, Saks, 2011), e.g., information-seeking that leads to reducing uncertainty and creating a safer environment. Given the importance of proactive behavior at work, we emphasize the need to test proactive coping in the adaptation process to work, which is further linked to better performance, such as a lower tendency to leave (Ślebarska et al., 2019). Drawing from the stress-oriented perspective on organizational socialization (Ellis et al., 2015) and the need for self-initiated, proactive employees (Frese, 2008), we presented the tool to diagnose proactive coping during the work adaptation process. We introduced the new and short scale to build the bridge between both scientific measures and practice. This scale might be useful to assess the employee's skills and behaviors in the organizational setting, meeting the needs of practitioners, and parallel based on the strong and well-developed theoretical basis, i.e., proactive coping. According to the assumption, a three-dimensional structure of proactive action during adaptation was obtained. The common method variance (CMV) was used to test whether individual scales were adequately varied. Harman's single-factor test with an unrotated factor solution was used to manage the variance, which showed the explained variance of 31.72%, well below the suggested threshold of 50% (Podsakoff et al., 2003). On this basis, it seemed reasonable to maintain the three-factor design of the tool. The validity of differentiating the three factors in the questionnaire was affirmed by the exploratory factor analysis. Precisely, the 15-item scale contains three subscales that allow for the assessment of proactive adaptation to the workplace in general and in reference to distinguished dimensions, i.e., undertaking initiative, constructing opportunities, and recognizing/gathering resources. The analyzed structure adequately described proactive work behavior. Drawing from the proactive coping theory, this tool covers all the crucial aspects of proactive behavior and embeds them in the workplace environment. Thus, we perceive the possibility for broad usage of PWAQ, as an assessment of the baseline level of proactive coping at work, as well as further change in proactivity, particularly in the first phase of organizational entry.

The external validity of PWAQ was confirmed by the hypothesized relations of proactive work adaptation with proactive personality, self-efficacy, and motivation to work. Significant relationships between the selected dimensions and the dimensions of proactivity, work motivation, and self-efficacy confirmed the relevance of the proposed approach to proactive behavior in the new workplace. The results indicate an increased tendency to proactive behaviors on all dimensions accordingly to a higher score of proactive personality, or self-efficacy. The obtained results confirmed the main assumptions in the approach to proactive coping in a challenging situation.

5.1. Limitations

Several potential limitations of the present study should be kept in mind. First, our sample is not representative, which is related to one-country aspects. However, available evidence pointed out that Poland reflects the processes of Central and Eastern Europe and might be considered a representative country (Sanocka, Kurpisz, 2003). More precisely, similarities in economic development are common for all countries of the region. However, further exploration of the scale in more countries might provide valuable input into its properties. Nevertheless, our sample was large ($N = 220$) and comprised no college students, but was strongly associated with the organizational setting, which makes the results more reliable. Moreover, the sample provided sufficient statistical power to test the hypothesized model. Second, since the participation was voluntary and data were collected online, a self-selection bias may have occurred, with more proactive individuals being more likely to participate. Nevertheless, the diversity of the sample in terms of occupational sectors and demographic characteristics helps mitigate this limitation. In addition, the factor structure and reliability indices were consistent with theoretical expectations, supporting the robustness of the PWAQ despite potential sampling bias. Future research, however, should aim to include a more diverse and randomly selected sample, possibly through cooperation with different organizations and recruitment channels. Next, we used self-report measures, which are often the only possible way to examine psychological constructs, such as self-efficacy in a specific context (Lucas, 2018). Finally, we examined the perceived effectiveness but not the likelihood of undertaking certain actions. It should be considered in future studies since it refers more directly to a behavioral intention. Despite that, all measures used for assessing the external relevance of the PWAQ had well-assessed psychometric properties (reliability and validity) and were used in other research settings. The use of self-report data was reasonable since we were primarily interested in the perceptions of employees and subjective evaluations of their employment situation. Nonetheless, longitudinal studies should be conducted to assess behavioral indicators. However, the above-mentioned cases are rarely a serious problem in most research settings (Paulhus, Vazire, 2009), which may be solved by the verification of the psychometric properties of the instruments (Lucas, 2018).

5.2. Implications for research

The current study contributed in several ways to our understanding of the importance of proactive coping in the context of adaptation to a new workplace, referring to HRD. The perspective of combining both concepts, i.e., HRD (McLean, McLean, 2001; Swanson, 2001) and proactive coping (Aspinwall, Taylor, 1997; Schwarzer, Taubert, 2002), can lead in practice to a higher level of engagement and motivation among employees. Proactive employees are more likely to actively seek opportunities for development and growth, while organizations prioritizing human resource development aim to support their workers and encourage them to take on new challenges. Accordingly, organizations that foster a culture of proactivity provide individuals with opportunities for training, development, and career advancement. Particularly, offering the proper assistance during the adaptation phase to a new workplace, such as an onboarding program based on proactive theory, would improve their adaptation outcomes. The PWAQ might be useful in assessing proactivity among organizational newcomers, as well as the employed facing the job transition or during the work form change, e.g., from stationary to remote. Although workplace changes may compel employees to learn, yet contextual factors in their immediate work environment can also encourage proactive attitudes toward learning. One of the factors that influence participation in the learning process is the appropriate HR management since HR practitioners are responsible for introducing learning opportunities (Lundqvist et al., 2023; Purcell, Hutchinson, 2007). PWAQ, as a short-scale to assess the proactivity of the stakeholders, might be beneficial for recognizing and enhancing employees' learning attitudes and behavior (Park et al., 2018) and, in further perspective, transferring learning into performance (Blume et al., 2010). By investing in human resource development that encourages proactive behaviors, organizations can create more self-initiated and resilient employees who are better equipped to undertake the challenges of modern business environments. This can further lead to increased productivity, innovation, and overall success for both, individuals and the organization.

A prior study (Ślebarska et al., 2019) showed that from the individuals' perspective, proactivity promotes ongoing career development, including the search for career opportunities also outside the current organization. Deriving from the personal resources development concept (Danquah et al., 2022; Swanson, 2001), the organization should ensure the means to increase organizational commitment to avoid employee fluctuation while fostering proactive coping. Thus, there is still a need to investigate the organizational benefits and costs of employees' proactive coping in more detail, as well as managers' perception of newcomers' proactive behaviors (Ellis et al., 2017).

5.3. Implications for practice

Referring to the above, the current evaluation study has several practical implications. In the near past, we could observe a massive transfer of job duties from in-person to remote working. This tendency, although in the smaller range, lasts up to nowadays. From a practical perspective, organizations are supposed to support the employee during the work change, including the change from on-site to remote work or vice versa. Proactive adaptation in accordance with a new work environment, particularly remote working, refers to regular employees, team leaders, and managers as well. A prior study (Kowalski, Ślebarska, 2022) showed the importance of activating the available strengths of remote work to empower organizational resources and work effectiveness. Thus, pointed out the role of proactivity at work. The PWAQ might provide useful information on how employees adapt to new work circumstances, assessing their proactive coping that leads to further suggestions for organizational assistance. Moreover, the current processes of transformation in the energy sector as a part of sustainable development comprise a perspective of workforce relocation. That means constant movement in the labor market, such as the influx of new employees or workplace changers within the same organization, resulting in the need for proactive adaptation measurement. Another possibility to apply the theory-based and evidence-based PWAQ is the onboarding programs for organizational newcomers, as well as employees returning to work after longer breaks (i.e., parental leave) to monitor their coping abilities during the adaptation process.

In the current study, we draw the focus on organizational socialization from the newcomers' perspective and thus follow the previous suggestion (Ellis et al., 2015) that resources can contribute to the socialization process. Drawing from the human resources development theory (McLean, McLean, 2001) and proactive coping approach (Aspinwall, Taylor, 1997; Schwarzer, Taubert, 2002), encouraging employees to engage in continuous learning and coping skill development will enhance their coping abilities and resilience in the face of difficulties. The above aim might be reached by providing tailored training programs focused on proactive coping strategies, referring to strategic planning, resource accumulation, and stress management. Focusing on individual resources, i.e., proactive coping skills, might exert its influence on adaptation outcomes such as work-life balance, mental health, and well-being. Encouraging employees to take responsibility and initiative in their personal development and well-being by setting goals, searching for feedback, and actively seeking opportunities for growth and improvement would enhance their coping competencies and adaptation outcomes.

Summing up, by using the PWAQ in HRD practice, organizations can assess employees' proactive coping skills and develop interventions to enhance them. This can lead to higher levels of employee resilience, productivity, and overall well-being. Furthermore, using a theory-based questionnaire like the PWAQ allows organizations to have a standardized and structured approach to assessing proactive coping skills, ensuring that results are reliable and

valid, independently of the cultural or organizational context. This can help organizations make informed decisions about employee training and development initiatives.

It should be taken into account, however, that the PWAQ dimensions may vary depending on organizational context or work mode (on-site, hybrid, or remote). Considering these contextual factors would enhance the relevance of proactive coping assessment and allow for the development of more targeted organizational support strategies. From the organization's perspective, fostering proactive coping should be accompanied by measures aimed at increasing employees' organizational commitment.

6. Conclusions

The Proactive Work Adaptation Questionnaire (PWAQ) satisfies essential requirements for factor validity and reliability. This allows the tool to be considered useful in research studies that regulate one's influence and importance in the organization. The developed questionnaire to measure proactive coping during adaptation to work can become a useful tool when employees start a new job. It can be applied to analyze their ability to act proactively in new and challenging professional conditions, such as a new workplace or a new form of work. Overall, the PWAQ has the potential to be a valuable tool in the international arena of HRD practice, helping organizations to better understand and support their employees' proactive behaviors.

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References

1. Adamek, D. (2019). *Polish adaptation of Proactive Personality Scale, unpublished raw data*. Katowice: University of Silesia in Katowice.
2. Ashford, S.J., Black, J.S. (1996). Proactivity during organizational entry: The role of desire for control. *Journal of Applied Psychology*, 81, 199-214. Doi: 10.1037/0021-9010.81.2.199
3. Aspinwall, L., Taylor, S. (1997). A stitch in time: self-regulation and proactive coping. *Psychological Bulletin*, 121, 417-436. Doi: 10.1037/0033-2909.121.3.417
4. Bateman, T.S., Crant, J.M. (1993). The proactive component of organizational behavior. *Journal of Organizational Behavior*, 14, 103-118. Doi: 10.1002/job.4030140202
5. Bauer, T., Erdogan, B. (2011). Organizational socialization: The effective onboarding of new employees. In: S. Zedeck (Ed.). *APA handbook of industrial and organizational psychology*. Washington, DC: APA Press.
6. Blume, B.D., Ford, J.K., Baldwin, T.T., Huang, J.L. (2010). Transfer of training: A meta-analytic review. *Journal of Management*, 36, 1065-1105. doi: 10.1177/0149206309352880
7. Chrupała-Pniak, M., Grabowski, D. (2016). Work Extrinsic and Intrinsic Motivation Scale (WEIMS-PL). Psychometric description of the Polish version. *Psychologia Społeczna*, 38, 339-355. doi: 10.7366/1896180020163808
8. Cooper-Thomas, H.D., Paterson, N.L., Stadler, M.J., Saks, A.M. (2014). The relative importance of proactive behaviors and outcomes for predicting newcomer learning, well-being, and work engagement. *Journal of Vocational Behavior*, 84, 318-331. doi: 10.1016/j.jvb.2014.02.007
9. Danquah, J.K., Crocco, O.S., Mahmud, Q.M., Rehan, Rizvi, L.J. (2022). Connecting concepts: bridging the gap between capacity development and human resource development. *Human Resource Development International*, 26, 246-263. doi: 10.1080/13678868.2022.2108992
10. De Stobbeleir, K.E.M., Ashford, S.J., Sully de Luque, M.F. (2010). Proactivity with image in mind: How employee and manager characteristics affect evaluations of proactive behaviours. *Journal of Occupational and Organizational Psychology*, 83, 347-369. Doi: 10.1348/096317909X479529
11. De Vos, A., De Clippeleer, I., Dewilde, T. (2009). Proactive career behaviours and career success during the early career. *Journal of Occupational and Organizational Psychology*, 82, 761-777. Doi: 10.1348/096317909X471013
12. Ellis, A.M., Bauer, T.N., Mansfield, L.R., Erdogan, B. Truxillo, D.M., Simon, L.S. (2015). Navigating uncharted waters: Newcomer socialization through the lens of stress theory. *Journal of Management*, 41, 203-235. doi: 10.1177/0149206314557525
13. Ellis, A.M., Nifadkar, S.S., Bauer, T.N., Erdogan, B. (2017). Newcomer adjustment: Examining the role of managers' perception of newcomer proactive behavior during

- organizational socialization. *Journal of Applied Psychology*, 102, 993-1001. doi:10.1037/apl0000201
14. European Foundation for the Improvement of Living and Working Conditions (2006). Retrieved from: <https://www.eurofound.europa.eu/>
15. Fisher, C.D. (1985). Social support and adjustment to work: A longitudinal study. *Journal of Management*, 11, 39-53. Doi: 10.1177/014920638501100304
16. Frese, M. (2008). The word is out: we need an active performance concept for modern workplaces. *Industrial and Organizational Psychology*, 1, 67-69, Doi: 10.1111/j.1754-9434.2007.00012.x
17. Frese, M., Hass, L., Friedrich, C. (2016). Personal initiative training for small business owners. *Journal of Business Venturing Insights*, 5, 27-36. Doi: 10.1016/j.jbvi.2016.01.001
18. Fugate, M., Kinicki, A.J. (2008). A dispositional approach to employability: Development of a measure and test of implications for employee reactions to organizational change. *Journal of Occupational and Organizational Psychology*, 81, 503-527. Doi:10.1348/096317907X241579
19. Fugate, M., Kinicki, A.J., Ashforth, B.E. (2004). Employability: A psychosocial construct, its dimensions, and applications. *Journal of Vocational Behavior*, 65, 14-38. Doi: 10.1016/j.jvb.2003.10.005
20. Grant, A., Ashford, S. (2008). The dynamics of proactivity at work. *Research in Organizational Behavior*, 28, 3-34. Doi: 10.1016/j.riob.2008.04.002.
21. Greenan, P. (2023). The impact of implementation intentions on the transfer of training from a management development program. *Human Resource Development International*, 26, 577-602. doi: 10.1080/13678868.2023.2174976
22. Greenglass, E.R., Fiksenbaum, L. (2009). Proactive coping, positive, affect, and well-being: Testing for mediation using path analysis. *European Psychologist*, 14, 29-39. doi: 10.1027/1016-9040.14.1.29
23. Griffin, M.A., Neal, A., Parker, S.K. (2007). A new model of work role performance: positive behavior in uncertain and interdependent contexts. *Academy of Management Journal*, 50, 327-347, Doi: 10.5465/AMJ.2007.24634438
24. Hall, D.T. (2004). The protean career: A quarter-century journey. *Journal of Vocational Behavior*, 65, 1-13. Doi: 10.1016/j.jvb.2003.10.006
25. Hirudayaraj, M., Matić, J. (2021). Leveraging Human Resource Development Practice to Enhance Organizational Creativity: A Multilevel Conceptual Model. *Human Resource Development Review*, 20, 172-206. doi:10.1177/1534484321992476
26. Hornowska, E. (2005). *Testy psychologiczne. Teoria i praktyka [Psychological tests. Theory and practice]*. Warszawa: Scholar.
27. Kline, R.B. (2005). *Principles and practice of structural equation modeling*. The Guilford Press.

28. Konarski, R. (2009). *Modele równań strukturalnych. Teoria i praktyka [Structural equation models. Theory and practice]*. Warszawa: PWN.
29. Kowalski, G., Ślebarska, K. (2022). Remote Working and Work Effectiveness: A leader Perspective. *International Journal of Environmental Research and Public Health*, 19, 15326. doi: 10.3390/ijerph192215326
30. Lucas, R.E. (2018). Reevaluating the strengths and weaknesses of self-report measures of subjective well-being. In: E. Diener, E. Oishi, E., L. Tay (eds.), *Handbook of well-being*. Salt Lake City, UT: DEF Publishers.
31. Lundqvist, D., Wallo, A., Coetzer, A, Kock, H. (2023). Leadership and learning at work: A systematic literature review of learning-oriented leadership. *Journal of Leadership & Organizational Studies*, 30, 205-238. doi: 10.1177/15480518221133970
32. Mahmood, U.H., Miller, F. (2022). Discrimination with unidimensional and multidimensional item response theory models for educational data. *Communications in Statistics - Simulation and Computation*, 51, 2992-3012. doi: 10.1080/03610918.2019.170534
33. McLean, G.N., McLean, L. (2001). If we can't define HRD in one country, how can we define it in an international context? *Human Resource Development International*, 4, 313-326. doi: 10.1080/13678860110059339
34. Nicholson, N. (1984). A theory of work roles transition. *Administrative Science Quarterly*, 29, 172-191, Doi: 10.2307/2393172
35. Park, S., Kang, H.S., Kim, E.J. (2018). The role of supervisor support on employees' training and job performance: An empirical study. *European Journal of Training & Development*, 42, 57-74. doi: 10.1108/EJTD-06-2017-0054
36. Parker, S.K., Sprigg, C.A. (1999). Minimizing strain and maximizing learning: The role of job demands, job control and proactive personality. *Journal of Applied Psychology*, 84, 925-939. Doi: 10.1037//0021-9010.84.6.925
37. Paulhus, D.L., Vazire, S. (2009). The self-report method. In: R.W. Robins, R.C. Fraley, R.F. Krueger (eds.), *Handbook of research methods in personality psychology*. New York: Guilford.
38. Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., Podsakoff, N.P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879-903. Doi: 10.1037/0021-9010.88.5.879
39. Polskie Forum HR (2020). *Career Management. Raport 2020*. Retrieved from: <https://www.polskieforumhr.pl/wp-content/uploads/2020/01/RAPORT-Career-Management-2020.pdf>
40. Pulakos, E.D., Arad, S., Donovan, M.A., Plamondon, K.E. (2000). Adaptability in the Workplace: Development of Taxonomy of Adaptive Performance. *Journal of Applied Psychology*, 85, 612-62. Doi: 10.1037/0021-9010.85.4.612

41. Purcell, J., Hutchinson, S. (2007). Front-line managers as agents in the hrm-performance causal chain: Theory, analysis and evidence. *Human Resource Management Journal*, 17, 3-20. doi: 10.1111/J.1748-8583.2007.00022.X
42. Reio, T.G. (2020). The quest for novelty. *Human Resource Development Quarterly*, 31, 247-248. doi: 10.1002/hrdq.21409
43. Saks, A.M., Uggerslev, K.L., Fassina, N.E. (2007). Socialization tactics and newcomer adjustment: A meta-analytic review and test of a model. *Journal of Vocational Behavior*, 70, 413-446. <http://doi.org/doi:10.1016/j.jvb.2006.12.004>
44. Sanocka, D., Kurpisz, M. (2003). Infertility in Poland—present status, reasons and prognosis as a reflection of Central and Eastern Europe problems with reproduction. *Medical Science Monitor*, 9, 16-20.
45. Savickas, M.L. (1997). Career Adaptability: An Integrative Construct for Life-Span, Life-Space Theory. *The Career Development Quarterly*, 45, 247-259. Doi:10.1002/j.2161-0045.1997.tb00469.x
46. Schein, E.H. (2004). *Organizational culture and leadership* (3rd ed.). San Francisco: Jossey-Bass.
47. Schwarzer, R., Jerusalem, M., Juczynski, Z. (2008). Polish version of GSES. Available at: <http://userpage.fu-berlin.de/%7Ehealth/polish.htm>
48. Schwarzer, R., Taubert, S. (2002). Tenacious goal pursuits and striving toward personal growth: proactive coping. In: E. Frydenberg (Ed.), *Beyond Coping: Meeting Goals, Visions, and Challenges*. London: Oxford University Press.
49. Seibert, S.E., Kraimer, M.L., Crant, J.M. (2001). What do proactive people do? A longitudinal model linking proactive personality and career success. *Personnel Psychology*, 54, 845-874. Doi: 10.1111/j.1744-6570.2001.tb00234.x
50. Ślebarska, K., Flakus, M. (2021). Career self-management of unemployed workers: the role of proactive coping in job-to-job transition. *Baltic Journal of Management*, 16, 135-153. Doi: 10.1108/BJM-06-2020-0189
51. Ślebarska, K., Soucek, R., Moser, K. (2019). Increasing Proactive Coping in Organizational Newcomers: Improving Job Adaptation or Rocking the Boat? *Journal of Career Development*, 46, 295-313. Doi: 10.1177/0894845318763947
52. Strack, R., Caye, J.M., Von der Linden, C., Quiros, H., Haen, P. (2012). *From Capability to Profitability: Realizing the value of people management*. The Boston Consulting Group (BCG). World Federation of People Management Associations (WFPMA). Retrieved from: <https://www.bcg.com/publications/2012/people-management-human-resources-leadership-from-capability-to-profitability>
53. Swanson, R.A. (2001). Human resource development and its underlying theory. *Human Resource Development International*, 4, 299-312. doi:10.1080/13678860110059311
54. Tamontseva, M., Akkermans, J. (2024). Increasing the chances of career success abroad: the role of cultural orientations in the relationship between international students' protean

- career orientation, career competencies, and perceived employability. *Human Resource Development International*, 1-27. doi: 10.1080/13678868.2024.2366729
55. Thomas, J.P., Whitman, D.S., Viswesvaran. (2010). Employee proactivity in organizations: A comparative meta-analysis of emergent proactive constructs. *Journal of Occupational and Organizational Psychology*, 83, 257-300. doi: 10.1348/096317910X502359
56. Torraco, R.J., Lundgren, H. (2020). What HRD Is Doing—What HRD Should be Doing: The Case for Transforming HRD. *Human Resource Development Review*, 19, 39-65. doi:10.1177/1534484319877058
57. Tremblay, M.A., Blanchard, C.M., Taylor, S., Pelletier, L.G., Villeneuve, M. (2009). Work Extrinsic and Intrinsic Motivation Scale: Its value for organizational psychology research. *Canadian Journal of Behavioural Science [Revue canadienne des sciences du comportement]*, 41, 213-226. Doi: 10.1037/a0015167
58. Wanberg, C.R., Kammeyer-Mueller, J.D. (2000). Predictors and outcomes of proactivity in the socialization process. *Journal of Applied Psychology*, 85, 373-385. doi: 10.1037//0021-9010.85.3.373

LOGISTICAL SERVICE FOR PATIENTS IN A DAY REHABILITATION CENTRE – CASE STUDY

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Purpose: The aim of the study was to determine the level of satisfaction of parents of children attending a day rehabilitation centre by assessing the quality of logistical services, communication with staff, and the organisation of the therapeutic process.

Design/methodology/approach: The present study was conducted using a quantitative and qualitative survey among parents of children attending a day-time rehabilitation centre. The research tool employed was a structured questionnaire comprising both closed questions based on the Likert scale and open questions that permitted free expression.

Findings: The study demonstrated that parents of children undergoing rehabilitation at the day-time centre expressed high levels of satisfaction with the services provided. The most significant factors contributing to the favourable evaluation of the facility were the provision of appointment times, the effective organisation of admissions, and the professional demeanour of the staff. The majority of respondents highlighted the importance of punctual appointments, effective communication, and the precision of diagnoses.

Research limitations/implications: The study was conducted in a single rehabilitation centre, which limits the possibility of generalising the results to other facilities of this type. The respondents were parents of children who were users of the services of a specific centre, which may naturally introduce subjectivity into the assessments. The findings are derived from the participants' self-reported statements rather than from objective indicators of rehabilitation effectiveness. Moreover, a comparison of satisfaction levels between different types of facilities (for example, public and private) was not conducted.

Originality/value: The results of the study make a significant contribution to the development of management and quality sciences, particularly in the area of medical service logistics and quality management in healthcare. The study confirms that patient service logistics constitutes an integral part of the rehabilitation service quality system, and that customer satisfaction should be regarded as one of the key indicators of an institution's organisational effectiveness. The study emphasises the importance of customer relationship management (CRM) in the context of medical services, where patients and their families become active participants in the therapeutic process.

Keywords: customer satisfaction, medical service logistics, day-time rehabilitation, patient service quality.

Category of the paper: Research paper.

1. Introduction

The rehabilitation of patients necessitates an interdisciplinary approach, in which not only the therapeutic process itself plays an important role, but also its logistical organisation. The efficient management of patient services, incorporating transport planning, appointment registration, access to specialist equipment, and the coordinated management of medical documentation, exerts a substantial influence on the efficacy of treatment and the satisfaction of patients and their families. The measurement of healthcare quality and patient satisfaction is a key component of effective resource management, enabling consideration of user preferences and the creation of personalized medical services that are better tailored to their needs and expectations (Elixhauser et al., 2003).

The rehabilitation of infants, particularly those under one year of age, represents a highly challenging domain within the field of medicine. During this period, the child's psychomotor development is characterised by extreme dynamism, and any abnormalities require immediate therapeutic intervention. Nevertheless, the efficacy of rehabilitation measures is contingent not solely on the expertise of healthcare professionals and the therapeutic methodologies employed, but also on the overall quality of the patient care process. This encompasses the initial contact with the facility to regular therapeutic sessions and ongoing communication between parents and the therapeutic team.

The extant literature on the subject increasingly emphasises that the patient's experience in contact with a rehabilitation facility is one of the fundamental determinants of the quality of medical services. The latter encompasses both technical aspects, such as punctuality, accessibility, and organisational efficiency, and intangible factors – empathy, understanding, and the manner in which staff communicate with parents. The measurement of customer satisfaction enables the assessment of service quality and the identification of areas for improvement.

The objective of this study is to assess the level of customer satisfaction in a day-time rehabilitation centre, with a particular focus on the quality of logistics and communication services. The study analyses the opinions of parents of children under one year of age who use day-time rehabilitation services at a selected centre. The research aims to gain insight into the experiences, expectations, and satisfaction levels of parents regarding the organisation and progression of the rehabilitation process. In view of the aforementioned points, the following research questions were formulated:

- What is the overall level of satisfaction of parents using the services of the day-time rehabilitation centre?
- Which elements of patient care (organisational, communicative, emotional) have the greatest impact on the level of satisfaction of the centre's clients?

Based on the review of literature and preliminary assumptions, the following research hypothesis was proposed: A high quality of logistical organisation and effective communication between staff and parents significantly increases the level of customer satisfaction in a day-time rehabilitation centre. This hypothesis reflects the assumption that both tangible and intangible aspects of patient service – including punctuality, accessibility, and empathy – are key determinants of the perceived quality of rehabilitation services.

The research was conducted using a quantitative and qualitative survey method. The study employed a structured questionnaire distributed electronically among parents of children attending a day rehabilitation centre. The questionnaire included both closed questions based on a five-point Likert scale and open-ended questions allowing for descriptive responses. A total of 72 respondents participated in the study out of 75 invited, yielding a response rate of 96%, which ensures the reliability of the obtained data. The questionnaire consisted of three main sections: evaluation of the first visit, assessment of regular rehabilitation sessions, and demographic and diagnostic information about the child. Data were analysed using descriptive statistics, weighted averages, and qualitative analysis of open-ended responses, allowing for an integrated assessment of both quantitative and experiential aspects of customer satisfaction.

The scientific originality of the conducted research lies in the application of the concept of medical service logistics to the analysis of customer satisfaction in the context of pediatric rehabilitation, which represents an approach rarely found in existing studies. In the literature, issues of patient satisfaction have so far been analyzed mainly in relation to hospital care, outpatient services, or the general quality of healthcare. This study transfers that perspective to the area of infant day rehabilitation, demonstrating that logistical and organizational elements (such as timeliness, accessibility, and coordination of therapy) are equally important for customer satisfaction as medical competence and staff empathy. The study is not only of diagnostic importance, but also of practical significance. The results will facilitate the identification of the areas of the centre's activity with the greatest impact on the patient experience, thus providing a foundation for the enhancement of the quality and efficiency of rehabilitation services. Moreover, the findings contribute to the broader discourse on quality management and logistics in healthcare, highlighting the necessity of integrating patient satisfaction metrics into organisational improvement strategies.

2. Literature review

2.1. Rehabilitation of children up to 15 months of age in a day-time rehabilitation centre – general characteristics

The rehabilitation of children diagnosed with developmental disorders constitutes a pivotal component of a comprehensive healthcare system. The overarching objective of such a system is to provide support for the harmonious psychomotor and social development of the youngest patients. In accordance with the prevailing regulations, rehabilitation services provided at a centre or day ward encompass a maximum of 120 treatment days per calendar year for each beneficiary. The programme has been meticulously designed to cater to two distinct age groups of children, with the therapeutic interventions tailored to address their unique developmental needs (Nanda, Sharma, 2021).

Children up to the age of seven with developmental disorders are covered by a rehabilitation process that includes physiotherapy and support from a psychologist or speech therapist/audiologist. As stipulated in the Regulation of the Minister of Health of 26 March 2021, children aged between 8 and 18 who have been certified as requiring special education are obligated to participate in classes that incorporate physiotherapy, psychological therapy, speech therapy/surdologopedic therapy, and occupational therapy.

Children who require specialised, integrated medical and therapeutic care are typically referred to paediatric day-time rehabilitation wards. The primary criteria for eligibility for such rehabilitation are outlined in (Regulation of the Minister of Health of 26 March 2021):

- belonging to a high-risk pregnancy and childbirth group (children born after the 25th week of pregnancy),
- congenital malformations of the nervous system (e.g. meningomyelocele, microcephaly, congenital hydrocephalus),
- metabolic diseases of the nervous system,
- central motor coordination disorders,
- chromosomal aberration syndromes (e.g. Down syndrome),
- permanent dysfunctions of the musculoskeletal system (e.g. cerebral palsy, myopathies, neuromuscular atrophy, consequences of traumatic and inflammatory diseases of the central nervous system),
- sensory integration disorders,
- hearing, speech and vision disorders.

The utilisation of a day-time centre in the context of rehabilitation facilitates the implementation of an intensive, multi-specialist therapeutic programme. This approach is predicated on the maintenance of the child's contact with their family and home environment, a factor that is deemed to be crucial for the effectiveness of the therapeutic and educational process. Referrals to the day-time rehabilitation ward are issued by a specialist doctor employed

in hospital wards or specialist clinics, such as neonatology, rehabilitation, orthopaedics and traumatology of the musculoskeletal system, neurology, rheumatology, paediatric surgery, or a primary care doctor. This enables the child to be appropriately qualified for an intensive therapeutic programme.

The staffing requirements for the day-time care unit include a specialist in the field of musculoskeletal rehabilitation or paediatric neurology, a master's degree in physiotherapy with experience in neurodevelopmental therapy for children, a clinical psychologist, a speech therapist specialising in neuro-speech therapy, and a special education specialist or occupational therapist. The composition of an interdisciplinary team ensures a multifaceted therapeutic approach, integrating physiotherapy, psychology, speech therapy and occupational therapy. This contributes to the comprehensive functional development of children with developmental disorders. The physiotherapist is required to classify the patient according to the International Classification of Functioning, Disability and Health (ICF) classification system, which was developed by the World Health Organisation (WHO) and adopted at the World Health Assembly on 22 May 2001. The assessment is based on the observation and scoring of four developmental areas during spontaneous activity of children aged 0-15 months:

- postural control,
- motor control,
- fine motor skills,
- level of mental function development (Guidelines of the National Council of Physiotherapists).

The methods employed in the day-time care unit for children with developmental disorders are founded on the most recent advancements in multidisciplinary therapy and are customised to meet the distinct developmental requirements of each patient. The therapeutic programme utilises a combination of conventional rehabilitation techniques and contemporary methods, with the objective of promoting the psychomotor, communicative and social development of children. The integration of various therapeutic approaches has been demonstrated to exert a comprehensive impact on the motor, cognitive, emotional and social spheres, thereby ensuring optimal conditions for progress in the child's functioning. The rehabilitation methods employed in the day-time care unit include (Śliwiński, 2022):

NDT Bobath - a concept that was developed by the physiotherapist Berta Bobath and the neurologist Karel Bobath. This approach is holistic in nature, addressing disorders that arise from damage to the immature central nervous system (CNS). The text encompasses developmental and sensorimotor problems in children, in addition to cognitive, emotional and social disorders that arise in everyday life. The following elements are encompassed therein:

- early recognition of cerebral palsy (CP) symptoms,
- assessment of the child's functional status as a basis for programming rehabilitation,

- assessment of the child's functional status as a basis for selecting forms and means of therapy,
- monitoring of results (assessment of the effectiveness of therapy).

The NDT method does not include ready-made sets of exercises; its aim is to build the child's correct sensorimotor potential, which includes:

- inhibiting abnormal reflex activity,
- eliminating functional blocks,
- paving the way for correct adjustment and balancing reactions,
- normalising muscle tone,
- stimulation of the correct body schema,
- triggering correct movement patterns,
- care – correct lifting and carrying, feeding, dressing and securing the correct position during play and learning.

The SI method – sensorimotor integration – is a method of correct processing of sensory impressions that occur in the central nervous system. Factors that influence SI disorders include:

- Hereditary, congenital factors.
- Prenatal and perinatal factors.
- Premature birth.
- Environmental factors.

The therapeutic intervention utilises a range of mobile equipment designed to stimulate the balance and deep sensation systems. The objective of these activities is to furnish the child with exhaustive sensory information from multiple sensory systems in a manner that facilitates its appropriate processing by the central nervous system. The therapeutic approach is predominantly implemented through play, which facilitates the child's intrinsic activity. However, the therapeutic process is meticulously overseen and regulated by a credentialed therapist, thereby ensuring that the stimuli are meticulously adapted to the patient's individual requirements.

A significant element of physiotherapy administered within the context of the day-time care unit involves collaboration with the children's parents (Jean Ayres, 2020). The efficacy of rehabilitation is contingent upon the systematic continuation of therapeutic recommendations and exercises in the domestic environment. The involvement of parents in the therapeutic process has been shown to facilitate a more profound comprehension of the challenges confronted by their child, thereby enhancing their capacity to respond effectively to challenging situations in everyday life. Regular meetings between parents and therapists provide an opportunity for the exchange of feedback on the child's progress and behaviour. This process enables continuous adjustment and individualisation of the rehabilitation programme.

2.2. The importance of logistics in the rehabilitation process

Logistics is of fundamental importance in the rehabilitation process, as it ensures the smooth running and availability of medical services, which in turn has a direct effect on the effectiveness of therapy. The organisation of patient transport, especially for those with limited mobility, determines their ability to participate regularly in rehabilitation sessions. Inefficiencies in logistics can result in delays, irregular attendance and, consequently, reduced treatment effectiveness. Furthermore, the meticulous organisation of a visit schedule facilitates the efficient allocation of medical resources and minimises waiting times for therapy. One of the pivotal elements of logistics in rehabilitation pertains to the meticulous planning and seamless coordination of all activities pertaining to patient treatment. This encompasses the scheduling of treatments, the allocation of specialists, the management of time and space resources (e.g. the availability of rehabilitation rooms and physiotherapy equipment), and the adaptation of therapy to the individual needs of the patient (Twaróg, 2014). Effective logistics has been demonstrated to help avoid delays, staff overload and waste of resources, which in turn has a direct impact on the comfort and effectiveness of treatment (Jarzynkowski et al., 2016). For patients with limited mobility, logistics provides appropriate means of transport – both within the facility (e.g. transport by wheelchair between treatment rooms) and outside it (e.g. transport to rehabilitation centres, transport home or to follow-up appointments). It is imperative that such transport is not only efficient, but also safe and adapted to the patient's state of health. The utilisation of contemporary information technologies in the domain of medical logistics is becoming increasingly prevalent. Patient management systems (e.g. HIS, ERP) facilitate the monitoring of treatment progress, rehabilitation planning, the collection of medical records and communication between members of the therapeutic team. This facilitates expeditious decision-making and optimises the adaptation of therapeutic interventions to the individual patient's requirements. The areas of the rehabilitation process in which logistics plays an important role are shown in Fig. 1.

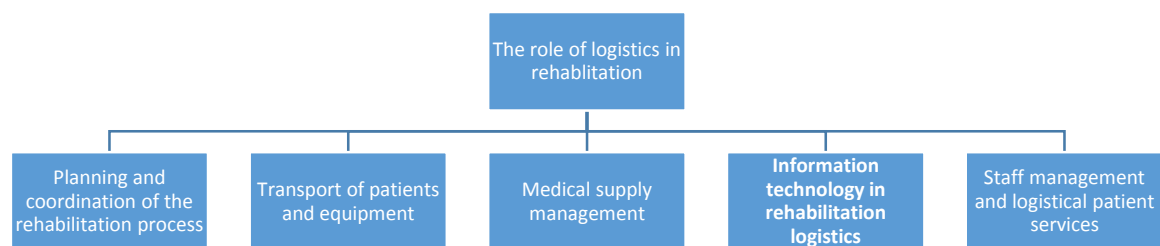


Figure 1. The role of logistics in rehabilitation.

Source: Own work based on: Marzantowicz, 2015, pp. 249-252.

Furthermore, an increasing number of patients are opting for home rehabilitation, a development that introduces novel challenges to the logistics sector. This necessitates not only the delivery of equipment and materials to the patient's residence, but also the coordination of home visits by specialists. The coordination of such a process necessitates meticulous planning

and adaptable management, thereby ensuring the continuity of therapy and patient comfort. The remainder of this paper will focus on customer service logistics. The implementation of efficient logistics has been demonstrated to have a positive impact on the reduction of stress and administrative burdens for both patients and medical staff. It has been demonstrated that patients experience an increased sense of safety when their treatment is well coordinated. This, in turn, enables members of the medical staff to focus on the quality of the service rather than on the resolution of organisational issues.

2.3. Logistics customer service

Customer service is defined as all operations aimed at designing service standards, order processing and after-sales service (Kramarz, 2012; Spyra, 2009; Kempny, 2001). Customer service is a broad concept that is difficult to define unambiguously. The term encompasses all dimensions of customer contact, both tangible and intangible. A fundamental aspect of establishing an effective customer relationship management system and attaining customer satisfaction is the customisation of the service strategy to align with the identified needs of the customer (Kramarz, 2017). K. Rutkowski asserts that the capacity of a company's logistics system to cater to customers' requirements in terms of temporal factors, reliability, communication and convenience constitutes the essence of customer service. The quality of the logistics system is reflected in the logistical customer service provided. (Jedynak, p. 6). It establishes potential limitations in terms of customer service, thereby subordinating the marketing or financial concept (Dwiliński, p. 217). Logistical customer service can be defined as a system of solutions that guarantee customer satisfaction. The capacity to respond in a dynamic manner to the expectations and requirements of customers is of paramount importance. In the extant literature on the subject, the concept of customer service is most often presented in three dimensions: as a specific activity; as a measurement of activities performed; as a philosophy, i.e. a way (ability) of thinking (Coyle, p. 155). Consequently, the notion of logistical customer service encompasses a process dedicated to ensuring the efficient and effective satisfaction of customer expectations and requirements, primarily in terms of the time and place of product availability, utilising available logistical activities and considering the capabilities of the company and the conditions of the environment (Jedynak, p. 80). According to Kisperska Moroń, customer service elements are the features to which customers pay the most attention during the process of evaluating and selecting a given product (Kisperska-Moroń, p. 77). The following areas are covered: time, reliability, communication and convenience (Coyle, p. 156). The identification of these elements necessitates the establishment of quantifiable parameters. These parameters must be characterised by, among other things, adequacy, timeliness, usefulness and comprehensibility (Jedynak, 2019).

2.4. Logistical support for patients during rehabilitation

In the contemporary healthcare system, logistics assumes an increasingly pivotal role (Klein, Thielen, 2024), a fact that is especially evident in the domain of patient rehabilitation. Rehabilitation can be defined as a complex and multi-stage process aimed at restoring the patient's physical, mental and social functioning. Logistical customer (patient) service is an extremely important aspect of rehabilitation, which affects not only the effectiveness of treatment, but also the patient's overall experience in contact with the medical facility. In this context, the patient is not merely a recipient of health services, but also a customer whose needs, comfort and satisfaction are as important as purely medical aspects. The efficiency of a patient logistics service is contingent on the efficacy of its initial point of contact, whether in a stationary facility or within online systems. Patients should be granted straightforward access to information regarding available rehabilitation dates, specialist appointment times, requisite documentation, and reimbursement options. The advent of modern registration systems (telephone, online, mobile applications) and the provision of rapid feedback (e.g. SMS reminders about appointments) have been shown to have a significant impact on the quality of service. The effective management of logistics facilitates the customisation of therapy to the individual patient's requirements, encompassing both the modality and the scheduling of treatment. The patient's preferences, daily routine and time constraints have been shown to affect their commitment to the treatment process and overall satisfaction with the service. For patients with long-term conditions, it is imperative to ensure the continuity of their therapeutic care. This continuity may be facilitated by allocating the same therapist to the patient or by scheduling sessions at regular intervals.

In the case of infants, rehabilitation is very often based on close cooperation with parents. A plethora of methodologies – including the Vojta method and NDT Bobath – presuppose the active involvement of caregivers in exercises that are to be conducted in the caregiver's home environment. It is therefore essential to establish a collaborative relationship between the therapist and the child's family. It is well-documented that parents of infants, particularly those whose offspring exhibit developmental deficits, experience elevated levels of stress, emotional tension, uncertainty and anxiety. When individuals seek treatment at a rehabilitation facility, they are seeking more than mere assistance; they are also seeking an environment characterised by understanding, empathy and professional support. The quality of customer service – from the initial contact with the registration desk, through interactions with staff, to communication with the physiotherapist – exerts a significant influence on patients' decisions, trust, and commitment. In the context of infant rehabilitation, effective communication represents a pivotal component of customer service. The provision of high-quality information to parents, the delivery of clear instructions, the demonstration of patience in explaining procedures, and the establishment of an atmosphere of openness to questions have been identified as key factors in the development of a relationship based on trust. Parents who

feel informed and involved become active participants in therapy, rather than passive observers. Adverse experiences associated with a paucity of information, uncooperative staff, or difficulties in contacting the facility may result in the discontinuation of therapy or its incorrect continuation at home. Consequently, it is imperative to implement training programmes that emphasise interpersonal communication skills, particularly in high-pressure scenarios that demand a substantial degree of empathy. Parents who feel listened to and cared for are more likely to participate regularly in therapy and follow recommendations. It is incumbent upon facilities to ensure that those responsible for customer contact receive adequate training and are familiar with the specifics of child rehabilitation. It is evident that a friendly, non-judgemental attitude, coupled with organisational flexibility – for example, in terms of scheduling appointments – has a positive impact on the entire treatment process. Staff members who demonstrate commitment, empathy, and an individualised approach to the patient not only enhance the child's well-being, but also fortify the parents' motivation. In this context, customer service is not merely a technical issue, but also a psychological one. It is essential to demonstrate to parents that their child is important, and that they are treated with care and respect. In the long term, this also contributes to the establishment of a positive image of the facility and an increase in its therapeutic effectiveness. Parents of children undergoing rehabilitation frequently experience feelings of disorientation and uncertainty, particularly during the initial stages of therapy. Customer service should also comprise educational activities. These should include the explanation of the goals of therapy, the demonstration of exercises to be performed independently, the provision of information materials, and the organisation of support group meetings. This type of support has been shown to engender feelings of competence and agency in parents (Smith, 2023). They are aware of how to behave, what they can do for their child, and they feel that they are part of the therapeutic team. This, in turn, has a direct impact on the effectiveness of rehabilitation, as a significant proportion of the treatment process takes place in the home environment, rather than in a therapist's office. The factors influencing customer service in the rehabilitation process of infants are presented in Figure 2.

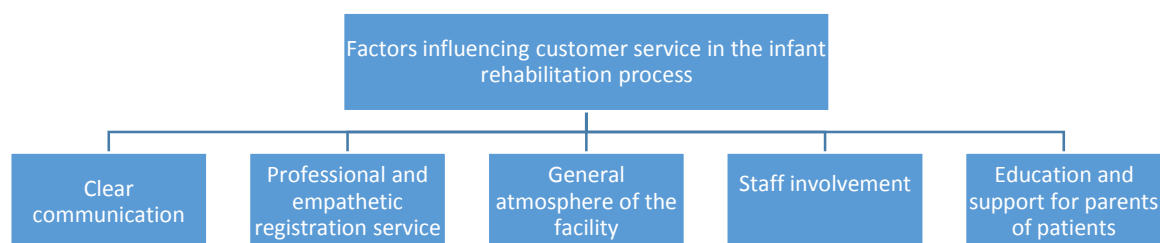


Figure 2. Factors influencing customer service in the rehabilitation process of infants.

Source: Own work based on: Marzantowicz, 2015, pp. 249-252.

3. Methods

The research was conducted at a selected rehabilitation centre with a day-time rehabilitation ward. The researchers employed a structured questionnaire as the research tool. Due to the age of the patients, the survey was conducted among the carers of patients at the day-time rehabilitation ward in order to examine the impact of logistics on the effectiveness of rehabilitation. The questionnaire comprised a variety of questions, including open-ended, closed-ended questions with single and multiple choice options, nominal intervals, and a Likert scale. The distribution of the questionnaire was conducted electronically, with a sample of 75 carers of patients under 15 months of age in the designated ward being the target demographic. A total of 72 responses were received, resulting in a response rate of 96%. The survey is divided into three sections: the initial visit is assessed, regular appointments are evaluated, and patient characteristics are analysed. The initial section pertains to the initial visit, encompassing the rationale behind the selection of the facility, the duration of the wait for the visit, the issue of punctuality, and the quality of the interview and diagnosis. The level of satisfaction with the provided answers and the organisation of subsequent treatment was also taken into account. The second part of the survey focuses on regular rehabilitation classes. The assessment encompasses a range of domains, including the observations made by the physiotherapist, the technical capabilities of the centre, its accessibility for individuals with disabilities, the staff's empathy and commitment, and the impact on the individual. The final section of the questionnaire is of a demographic and diagnostic nature. It contains questions regarding the duration of rehabilitation, the frequency of visits, the reasons for rehabilitation, and the patient's age. The variables used in the study were selected based on a review of previous research on patient satisfaction and healthcare logistics, as well as theoretical models linking service quality, communication, and organizational efficiency with perceived satisfaction. Particular emphasis was placed on variables reflecting logistical and interpersonal aspects of healthcare delivery—such as timeliness, accessibility, coordination, and empathy—identified as key determinants in existing studies.

3.1. Research results

The primary enquiry addressed the rationale behind the selection of the specific centre. The question posed was of the multiple-choice variety. An analysis of the respondents' answers indicates that the primary factors determining the selection of a day-time rehabilitation centre were the availability of appointments (61.1%) and distance from the place of residence (55.6%). This finding underscores the prevailing influence of pragmatic considerations pertaining to the structuring and operationalisation of rehabilitation services. The influence of personal contacts, such as friends (38.9%) and acquaintances of centre employees (22.2%), as well as recommendations from healthcare professionals such as midwives or doctors (19.4%),

was found to be of lesser social importance. The findings indicate that when selecting a rehabilitation facility, patients primarily consider the availability of services and the convenience of location, with personal and medical recommendations playing a less significant role. The detailed results are presented in Figure 3.

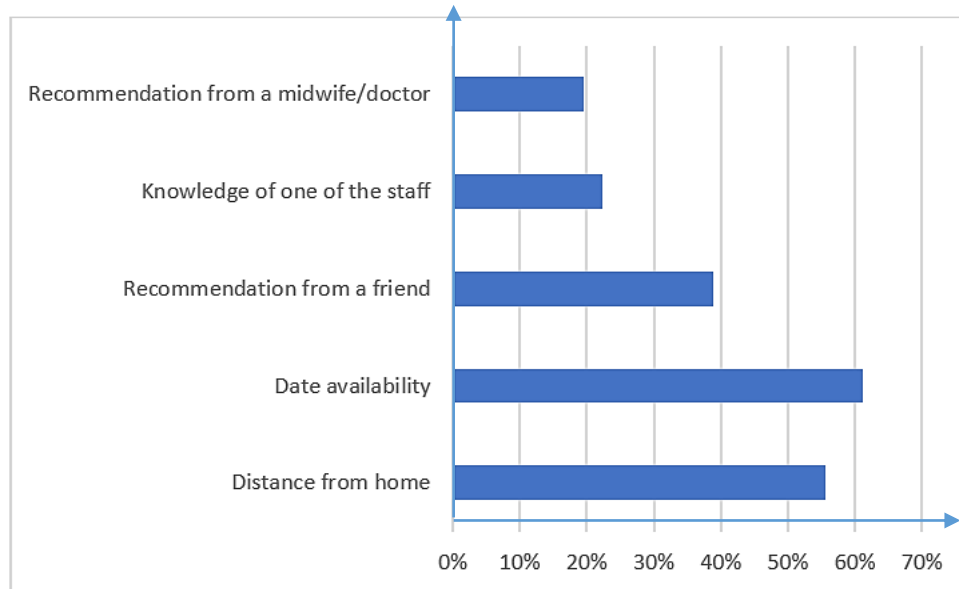


Figure 3. Reasons for choosing the surveyed centre by customers.

Source: Own work based on conducted research.

The most frequently indicated waiting period for the initial visit was between two weeks and one month (44.4%), which indicates relatively expeditious service availability. Shorter waiting periods (up to two weeks) accounted for 27.8%, and longer ones (from one month to two months) for 25%. The results of the survey suggest that the services at the centre in question are generally available. The vast majority of respondents (91.7%) indicated that their visit to the rehabilitation centre commenced at the scheduled time, indicating a high degree of adherence to the established appointment schedule. A mere 8.3% of respondents reported experiencing a delay in the commencement of their visit. It was confirmed by respondents that a medical interview was conducted with them during their initial visit. The most frequently mentioned element of the interview was the question regarding the rationale for referral to the day-time care unit. This response was selected by 86.1% of respondents (62 people). The significant proportion of responses in this category indicates that this component of the diagnostic process is both standardised and consistent.

The remaining frequently asked questions pertained to the course of labour (63.9%) and prematurity (63.9%), both of which are pivotal aspects of a child's perinatal history. Questions regarding previous diagnoses, for instance those made during a hospitalisation following birth (61.1%), were marginally less prevalent but nevertheless exhibited a high degree of consistency in the aggregation of medical data. A thorough analysis of the results indicates that the interview conducted at the rehabilitation centre was comprehensive in nature, with the objective of ascertaining a comprehensive overview of the patient's health status. The primary emphasis is

placed on ascertaining the rationale behind referral, a crucial aspect in ensuring the appropriate selection of therapy. Frequent references to the history of birth, prematurity and previous diagnoses indicate a holistic approach to the patient, taking into account their development from birth.

In the subsequent phase of the study, respondents were invited to rate the accuracy of the patient's diagnosis on a scale ranging from 1 to 5, with 5 denoting a diagnosis of exceptional accuracy and 1 representing a diagnosis of suboptimal accuracy. The majority of respondents, 66.7% (48 people), assigned a rating of 5, indicating a very high level of satisfaction with the assessed element. Furthermore, 30.6% (22 respondents) allocated a rating of 4, while a mere 2.8% (2 respondents) assigned a rating of 3. It is noteworthy that no respondent assigned a rating of 1 or 2, suggesting that the respondents' assessments were predominantly positive.

The results of the study indicate that the initial visit to a rehabilitation centre typically lasts between 30 and 45 minutes, during which the physiotherapist provides patients with comprehensive answers to all their questions and concerns. The respondents' evaluation of the information provided was overwhelmingly positive, with 66.67% rating it as very satisfactory and 33.33% as satisfactory. This outcome signifies a commendable level of communication and professionalism exhibited by the medical staff during the initial therapeutic interaction.

The next question concerned scheduling the next appointment. The survey results indicate that for the largest group of respondents (38.9%), the next appointment was scheduled within a week of the first visit, which demonstrates the high flexibility and efficient organisation of the facility. The second most frequent response was "up to two weeks" (30.6%), while 16.7% of respondents indicated a date of up to three weeks. It was much less common to schedule sessions up to a month (approx. 8%) or more than a month (the remaining few percent). Figure 4 shows the distribution of responses to the question concerning the time of scheduling subsequent sessions from the date of the first visit to the day-time rehabilitation centre.

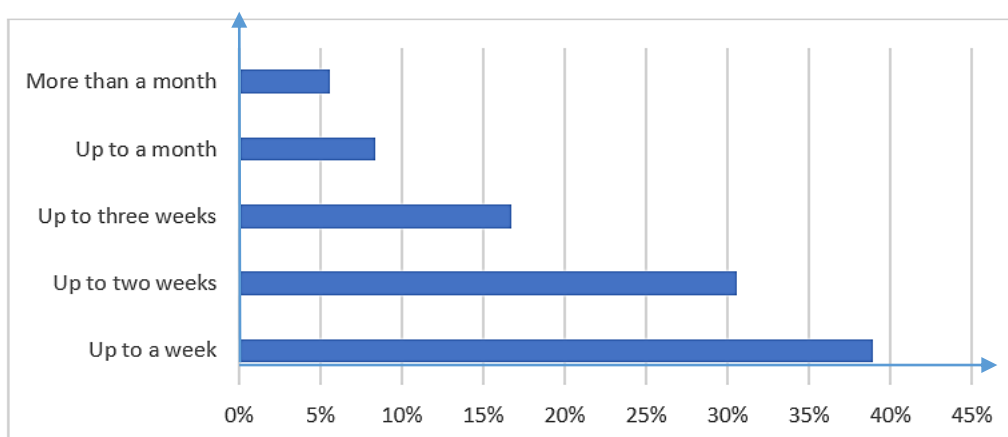


Figure 4. Time of scheduling subsequent visits.

Source: Own work based on conducted research.

The distribution of responses displayed in Chart 2 demonstrates that the centre facilitates expeditious access to subsequent phases of therapy, thereby ensuring the efficient operation of the rehabilitation process. The preponderance of brief waiting times (extending to a maximum of one or two weeks) serves as a testament to the efficacy of the system, which is characterised by its meticulous organisation and well-coordinated logistics. This observation is indicative of a favourable evaluation of the quality of patient care at the facility.

The respondents were subsequently invited to indicate the aspects of the visits to which they allocate the most attention. The results are set out in Table 1.

Table 1.

The most important aspects of customer logistics in the rehabilitation process

	Very small	Small	Medium	Large	Very large
Social		3	22	31	44
Motor coordination		0	8	33	58
Progress from previous sessions		0	3	39	58
Person's mood		0	14	33	53
Exercise variety		0	14	39	47
Caregiver involvement	6	3	3	33	56

Source: Own work based on conducted research.

In order to facilitate a more detailed analysis, a rating scale was utilised, with each rating assigned a specific numerical value. In the context of the study, the following scale was utilised to assign weights to the various sizes: very small = -2, small = -1, medium = 0, large = 1, very large = 2. Subsequently, a weighted average was calculated for each aspect. The mean results are presented in Figure 5.

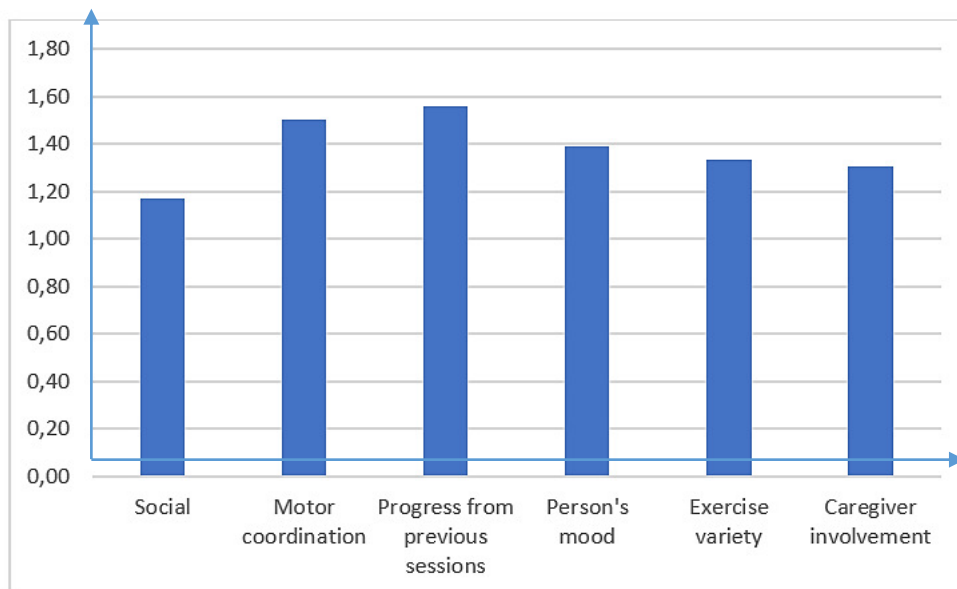


Figure 5. The most important aspects of customer logistics service in the rehabilitation process based on weighted average.

Source: Own work based on conducted research.

When interpreting the data obtained, it should be noted that, in the opinion of the respondents, both the competence and commitment of the therapeutic team and the support and activity of carers play a leading role in the success of the rehabilitation process. The preponderance of favourable ratings in pivotal categories substantiates the efficacy of the facility's patient-centred rehabilitation model, wherein environmental and emotional factors synergise with professional medical interventions. These results are consistent with the most recent recommendations for a holistic approach to paediatric physiotherapy. These recommendations advocate that therapy should take into account both motor functions and social and emotional aspects, as well as parental support throughout the entire rehabilitation process. It is also noteworthy that at the centre under scrutiny, parents are permitted to remain with their children during educational activities. Furthermore, all of the children's physiological needs (the desire to eat, drink, and cuddle) are met, as confirmed by 100% of respondents.

In the subsequent phase of the survey, respondents were presented with a series of statements pertaining to the organisational quality of the rehabilitation centre and the work of the therapeutic team, and were invited to indicate their level of agreement with each statement. The Likert scale employed in this study allowed respondents to select responses ranging from "strongly agree" to "strongly disagree", a method frequently utilised for the quantitative and qualitative assessment of experiences and levels of satisfaction with healthcare. This facilitated the acquisition of comprehensive data, encompassing not only the overall level of satisfaction, but also the identification of strengths and areas for potential enhancement in the facility's activities. The assessment covered, among other things: staff competence, quality of communication, individualisation of the therapeutic process, punctuality of service provision, appearance and accessibility of infrastructure, and the organisational culture of the team.



Figure 6. Assessment of logistical customer service.

Source: Own work based on conducted research.

The results presented in Figure 6 indicate that the vast majority of respondents expressed full agreement with the statements concerning the competence, empathy, punctuality and personal culture of the staff, thereby confirming the very high quality of service in the rehabilitation facility. The individualised approach of the staff, their knowledge and commitment to communication and solving patients' problems were rated particularly positively, with "strongly agree" ratings exceeding 70% in most categories. Conversely, it is noteworthy that neutral or negative responses are infrequent, suggesting that the survey participants as a whole are generally satisfied. The infrastructure features – the appearance of the equipment, the attractiveness of the facilities and their accessibility – were also assessed and received lower but still positive ratings, indicating areas for further development and investment. It is particularly noteworthy that there is virtually no disagreement with the values set by the staff, and the organisation of classes meets the expectations of families in terms of timeliness and flexibility. To summarise, the results of the chart demonstrate that the centre's team and facilities engender an environment conducive to development and effective therapy, in accordance with the principles of modern paediatric rehabilitation.

Next, respondents were asked to evaluate the physiotherapist's behaviour during the visits. The results are presented in Fig. 7.

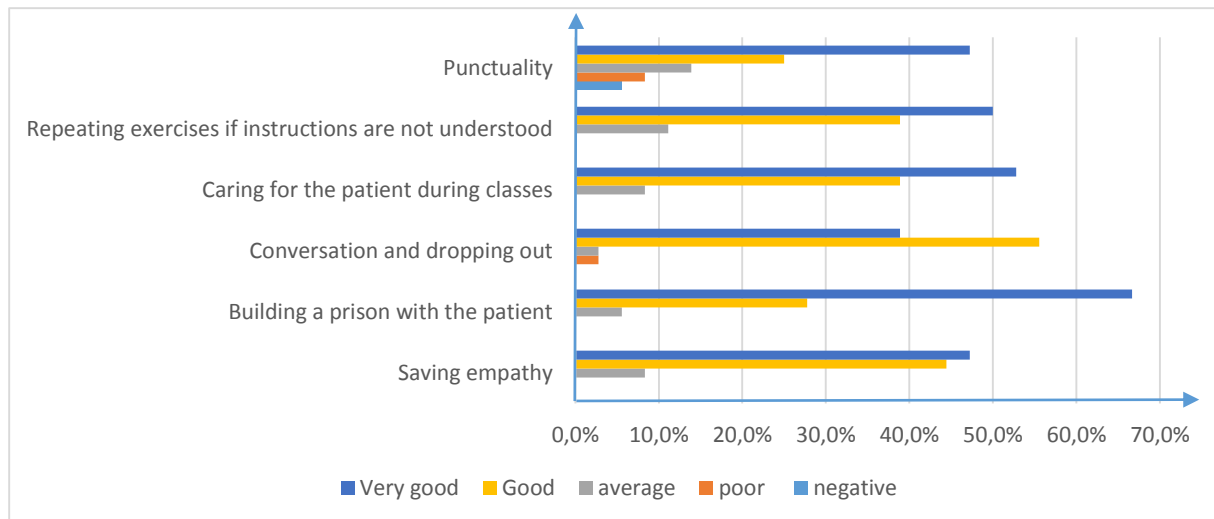


Figure 7. Assessment of the physiotherapist's behaviour during classes.

Source: Own work based on the conducted research.

It is evident from the data obtained that patients provide a high level of satisfaction with regard to the attitude and work of physiotherapists. The aspect that received the highest ratings was the establishment of a relationship with the patient, with 66.7% of respondents rating this behaviour as very good, and a further 27.8% as good. The ability to show empathy was also highly regarded, with 47.2% of respondents rating it as very good and 44.4% rating it as good. Collectively, these ratings accounted for over 90% of positive ratings. The patient received a favourable rating for conversation and interest (55.6% good, 38.9% very good) and care during classes (38.9% good, 52.8% very good). Furthermore, the repetition of exercises in the event of an erroneous interpretation of the instructions was evaluated as 'very good' by 50.0% of the respondents and as 'good' by 38.9%. This finding serves to substantiate the commendable levels of patience and communication skills exhibited by physiotherapists. Punctuality received slightly lower ratings, yet these were still positive, with 47.2% of respondents rating it as very good, 25% as good, and 13.9% as average. A small percentage of respondents expressed a poor (8.3%) or negative (5.6%) opinion of this aspect, suggesting that punctuality remains an area for improvement. In consideration of the data obtained, it can be concluded that the vast majority of respondents (88.9%) confirm the existence of designated parking spaces for disabled individuals. This finding indicates that the facility's infrastructure is adequately adapted to meet the needs of people with reduced mobility. Consequently, 77.8% of respondents expressed satisfaction with the building's adaptation to patients' needs, citing the presence of amenities such as a baby changing table. Conversely, 22.2% of respondents identified deficiencies in this regard. These results suggest that, despite the facility's overall high accessibility, there is still scope for enhancement of amenities for patients with special needs.

The final element of the study was a brief description of the respondents, including information on the duration and frequency of rehabilitation, its causes and the age of the patients. The results of the study indicate that the majority of respondents (41.7%) have been

attending rehabilitation for a period of one to three years, suggesting a long-term commitment to the therapeutic process. The most prevalent number of rehabilitation sessions per individual is twice weekly (33.3%), which suggests a methodical approach to the rehabilitation process. The predominant reasons for rehabilitation are perinatal disorders (44.4%) and prematurity (27.8%), indicating that the study primarily focuses on children necessitating early intervention. This assertion is corroborated by the age structure of the patients, with a significant proportion, amounting to 72.2%, comprising children within the age range of 6 to 12 months.

4. Discussion

As Sricharoenpramong (2018) asserts, the hallmarks of an effective employee are reliability, punctuality and caution in the execution of duties. Furthermore, the possession of effective communication skills, a courteous disposition, and a readiness to assist are of paramount importance. Clegg, Kersten, Koch (2010) posit that employees should prioritise customer satisfaction, possess advanced professional competencies, and maintain effective accessibility. As Sarwar et al. (2012) have observed, customer loyalty and trust are pivotal factors in determining the quality of services provided. Trust, as a foundational element of any relationship, exerts a substantial influence on behaviour and interactions. Consequently, the establishment of customer trust is imperative to ensure the delivery of satisfactory service across diverse operational domains. The provision of logistical customer service in the field of rehabilitation is not solely concerned with the efficient management of patient flow and resources; of paramount importance is the creation of an environment in which patients feel cared for, understood and respected. The provision of high-quality service, predicated upon the principles of logistics, has been demonstrated to engender an enhancement in the effectiveness of therapy, an improvement in relations between the patient and staff, and the establishment of a positive image of the medical facility. In the context of evaluating patient service, Waśniewski (2020) emphasises the significance of analysing factors such as waiting time for appointments, the quality of transportation provided, and patient satisfaction with logistics services. The authors of this paper emphasise that relations with patients are equally important, as they greatly influence the progress of treatment. The measurement of the quality of logistics services must be operationalised using measurable indicators. Consequently, it is regarded as the foundation for the development of the structure (Clegg et al., 2010).

It is recommended to optimise logistics processes by implementing IT systems that support appointment scheduling, digitisation of medical records and improvement of medical transport. Cooperation between rehabilitation facilities and institutions responsible for organising medical transport is also a key element.

5. Summary

Based on the results of the conducted surveys, it was confirmed that high-quality logistical organization and effective communication between the staff and parents significantly contribute to increased satisfaction among clients of the day rehabilitation center. The findings of this study indicate that the professional competence and knowledge of the therapeutic team, as well as their empathy, openness and willingness to cooperate with parents, are all significant factors in the shaping of positive customer experiences.

The results of the analysis provided answers to all the research questions. Firstly, it was established that the overall level of satisfaction among clients of the day-time rehabilitation centre is very high, which confirms the effectiveness of the organisational and quality model adopted by the facility. Secondly, the elements of patient care that have the greatest impact on parental satisfaction were identified. These elements are as follows: the timeliness of visits, the availability of services, the quality of communication and the attitude of the therapeutic staff. Thirdly, the study demonstrated that logistical aspects, such as appointment scheduling and coordination of therapeutic activities, are perceived by parents as a significant factor in the effectiveness of rehabilitation. It was confirmed that the empathy and commitment demonstrated by staff members significantly strengthens the trust that parents place in the facility, thereby encouraging their active participation in the therapeutic process. The responses to the research questions indicate that customer satisfaction in paediatric rehabilitation is a multidimensional category, contingent on the interplay of logistical, communication and emotional factors.

The results of the conducted study confirm that the organization of logistics and communication processes in the day rehabilitation centre significantly influence the level of customer satisfaction. Respondents particularly valued the professionalism, empathy, and commitment of the therapeutic team, as well as the timeliness and coordination of services. The findings indicate that effective scheduling, short waiting times, and individualized therapeutic approaches enhance the perceived quality of rehabilitation services. Moreover, the holistic model adopted by the facility — integrating medical, organizational, and emotional aspects of care — supports patient engagement and parental satisfaction. Overall, the study demonstrates that efficient logistics and human-centered management constitute key determinants of the success and quality of pediatric rehabilitation.

The present study contributes to the development of knowledge in the field of quality management in healthcare and medical service logistics. The study confirms the importance of integrating a logistical approach with the concept of customer relationship management (CRM) in rehabilitation facilities.

References

1. Aashima, A., Nanda, M., Sharma, R. (2021). *Przegląd satysfakcji i doświadczeń pacjentów z telemedycyną: wirtualne rozwiązanie w trakcie i po pandemii COVID-19*. *Telemedicine and e-Health*, 27(12), 1325-1331. <https://doi.org/10.1089/tmj.2020.0570>
2. Alfarizi, M., Ngatindriatun (2022). *Czynniki determinujące jakość usług szpitalnych i satysfakcję pacjentów: podejście do zarządzania logistyką szpitalną*. *Asian Management and Business Review*, 2(2), 121-138. <https://doi.org/10.20885/AMBR.vol2.iss2.art2>
3. Cavaliere, L., Khan, R., Sundram, S., Jainani, D., Bagalee, G., Chakravarthi, M., Regin, R., Rajest, S.S. (2021). The impact of customer relationship management on customer satisfaction and retention: The mediation of service quality. *Turkish Journal of Physiotherapy and Rehabilitation*, 32(3), 22110. ISSN 2651-4451
4. Clegg, B., Kersten, W., Koch, J. (2010). The effect of quality management on the service quality and business success of logistics service providers. *International Journal of Quality & Reliability Management*, 27(2), 185-200. <https://doi.org/10.1108/02656711011014302>
5. Coyle, J.J., Bardi, E.B., Langley, C.J.Jr. (2010). *Zarządzanie logistyczne*. Warszawa: PWE.
6. Dwiliński, L. (2006). *Zarys logistyki przedsiębiorstwa*. Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej.
7. Elixhauser, A., Steiner, C., Fraser, I. (2003). Volume thresholds and hospital characteristics in the United States. *Health Affairs*, 22(2), 167-177. <https://doi.org/10.1377/hlthaff.22.2.167>
8. Jarzynkowski, P., Książek, J., Piotrkowska, R. (2016). Specyfika procesów logistycznych ochrony zdrowia w Polsce. *Strategie i Koncepcje Logistyczne, Logistyka*, 5, 13-15.
9. Jean Ayres, A. (2020). *Dziecko a integracja sensomotoryczna*. Gdańsk.
10. Jedynak, Z. (2017). *Audyt logistyki w przedsiębiorstwach handlu detalicznego wielkopowierzchniowego*. Warszawa: CeDeWu.
11. Jedynak, Z. (2018). Logistyczna obsługa klienta w przedsiębiorstwach handlu detalicznego wielkopowierzchniowego. *Autobusy*, 6, 1047.
12. Klein, T., Thielen, C. (2024). *Improving patient transport in hospitals: A literature review of operations research methods*. <https://doi.org/10.48550/arXiv.2404.03282>
13. Kramarz, M., Słupina, M. (2017). Assessment of customer satisfaction in logistic operators. *Logistics and Transport*, 3(35), 14.
14. Levin-Scherz, J., DeVita, N., Timbie, J. (2006). Impact of pay-for-performance contracts and network registry on HEDIS® measures in diabetes and asthma. *Medical Care Research and Review*, 63(1), 14-28. <https://doi.org/10.1177/1077558705284057>
15. Marzantowicz, Ł. (2015). Rozwój logistyki w ochronie zdrowia w Polsce. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, 249, 249-252.

16. Nanda, M., Sharma, R. (2021). A review of patient satisfaction and experience with telemedicine: A virtual solution during and beyond COVID-19 pandemic. *Telemedicine and e-Health*, 27(12), 1325-1331. <https://doi.org/10.1089/tmj.2020.0570>
17. Restuputri, D.P., Indriani, T.R., Masudin, I., Tan, A.W.K. (2021). The effect of logistic service quality on customer satisfaction and loyalty using Kansei engineering during the COVID-19 pandemic. *Operations, Information & Technology*. <https://doi.org/10.1080/23311975.2021.1906492>
18. Rogers, A.E., Hwang, W.T., Scott, L.D., Aiken, L.H., Dinges, D.F. (2004). The working hours of hospital staff nurses and patient safety. *Health Affairs*, 23(4), 202-212. <https://doi.org/10.1377/hlthaff.23.4.202>
19. Rozporządzenie Ministra Zdrowia z dnia 26 marca 2021 r. w sprawie świadczeń gwarantowanych z zakresu rehabilitacji leczniczej. *Dziennik Ustaw*, 2021, poz. 265.
20. Sarwar, M.Z., Abbasi, K.S., Pervaiz, S. (2012). The effect of customer trust on customer loyalty and customer retention: A moderating role of cause related marketing. *Global Journal of Management and Business Research*, 6(12), 26-36. <https://www.journalofbusiness.org/index.php/GJMBR/article/view/685>
21. Sricharoenpramong, S. (2018). Service quality improvement of ground staff at Don Mueang International Airport. *Kasetsart Journal of Social Sciences*, 39(1), 15-21. <https://doi.org/10.1016/j.kjss.2017.12.001>
22. Śliwiński, Z., Sieroń, A. (2022). *Wielka fizjoterapia (t. III)*. Wrocław.
23. Twaróg, S. (2017). Miejsce i użyteczność logistyki w zarządzaniu szpitalami. *Logistyka*, 5, 2116-2117. Uniwersytet Ekonomiczny w Katowicach.
24. Waśniewski, J., Strumiłło, J. (2020). *Koncepcje zarządzania podmiotami leczniczymi*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.
25. Wytyczne Krajowej Rady Fizjoterapeutów do udzielania świadczeń zdrowotnych z zakresu fizjoterapii i ich opisywania w dokumentacji medycznej.

PROJECT SUCCESS OR PROJECT MANAGEMENT SUCCESS – DISCUSSION ON TERMINOLOGY

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Purpose: The aim of the article is to conduct an analysis of the literature from 2015-2024 in the field of evolution of the definition of project success and project management success. Also helps in identifying the key conceptual distinctions between them.

Design/methodology/approach: The study is based on a mixed approach. In the quantitative part, a bibliographic review was carried out in selected international databases, identifying publications that meet the inclusions and exclusions. In the qualitative part, an analysis of the content of a deliberately selected sample was used.

Findings: The analysis highlights four key dimensions distinguishing project success from project management success. It also reveals a clear evolution in the conceptualization of both project success and project management success over the past decade.

Research limitations/implications: The limitation of the study is the selectivity of the publication sample and the focus on English-language sources. It is worth expanding the analysis to include local and comparative perspectives, taking into account cultural differences in understanding project success.

Practical implications: Separating project success from project management success allows for better alignment of evaluation metrics with the nature of the venture, which is important for project portfolio management and stakeholder communication.

Social implications: Understanding the evolving definitions of project and project management success underscores the human dimension of success—emphasizing collaboration, trust, and shared learning as key elements of sustainable project outcomes.

Originality/value: This study value lies in clarifying the hierarchical and multidimensional relationship between project success and project management success, offering a coherent framework for future empirical and theoretical research.

Keywords: project success, project management success, analysis.

Category of the paper: Literature review.

1. Introduction

The complexity and ambiguity surrounding the definition of success remains one of the most important issues in the field of project management (Murphy, Cormican, 2015). In the literature on the subject, there is still a gap in terms of an unambiguous definition of what we can describe as a successfully completed action. The use of this term, in many cases, depends on the author and his perspective on the issue discussed (Davis, 2017). Some researchers use the above terms to refer to activities in selected aspects of project management, such as leadership, communication, project teams, experience (Müller, Jugdev, 2012; Mullaly, 2014). R. Joslin and R. Müller (2016) use these terms in the context of project management methodologies. Often in the literature on the subject, the term i.e.; "success" is used interchangeably with effectiveness or efficiency, suggesting the need to analyze existing definitions and organize the terminology regarding the meaning of "success" in project management.

Project success and project management success are two different, albeit interrelated, concepts. Confusing them leads to wrong judgments and decisions. While both terms refer to the evaluation of project results, they focus on different dimensions of performance. According to the Project Management Methodology (EU, 2018), project success is achieved when goals are achieved and all end products are developed and accepted by the project client. Turner and Xue (2018) believe that a project is successful when there are appropriate benefits, based on the end products and on schedule and budget.

In contrast, project management success refers to traditional performance measures such as cost, time, and quality that determine the success of project management (Svejvig et al., 2019; Scheffer, Soares, 2023). In other words, the term "project success" is broader and often evaluated by stakeholders after its completion (Silvius, Schipper, 2016), while "project management success" refers to how the project was delivered against established criteria such as cost, time, and scope (Scheffer, Soares, 2023). This distinction has been widely discussed in the literature, with bibliometric analyses confirming the diversity and evolution of success definitions over time (Machado, Martens, 2015).

Despite the growing number of publications on this topic, the project management literature still lacks a systematic analysis of the evolution and demarcation of the two concepts. Existing research typically focuses on single aspects of design success (Joslin, Müller, 2015) or presents fragmentary shots without a deeper analysis of the conceptual difference between the two categories (Serrador, Turner, 2015).

The aim of this article is to conduct a systematic analysis of the literature from 2015 to 2025, aimed at identifying the evolution of definitions and a clear conceptual demarcation between project success and project management success. The study focuses on two research questions: (RQ1) How have the definitions of both terms evolved over the past decade?

and (RQ2) What are the key conceptual differences between project success and project management success in the context of the contemporary theoretical framework?

2. Methods

The study used mixed methods of data collection, i.e. quantitative methods were used, i.e. a review of bibliographic data in selected databases and a qualitative method of a purposefully selected sample (Fig. 1). In the first stage, a list of keywords and phrases was compiled, according to which databases were searched and scientific publications were collected. The database search uses the keyword strings: "project success" and "project management success".

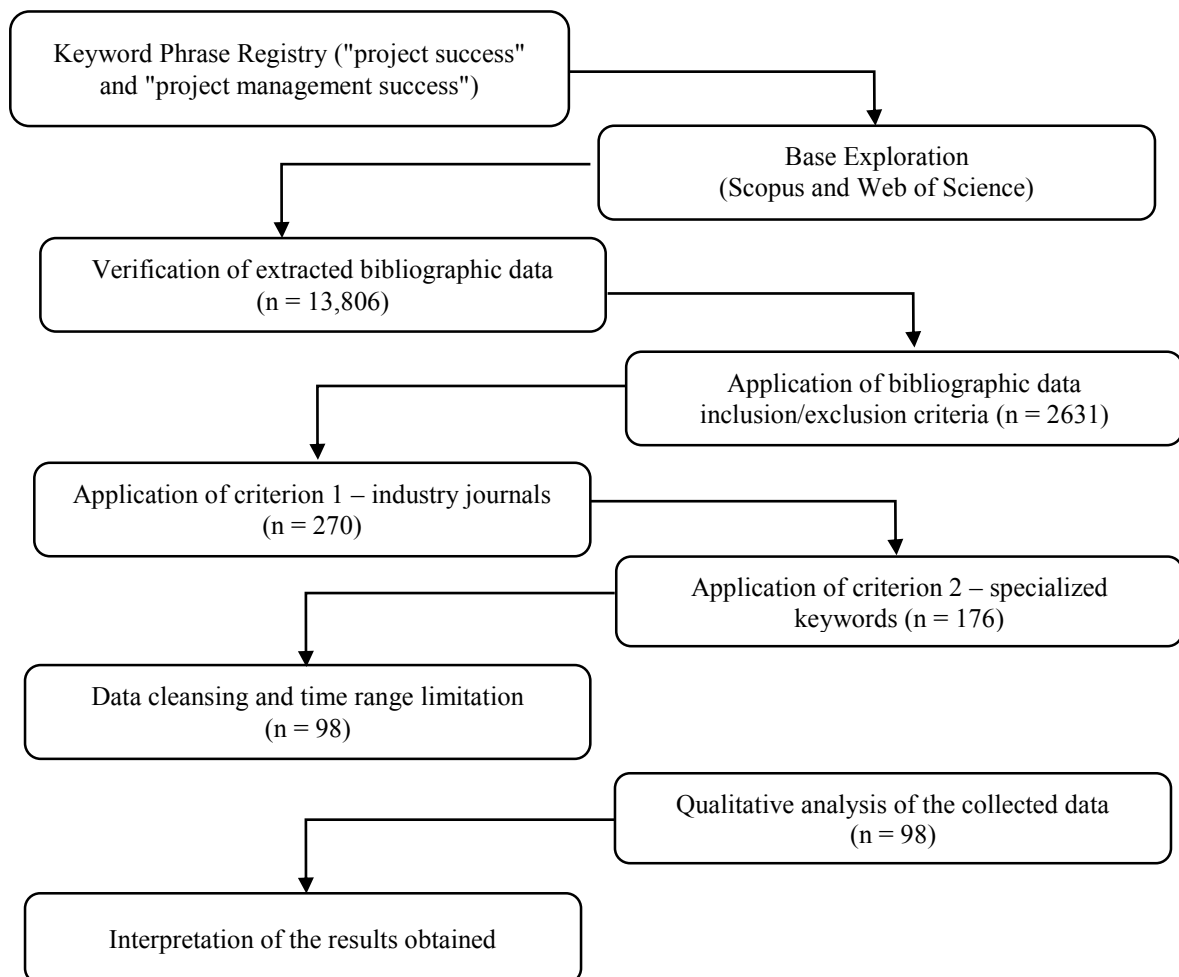


Figure1. Systematic literature review.

Source: own elaboration.

The next step was to identify subsets of potentially relevant articles from the available resources of individual databases that addressed issues related to project success and project management success. For this action, it was necessary to use selection using the following inclusion/exclusion criteria:

- Only materials in Open Access are included.
- Only English language materials are included.
- Only articles, book chapters, books are included.
- No exclusion was made due to the year of publication.

Exploration of selected databases with the use of specific keywords confirmed that the topics related to project success and project management success are widely described in the literature and are the subject of numerous scientific papers (Table 1).

Table 1.

Summary of the results of the review of selected databases

Base	Keywords	Lack Exemptions	Exclusions applied	Criterion 1	Criterion 2
Web of Science	"Project success"	4740	1104	84	56
	"Project Management Success"	169	49	30	15
SCOPUS	"Project success"	8406	1420	138	94
	"Project Management Success"	491	58	18	11
Total number of publications		13,806	2631	270	176

Source: own elaboration.

Criterion 1 was then applied, accepting only publications from journals that had the word "project" in the title. This criterion was intended to ensure that the literature analyzed comes from journals directly related to the field of project management, and not from general management journals, where project management can only be one of many topics. Subsequently, Criterion 2 was applied, concerning the content of the articles, accepting only publications that had the keywords "project success" or "project management success". This allowed us to narrow down the collection to articles that directly and principally referred to the examined issue. In this way, a collection of 176 publications was obtained. After removing duplicates and narrowing the study period to 2015-2024, 98 publications were obtained for research.

3. Results

The analysis included 98 scientific articles published in project management journals. The distribution of publications by source reveals a clear dominance of several key journals in the field (Table 2).

Table 2.*Distribution of publications in selected journals*

Name of journal	Number of publications
International Journal of Project Management	20
Journal of Engineering Project and Production Management	15
Journal of Project Management Canada	6
International Journal of Information Technology Project Management	5
Other	52

Source: own elaboration.

The International Journal of Project Management *had the largest share*, with 20 articles. The next positions were taken by the *Journal of Engineering Project and Production Management* with 15 publications and the *Journal of Project Management Canada* with six articles. *The International Journal of Information Technology Project Management* ranked fourth with five publications, while the remaining 52 articles came from a wide range of other specialist journals, where the number of publications in each of them did not exceed three articles.

The timeline of the publication reveals an interesting dynamic of interest in the topic. After a relatively high level in 2015 ($n = 9$), there was a decline in 2016-2018, when the number of articles oscillated between 3 and 6 per year (Table 3).

Table 3.*Dynamics of publications in the analyzed period*

Year of publications	Number of publications
2024	17
2023	14
2022	12
2021	12
2020	13
2019	6
2018	6
2017	3
2016	6
2015	9

Source: own elaboration.

Since 2020, we have seen a clear increase in interest, with the number of publications in 2020 at 13 to 17 publications in 2024. This growing trend suggests that the topics of project success and project management success are gaining importance in the context of increasing project complexity, digital transformation and changing stakeholder expectations.

Contemporary literature challenges the traditionally narrow approach to defining success, pointing out that what constitutes "success" itself remains contested and subject to ongoing debate (Korhonen et al., 2023). For this reason, researchers increasingly distinguish between two related but distinct dimensions: Project Management Success, usually a narrower concept focused on process efficiency, and Project Success, a broader, multidimensional concept related to organizational goal achievement and stakeholder satisfaction (Korhonen et al., 2023).

Understanding this distinction has become crucial for grasping the tensions between operational efficiency and the strategic value that projects deliver.

Contemporary literature challenges the traditionally narrow approach to defining success, pointing out that what constitutes "success" itself remains contested and subject to ongoing debate (Pinto et al., 2022). For this reason, researchers increasingly distinguish between two related but distinct dimensions: Project Management Success, usually a narrower concept focused on process efficiency, and Project Success, a broader, multidimensional concept related to organizational goal achievement and stakeholder satisfaction (Korhonen et al., 2023). Similarly, Pinto and co-authors (2022) argue that project success remains a contested and evolving concept, shaped by contextual, symbolic, and stakeholder-driven factors. Understanding this distinction has become crucial for grasping the tensions between operational efficiency and the strategic value that projects deliver.

3.1. The Evolution of Project Success

The literature reveals considerable diversity in how authors conceptualize both project success and project management success, with definitions varying across time periods and project contexts. Aldayondri and co-authors (2015) defined project success primarily through parameters such as time, cost, and quality, complemented by achieving strategic goals set at project initiation. Abdulla and Al-Hashimi (2019) indicated that decision-makers in high-risk sectors understood success through two core components: efficiency and effectiveness. Their research emphasized that achieving project success required systematic use of tailored methodologies, team integration and precise definition of the scope of work. Serra (2015) linked project success to the realization of benefits and the effective implementation of business strategies, though this still operated within a relatively conventional framework. Authors made little conceptual distinction between managing a project well and achieving project success, with both assessed primarily through delivery metrics.

Similarly, Samimpay and Saghatforoush (2020) reinforced this practical perspective in their study of infrastructure projects, demonstrating that success meant reducing errors, costs and time, as well as improving integration and communication. Sandsto and Reme-Ness (2021) took a slightly different angle, pointing to the Agile framework as a response to the unpredictability of project environments, enabling better control over timeliness, cost control and quality. Obondi (2022) contributed a structured framework by identifying four components of project success: schedule results, cost outcomes, customer satisfaction, and business success. The study showed a positive impact of risk audits and reserve analysis on all four components.

However, around 2020-2022, a notable shift occurred. Researchers began moving away from unidimensional metrics toward more nuanced, multidimensional frameworks that acknowledged the complexity of modern projects. Harwardt (2020) was among the first to propose a three-dimensional model that disaggregated project success into three distinct

elements: project management success, perception success, and outcome success. In his conceptualization, project management success referred to the subjective perception that planning was successful, management was highly effective, and that the project was carried out without major incidents. Perception success captured the satisfaction of all stakeholders and their positive outlook on the project, while outcome success meant a positive evaluation of the result and its compliance with the objectives (Harwardt, 2020).

Building on this momentum, Sajid and co-authors (2021) proposed a model that integrated three complementary dimensions: execution efficiency, customer satisfaction, and strategic value for the organization. The first one refers to the completion of the project according to the set schedule and budget. Customer satisfaction reflects their satisfaction with the results of the project. The last dimension, the added value for the organization, includes the long-term benefits of the project, through the development of competencies and experience in building a position on the market (Sajid et al., 2021). Zaman and co-authors (2021) pushed the boundaries even further by expanding the understanding of success to include social and psychological aspects, pointing to the influence of leadership style and team communication as critical, yet often overlooked, factors.

This period also saw researchers explicitly acknowledging that success criteria could not remain static. Pinto and co-authors (2022) called for continuous updating of success criteria in response to changing social and organizational conditions. Their argument reflected a growing recognition that projects were becoming increasingly complex, stakeholders were diverse, and expectations went beyond traditional parameters (time, cost, schedule). Volden and Welde (2022) translated this insight into practice by developing an ex-post model for the evaluation of public projects that includes six dimensions: efficiency, effectiveness, relevance, other impacts, sustainability, and cost-benefit efficiency.

The most comprehensive reconceptualization emerged in 2023 with Varajão and co-authors' introduction of "Success Management" where success was defined as the realization of values valued by stakeholders and evaluated after the completion of the project. But Varajão and co-authors (2023) went further, arguing that truly understanding project success required analyzing multiple, interconnected aspects: project proposals success, project benefits success, project management success, project outcomes success, project related-operations success.

Liedtka and Locatelli (2023) argued that humans, not technology or mathematical models, shape project success, especially for complex projects with diverse stakeholders. Golomezić and Obradović Posinković (2024) noted that in the context of Industry 4.0 and digital transformation, project success increasingly depended on the organization's ability to integrate and use advanced digital technologies. Kumar and co-authors (2023) highlighted the need for multidimensional and locally tailored models of critical success factors, particularly in developing economies.

Ariffin and co-authors (2024) broadened the definitions of project management success to include organizational and competency aspects, encompassing effective teamwork, skillful task selection, resource calculation and results presentation. Importantly, some authors positioned assessment itself as a strategic tool - assessing project success became not just retrospective evaluation mechanism for on monitor progress against objectives, identifying risks early, and make adjustments for better results (Varajão et al., 2023). In this way, project success evolved from a simple verdict into a holistic, dynamic concept encompassing both operational and strategic perspectives.

Recent contributions have continued to broaden the concept. Pirotti and co-authors (2022) note that the project success is a broad concept and difficult to define unambiguously. They point to a set of critical success factors—such as leadership support, clear mission, team competency, communication, and planning—whose presence increases the likelihood of success. Crucially, their work emphasizes that success goes beyond classical criteria and also includes the social dynamics of the team (Zaman et al., 2021).

3.2. Project Management Success

While the concept of project success has expanded dramatically, project management success has retained a more focused, process-oriented character—though its boundaries have also evolved. The success of project management is traditionally defined by the achievement of the project according to certain predetermined metrics (Korhonen et al., 2023). Historically, it appeared less as a standalone concept and more as a precondition or mechanism supporting broader project success.

It this classical form, exemplified by early literature, project management success was understood through the prism of achieving goals related to completion time, costs and other operational indicators. This view reflected a reductionist view of projects as closed technical structures in which success was equated with adherence to a schedule, budget, and procedures. Varajão and co-authors (2021) indicate this distinction clearly: project management success focuses on the management process and, above all, on the successful implementation of the project in terms of scope, schedule and costs, which translates into the degree of efficiency and effectiveness of project implementation. Hussain (2015), Hoxha and McMahan (2019) also emphasize this operational definition, that project management success is measured using time, cost and specifications. Importantly, several authors have noted a potential paradox here: project management success can actually jeopardize the project success, as it is one of the categories of project success (Kumar et al., 2023).

Macheridis (2022) makes this tension explicit, observing that project management success does not necessarily mean the success of the project and vice versa. Project management success criteria focus on efficiency in project work, implementation, monitoring, and project control (Macheridis, 2022). A project can meet all project management success criteria—

delivered on time, within budget, according to specifications—yet still fail to deliver value to stakeholders or achieve strategic objectives.

More recent work has begun to expand the traditional boundaries of project management success, Ariffin and co-authors (2024) extend the definitions of project management success to include organizational and competency aspects. In their view, this reflects an increased recognition of effective teamwork and skillful selection of tasks, calculation of resources and the ability to present results as integral to management success.

Context also matters significantly in how project management success is understood and measured. In the context of IT projects (IS), Varajro and co-authors (2021) note that frequent changes in scope, schedule or costs do not significantly affect the perception of project management success. In such cases, more importance is given to flexibility, adaptability of the team and stakeholder satisfaction than to rigid implementation of the original assumptions. Conversely, in industrial projects, the success of project management is assessed not only through the prism of time and cost, but also through the operational and maintenance efficiency of the completed unit. This means that success metrics extend to the post-implementation stage, taking into account the durability, reliability and operating costs of the project product.

What emerges from this literature is a clear conceptual distinction between two related but separate constructs. The literature also highlights an important paradox: a project can be well managed in terms of time and cost, and thus meet the criteria for project management success, but at the same time fail to achieve broader goals relevant to stakeholders, such as business value, social impact or innovation. This situation points to the need to distinguish between the success of project management and the success of the project itself, which is crucial for further research into the effectiveness of projects in different sectors.

Overall, the reviewed literature indicates a marked conceptual differentiation between project management success and project success. While the former remains rooted in process efficiency and delivery performance, the latter has evolved into a multidimensional, value-oriented construct reflecting organizational strategy, stakeholder expectations, and contextual adaptability.

4. Discussion

The findings from this systematic review reveal a field undergoing significant transformation. Over the past decade, our understanding of what constitutes project success—and how it differs from project management success—has evolved from relatively simple, operationally focused definitions to complex, multidimensional frameworks that acknowledge the inherently contested and context-dependent nature of success.

4.1. Evolution of the definition of project success and project management success

The analysis of the collected literature allows to identify four distinct phases in which the importance of project success and project management success takes on a new meaning. In the first phase, covering the years 2015-2017, the traditional approach, based on the classic "golden three", dominated. Aldayondri et al. (2015) defined project success mainly by parameters such as time, cost, and quality, complemented by the achievement of strategic goals set at the beginning of the project. Abdulla and Al-Hashimi (2016), while studying the oil and gas industry in Bahrain, pointed out that companies must complete projects according to scope, schedule, cost, and quality as classic dimensions of success. During this period, the success of project management was mainly defined by operational efficiency.

The next phase, 2018-2019, was characterized by the transition from one-dimensional to multidimensional definitions of success. Pinto and co-authors (2018) observed that the concept of project success has evolved from one-dimensional, simplified, and reductive calculus to multivariate, holistic, and dynamic models. Davis (2017) drew attention to the problem of different interpretations of success criteria by different stakeholder groups, pointing out the lack of a coherent theory determining the success of a project that would take into account the perspective of multiple groups.

The third phase, 2020-2022, saw a shift towards value orientation and value delivery. Sajid and co-authors (2020) proposed a multidimensional approach to project success covering three dimensions: efficiency (completing the project on time or early, within budget), customer impact (customer satisfaction and meeting their requirements), and preparation for the future (contributing to future projects, new products, and opportunities). Harwardt (2020) introduced a particularly interesting three-dimensional model of IT project success, which clearly separates project management success (subjective perception of the effectiveness of planning and management), perception success (satisfaction of all stakeholders) and outcome success (positive evaluation of the result and its compliance with the objectives). In contrast, Varajão and co-authors (2023) introduced the concept of success management, which focuses on defining, leveraging, and securing the success of ventures at the maximum level through a comprehensive awareness of what is valued by stakeholders.

The last, fourth phase, the years after 2023, is characterized by a holistic and contextual approach to success. Liedtka and Locatelli (2023) argued that humans, not technology or mathematical models, shape the success of a project, especially for complex projects with diverse stakeholders. Golomezić and Obradović Posinković (2024) pointed out that in the context of Industry 4.0 and digital transformation, the success of a project is increasingly dependent on the organization's ability to integrate and use advanced digital technologies. Kumar et al. (2023) highlighted the need for multidimensional and locally tailored models of critical success factors, particularly in developing economies. In relation to the success of project management, the evolution took place in parallel. From focusing on process efficiency

in the early period, to recognizing the importance of methodologies and standards (Pirotti et al., 2017), to integration with broader concepts of value management and realization of benefits later on.

The picture emerging from the literature suggests a hierarchical relationship in which the success of project management is a necessary but insufficient condition for the success of the project. Harwardt's model, which treats project management success as one of the three dimensions of project success, illustrates this hierarchy (Harwardt, 2020). This can be thought of as a set of concentric circles: the success of project management is an inner circle, an essential foundation, but the success of a project requires more, it encompasses broader dimensions of perception and outcome. This layered view is echoed by Serrador and Turner (2015), who distinguish between efficiency (time, budget, scope) and strategic success, and by Pinto and co-authors (2022), who call for a multidimensional understanding of success that includes symbolic and contextual factors. Serra and Kunc (2015) similarly emphasize that effective project management should be judged by its ability to deliver strategic benefits, not just plan compliance.

What emerges across these four phases is not replacement but accumulation—each phase retained insights from previous ones while adding new layers of sophistication. The golden triangle hasn't been abandoned; it's been recognized as necessary but insufficient. Process efficiency remains important; it's simply no longer conflated with overall project success

4.2. Key conceptual differences between project success and project management success

Literature analysis identifies four fundamental dimensions in which project success differs conceptually from project management success: temporal orientation, scope of assessment, measurement criteria, and hierarchical relationship. But these dimensions also reveal deeper tensions in how we think about and practice project management (Figure 2).

The first dimension concerns temporal orientation. The project management success is short-term and process-oriented, focusing on the project implementation period and immediately after its completion. Harwardt (2020) defines it as the subjective perception that project planning is successful, project management is highly effective, and that the project is conducted without major incidents. On the other hand, the success of the project is long-term and result-oriented. Varajão (2018) refers to the success of a project after its completion (post-project), which implies a perspective beyond the period of formal implementation. Pinto and colleagues (2018) emphasize that project success should be viewed through the prism of repeated dynamism, which means that the assessment of success can change over time.

The second dimension is the scope and perspective of the assessment. The scope dimension, as articulated by Davis (2017), Bosch-Rekvelde et al. (2023), and Volden and Andersen (2022), points to the inherently political nature of success assessment. The project management success is assessed from an internal, operational perspective. Bosch-Rekvelde et al. (2023) indicate that

project management performance refers to the internal efficiency of processes and the ability to deliver results in an optimal way. On the other hand, the success of a project requires a broad, multi-stakeholder perspective. Davis (2017) highlights the key problem of different interpretations of success criteria by different stakeholder groups. Volden and Andersen (2022) propose a general model of six criteria for the success of a public project, which includes three analytical levels (delivery, goals, impact) and different evaluation perspectives (client, citizen, taxpayer), which illustrates the multidimensionality of assessing project success.

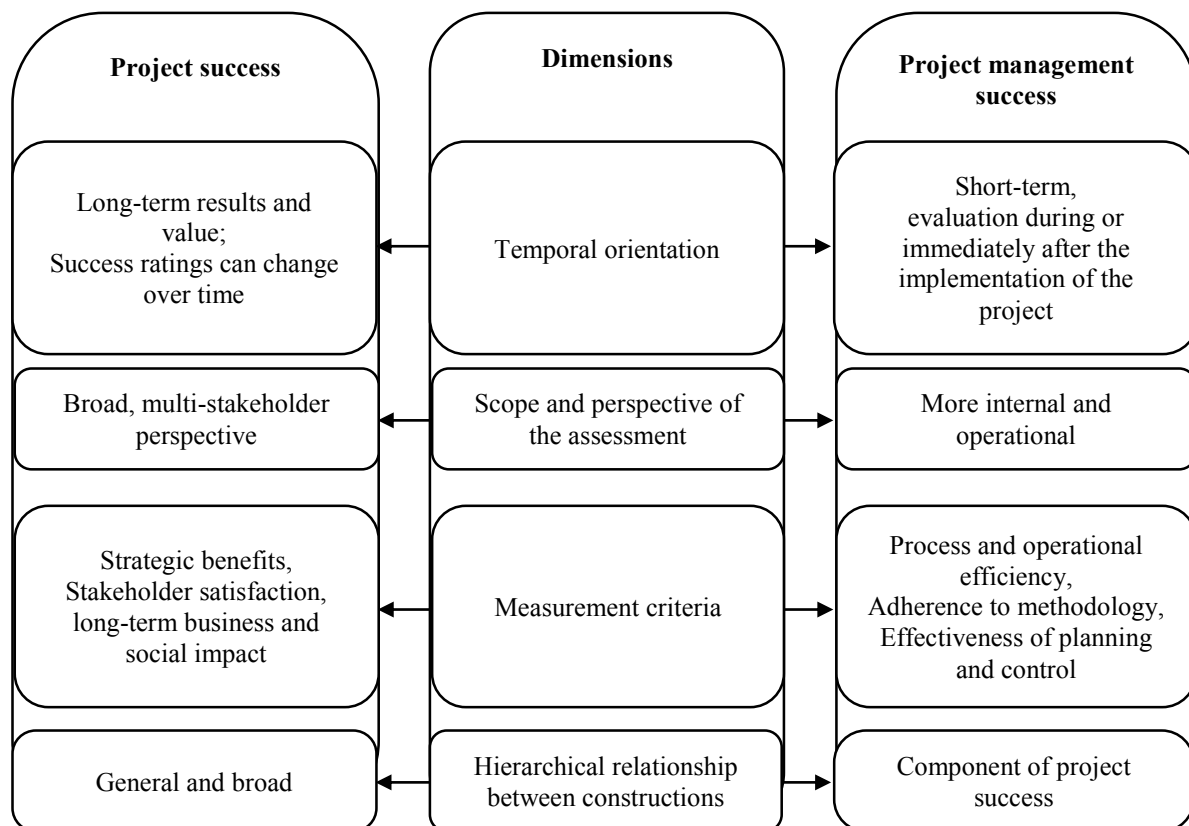


Figure 2. Four dimensions which differ project success and project management success.

Source: own elaboration based on Davis, 2017; Volden, Andersen, 2022; Harwardt, 2020; Sajid et al., 2020; Serra, Kunc, 2015; Pinto et al., 2018; Korhonen et al., 2023; Kumar et al., 2023; Pirotti et al., 2017; Macheridis, 2022.

The third dimension is the measurement criteria. The project management success is measured by the adherence to methodologies (Pace, 2019), the effectiveness of planning and control, and operational efficiency. These are mainly objective, measurable and operational measures. The success of a project, on the other hand, is measured by the realization of strategic benefits (Serra, Kunc, 2015), stakeholder satisfaction (Harwardt, 2020), long-term business and social impact, and the organization's preparedness for the future (Sajid et al., 2020). These criteria are often more subjective and manifest themselves in the long run. At the same time, it points to the need for two-track measurement systems that separately assess the success of project management and the implementation of broadly understood project success.

The fourth and last dimension is the hierarchical relationship between the two constructions. The literature suggests that the success of project management is a necessary but not sufficient condition for the success of a project. Harwardt (2020) explicitly treats project management success as one of the three dimensions of overall project success (alongside perception success and outcome success), which indicates the relationship of parts to the whole, rather than synonymy of concepts.

This hierarchical relationship has important theoretical and practical implications. First, it is possible to succeed in project management without achieving project success - a project can be perfectly managed from a technical point of view (on time, on budget, according to specifications), but still fail to achieve success if it does not provide value to stakeholders or achieve strategic goals (Serrador, Turner, 2015; Pinto et al., 2022). Second, as Korhonen and co-authors (2023) show, a project can achieve organizational success despite difficulties in implementation if it delivers strategic value, which illustrates the opposite situation. The contextual variation noted by Varajão and co-authors (2021) - where IT project stakeholders tolerate scope and schedule changes but industrial project stakeholders don't—suggests that the importance of project management success varies by project type.

In some contexts, project management success matters greatly because stakeholders expect predictability. In others, flexibility and value delivery trump process adherence. Yet most organizations apply standardized project management methodologies across all projects, failing to calibrate project management rigor to actual needs (Joslin, Müller, 2016; Varajão et al., 2021). The cases identified by Korhonen and co-authors (2023) where projects achieved organizational success despite implementation difficulties are particularly instructive. They suggest that in some situations, organizations should be willing to tolerate project management "failure" if it enables project success. A research project that goes wildly over budget but yields breakthrough insights. A product development project that misses deadlines but creates an unexpectedly valuable new capability. These aren't failures—they're examples of organizations correctly prioritizing project success over PM success. But most organizations lack frameworks for making such tradeoffs explicit and legitimate.

5. Summary

The evolution documented in this review and the four dimensions of distinction have several important implications.

First, the field needs clearer and more consistent terminology. Using "project success" to mean both the broad concept and one of two distinct subconcepts creates confusion. Some authors have tried "project management performance" or "project delivery success" as alternatives to "project management success", but no consensus has emerged. Clearer

terminology would help both researchers and practitioners think more precisely about what they're trying to achieve and measure.

Second, project governance structures need redesign. If project success only becomes apparent years after completion, governance can't end at project closure. Organizations need post-project review mechanisms that assess whether anticipated benefits were realized and feed learning back into future project selection and design. Some authors touched on this, but it remains underdeveloped in practice.

Third, the profession's emphasis on methodology and certification may be misplaced—or at least incomplete. Project management certifications almost exclusively focus on PM success dimensions: planning, execution, monitoring, control. They largely ignore the strategic, stakeholder, and value dimensions that define project success. This creates professionals highly skilled at delivering projects but less equipped to ensure those projects deliver value.

Fourth, the research reviewed here comes predominantly from certain regions and project types. Kumar and co-authors (2023) call for locally tailored success models in developing economies highlights that our understanding of success may be culturally bounded. What constitutes success in Western, developed-economy contexts may differ from success in other contexts. More research is needed on how cultural and institutional contexts shape success definitions.

This review has several limitations. The focus on academic journals may have missed important practitioner perspectives. The dominance of certain journals in the results (20 articles from a single journal) raises questions about whether we're seeing a comprehensive picture or the perspective of particular research communities. The four-phase periodization proposed here is interpretive—other scholars might parse the evolution differently. The phases overlap in time, and not all authors fit neatly into one phase or another. This is less a clean progression than a messy evolution with multiple threads developing simultaneously. Future research should explore several questions:

1. How do organizations actually use success criteria in practice? The literature documents increasingly sophisticated frameworks, but do organizations employ them?
2. What happens when PM success and project success conflict—how do organizations make tradeoffs? The cases identified by Korhonen et al. deserve deeper investigation.
3. How can we better measure project success given the temporal and subjectivity challenges?
4. Are organizations getting better at achieving project success, or just better at talking about it?

References

1. Abdulla, H., Al-Hashimi, M. (2019). The impact of project management methodologies on project success: A case study of the oil and gas industry. *Journal of Engineering Project and Production Management*, 9(2), 115-125.
2. Abson, E., Schofield, P., Kennell, J. (2024). Making shared leadership work: The importance of trust in project-based organisations. *International Journal of Project Management*, 42(2), 102575.
3. Ahmad, M.K., Abduhamid, A., Wahab, S.A., Nazir, M.U. (2023). Can the project manager's transformational leadership lead to project success? Empowerment, goal clarity, and CR leadership. *International Journal of Information Technology Project Management*, 14(1), 11-21.
4. Ahmed, R., Jawad, M. (2022). Avoiding or disregarding: Exploring the relationship between scope creep, project complexity, and the success of construction projects. *Project Leadership and Society*, 3, 100064.
5. Ahmed, R., Philbin, S.P. (2022). It takes more than the project manager: The importance of senior management support for successful social sector projects. *Project Leadership and Society*, 3, 100042.
6. Ahmed, R., Khan, I.Q., Philbin, S.P. (2022). Mediating role of switch leadership between dynamic work environment and project success. *International Journal of Information Technology Project Management*, 13(1).
7. Ahmed, R., Philbin, S.P., Paracha, O.S. (2024). Investigating the Impact of Task-Oriented, Relationship-Oriented, and Innovation-Oriented Leadership Competencies on Project Success in Pakistan: A Moderated Model of Multi-Dimensional Senior Management Support. *Engineering Management Journal*, 36(1), 42-65.
8. Alshihre, F., Chinyio, E., Nzekwe-Excel, C., Daniel, E.I. (2023). Pursuing alignment of clients' and contractors' perceptions of client satisfaction in Saudi Arabian projects. *Built Environment Project and Asset Management*, 13(3), 341-358.
9. Altaher, A.M., Al-Obaidly, G.A., Al-Badaine, G., Hammouri, Q., Khasawneh, M.A.S. (2024). The impact of leadership styles on project success: The mediating role of team collaboration. *Journal of Project Management (Canada)*, 9(4), 485-492.
10. Al-Zagheer, H., Al-Obaidly, G.A., Freijat, S.Y.A.L., Akhurshaidah, S.A.E.O., Al-Manaseer, S.R. (2024). Assessing the effect of IT infrastructure on project success in the financial sector: The role of project flexibility. *Journal of Project Management (Canada)*, 9(4), 337-344.
11. Amoako-Gyampah, K., Meredith, J., Loyd, K.W. (2018). Using a social capital lens to identify the mechanisms of top management commitment: A case study of a technology project. *Project Management Journal*, 49(1), 79-95.

12. Amster, R., Böhm, C. (2016). Improving intercultural competency in global IT projects through recognition of culture-based behaviors. *International Journal of Information Systems and Project Management*, 4(2), 5-20.
13. Anglani, F., Pennetta, S., Reaiche, C., Boyle, S. (2023). Crossing digital frontiers with cultural intelligence: A new paradigm for project managers. *International Journal of Project Management*, 41(8), 102543.
14. Ansari, M.S.A., Abouraia, M., El Morsy, R., Thumiki, V.R.R. (2024). Influence of transformational and transactional leadership on agile project success. *Project Leadership and Society*, 5, 100136.
15. Aramali, V., Gibson, G.E., El Asmar, M., Sanboskani, H. (2024). An effective earned value management system (EVMS) is a team sport. *Project Management Journal*, 55(4), 389-405.
16. Ariffin, N.H.M., Nasrudin, Z.A., Nor Azman, M.H.B. (2024). Navigating success: Analyzing team performance and leadership in IT project management. *European Project Management Journal*, 14(2), 92-104.
17. Barclay, C. (2015). A dialogue on the diversity in the constituents of project success. *Strategic Project Management: Contemporary Issues and Strategies for Developing Economies*, 13-30.
18. Barclay, C. (2015). Introduction to the project performance scorecard as a technique in determining project success. *Strategic Project Management: Contemporary Issues and Strategies for Developing Economies*, 293-304.
19. Barclay, C. (2015). Measuring the success of data mining projects: An exploratory application of the project performance scorecard. *Strategic Project Management: Contemporary Issues and Strategies for Developing Economies*, 305-322.
20. Barclay, C., Osei-Bryson, K.-M. (2015). A framework for developing performance objectives for projects, programs, and portfolios. *Strategic Project Management: Contemporary Issues and Strategies for Developing Economies*, 47-66.
21. Berg, H., Ritschel, J.D. (2023). The characteristics of successful military IT projects: A cross-country empirical study. *International Journal of Information Systems and Project Management*, 11(2), 25-44.
22. Bezdrob, M., Brkić, S., Gram, M. (2020). The pivotal factors of IT projects' success: Insights for the case of organizations from the Federation of Bosnia and Herzegovina. *International Journal of Information Systems and Project Management*, 8(1), 23-41.
23. Bilir, C., Yafez, E. (2021). Project success/failure rates in Turkey. *International Journal of Information Systems and Project Management*, 9(4), 24-40.
24. Bond-Barnard, T.J., Fletcher, L., Steyn, H. (2018). Linking trust and collaboration in project teams to project management success. *International Journal of Managing Projects in Business*, 11(2), 432-457.

25. Bucero, A. (2024). Project sponsor effectiveness and project success. *European Project Management Journal*, 14(2), 3-16.
26. Costantino, F., Di Gravio, G., Nonino, F. (2015). Project selection in project portfolio management: An artificial neural network model based on critical success factors. *International Journal of Project Management*, 33(8), 1744-1754.
27. Davis, K. (2017). An empirical investigation into different stakeholder groups' perception of project success. *International Journal of Project Management*, 35(4), 604-617.
28. de Araújo, C.C.S., Pedron, C.D. (2015). IT project manager competencies and IT project success: A qualitative study. *Organisational Project Management*.
29. Fareed, M.Z., Su, Q., Awan, A.A. (2021). The effect of emotional intelligence, intellectual intelligence and transformational leadership on project success: An empirical study of public projects of Pakistan. *Project Leadership and Society*, 2, 100036.
30. Fossum, K.R., Binder, J.C., Madsen, T.K., Aarseth, W., Andersen, B. (2020). Success factors in global project management: A study of practices in organizational support and the effects on cost and schedule. *International Journal of Managing Projects in Business*, 13(1), 128-152.
31. Gilbert Silvius, A.J., Schipper, R. (2016). Exploring the relationship between sustainability and project success: Conceptual model and expected relationships. *International Journal of Information Systems and Project Management*, 4(3), 5-22.
32. Golini, R., Kalchschmidt, M., Landoni, P. (2015). Adoption of project management practices: The impact on international development projects of non-governmental organizations. *International Journal of Project Management*, 33(3), 650-663.
33. Habibi, F., Birgani, O.T., Koppelaar, H., Radenović, S.N. (2018). Using fuzzy logic to improve project time and cost estimation based on the Project Evaluation and Review Technique (PERT). *Journal of Project Management*, 3(4), 183-196.
34. Harwardt, M. (2020). Servant leadership and its effects on IT project success. *Journal of Project Management*, 5(1), 59-78.
35. Hefley, W.E., Botton, M. (2021). Skills of junior project management professionals and project success achieved by them. *International Journal of Information Systems and Project Management*, 9(1), 56-75.
36. Hoxha, L., McMahan, C. (2019). The influence of project manager's age on project success. *Journal of Engineering Project and Production Management*, 9(1), 12-19.
37. Ijaola, I.A., Omolayo, O.H., Zakariyyh, K.I. (2020). Project manager's skills acquisition: A comparative study of indigenous and multinational construction firms. *Journal of Engineering Project and Production Management*, 10(1), 71-79.
38. Joslin, R., Müller, R. (2015). Relationships between a project management methodology and project success in different project governance contexts, *International Journal of Project Management*, 33, 1377-1392. 10.1016/j.ijproman.2015.03.005

39. Joslin, R., Müller, R. (2016). The impact of project methodologies on project success in different project environments, *International Journal of Managing Projects in Business*, Vol. 9, No. 2, 364-388
40. Kaufmann, C., Kock, A. (2020). Does project management matter? The relationship between project management effort, complexity, and profitability. *International Journal of Project Management*, 40(6), 624-633.
41. Kearney, J., Bond-Barnard, T., Chugh, R. (2024). Soft skills and learning methods for 21st-century project management: A review. *International Journal of Information Systems and Project Management*, 12(4), 5-20.
42. Klakegg, O.J., Williams, T., Shiferaw, A.T. (2016). Taming the 'trolls': Major public projects in the making. *International Journal of Project Management*, 34(2), 282-296.
43. Korhonen, T., Jääskeläinen, A., Laine, T., Saukkonen, N. (2023). How performance measurement can support achieving success in project-based operations. *International Journal of Project Management*, 41(1), 102429.
44. Kumar, V., Pandey, A., Singh, R. (2023). Critical success factor models for project success. *Journal of Engineering Project and Production Management*, 13(2), 148-158.
45. Larsen, A.S.A., Karlsen, A.T., Andersen, B. (2020). Hospital project front-end planning: Current practice and discovered challenges. *Project Leadership and Society*, 1, 100004.
46. Liedtka, J., Locatelli, G. (2023). Humanising complex projects through design thinking and its effects. *International Journal of Project Management*, 41(4), 102483.
47. Locatelli, G., Mikic, M., Kovačević, M., Brookes, N., Ivanisevic, N. (2017). The successful delivery of megaprojects: A novel research method. *Project Management Journal*, 48(5), 78-90.
48. Machado, F.J., Martens, C.D.P. (2015). Project management success: A bibliometric analysis. *Revista de Gestão e Projetos*, 6(1), 28-44.
49. Macheridis, N. (2022). Operationalizing project success criteria through control degree. *Journal of Engineering Project and Production Management*, 12(2), 179-187.
50. Mansell, P., Van Rooyen, D., Philbin, S., Sabini, L. (2021). Infrastructure projects' assessment through SDG targets: Towards a comprehensive framework. *Engineering Project Organization Journal*, 10(2).
51. Maqbool, R., Sridhar, H. (2024). Governing public–private partnerships of sustainable construction projects in an opportunistic setting. *Project Management Journal*, 55(1), 86-101.
52. Maylor, H., Geraldi, J., Budzier, A., Turner, N., Johnson, M. (2023). Mind the gap: Towards performance measurement beyond a plan-execute logic. *International Journal of Project Management*, 41(4), 102467.
53. McClory, S., Read, M., Labib, A. (2017). Conceptualising the lessons-learned process in project management: Towards a triple-loop learning framework. *International Journal of Project Management*, 35(7), 1322-1335.

54. Montequín, V.R., Fernández, S.C., Fernández, F.O., Balsera, J.V. (2016). Analysis of the success factors and failure causes in projects: Comparison of the Spanish information and communication technology (ICT) sector. *International Journal of Information Technology Project Management*, 7(1), 18-31.
55. Moradi, S., Kähkönen, K. (2022). Success in collaborative construction through the lens of project delivery elements. *Built Environment Project and Asset Management*, 12(6), 973-991.
56. Morcov, S., Pintelon, L., Kusters, R.J. (2021). A practical assessment of modern IT project complexity management tools: Taming positive, appropriate, and negative complexity. *International Journal of Information Technology Project Management*, 12(3), 90-108.
57. Mulla, M. (2014). The role of agency in project initiation decisions, *International Journal of Managing Projects in Business*, 7. 10.1108/IJMPB-09-2013-0043
58. Murphy, T., Cormican, K. (2015). Towards holistic goal centered performance management in software development: lessons from a best practice analysis. *International Journal of Information Systems and Project Management*, Vol. 3, No. 4, pp. 23-36.
59. Mweetwa, L.L., Mwanaumo, E.M. (2022). An in-depth analysis of the effects of the COVID-19 pandemic on project delays, disruptions and completion: The case of Botswana. *European Project Management Journal*, 12(2), 50-62.
60. Nanthagopan, Y., Williams, N., Thompson, K. (2019). Levels and interconnections of project success in development projects by non-governmental organisations (NGOs). *International Journal of Managing Projects in Business*, 12(2), 487-511.
61. Obondi (2022). The utilization of project risk monitoring and control practices and their relationship with project success in construction projects. *Journal of Project Management (Canada)*, 7(1), 35-52.
62. Olatunde, N.A., Odeyinka, H. A. (2021). Factors influencing stakeholder management in building projects procured by private corporate organisations. *Journal of Engineering Project and Production Management*, 11(1), 9-18
63. Olatunji, O.A., Orundami, A.O., Ogundare, O. (2018). Causal relationship between material price fluctuation and project outturn costs. *Built Environment Project and Asset Management*, 8(4), 358-371.
64. Oluseye, O. (2024). Exploring potential political corruption in large-scale infrastructure projects in Nigeria. *Project Leadership and Society*, 5, 100108.
65. Osuizugbo, I.C. (2020). Improving the performance of building construction firms through addressing the gap of building production management: A new production model approach. *Journal of Engineering Project and Production Management*, 10(1), 50-63.
66. Özturan, M., Gürsoy, F., Çeken, B. (2019). An empirical analysis on the effects of investment assessment methods on IS/IT project success. *International Journal of Information Systems and Project Management*, 7(4), 33-52.

67. Pace (2019). A correlational study on project management methodology and project success. *Journal of Engineering Project and Production Management*, 9(2), 56-65.
68. Pinto, J.K. (2024). A path less-traveled has become the highway: How Peter Morris's *The Anatomy of Major Projects* pointed the way to modern project management research and practice. *Engineering Project Organization Journal*, 11(Special Issue).
69. Pinto, J.K., Davis, K., Ika, L.A., Jugdev, K., Zwikael, O. (2022). Coming to terms with project success: Current perspectives and future challenges. *International Journal of Project Management*, 40(7), 831-834.
70. Pirotti, A., Keshavarzsaleh, A., Rahim, F.A.M., Zakaria, N. (2020). Effective factors on project success in Malaysian construction industry. *Journal of Engineering Project and Production Management*, 10(1), 1-10.
71. Pirotti, A., Rahim, F.A.M., Zakaria, N. (2022). Implementation of project management standards and project success: The mediating role of the project management office. *Journal of Engineering Project and Production Management*, 12(1), 39-46.
72. Piwowar-Sulej, K. (2021). Organizational culture and project management methodology: Research in the financial industry. *International Journal of Managing Projects in Business*, 14(6), 1270-1289.
73. Rehan, A., Thorpe, D., Heravi, A. (2024). A framework for leadership practices and communication in the context of the construction sector. *Project Leadership and Society*, 5, 100142.
74. Rehman, S.U. (2020). Impact of inclusive leadership on project success. *Journal of Engineering Project and Production Management*, 10(2), 87-93.
75. Safa, M., Weeks, K., ElHoubi, A., Sharma, N., MacGillivray, S. (2022). Construction strategic project readiness assessment. *Journal of Engineering Project and Production Management*, 12(1), 13-24.
76. Saidoun, A., Bodea, C.-N., Radujković, M. (2023). The impact of leader–leader exchange on project success in non-profit organisations. *European Project Management Journal*, 13(2), 3-15.
77. Sajid, M., Zaidi, S., Haq, S.U.L., Chughtai, M.A., Ahmed, A. (2021). Linking entrepreneurial orientation to project success in construction projects. *Journal of Project Management (Canada)*, 6(2), 61-72.
78. Samimpay, R., Saghatforoush, E. (2020). Benefits of implementing building information modeling (BIM) in infrastructure projects. *Journal of Engineering Project and Production Management*, 10(2), 123-140.
79. Sanda, Y.N., Anigbogu, N.A., Nuhu, L.Y., Olumide, O.S. (2020). A life-cycle framework for managing risks in public-private partnership housing projects. *Journal of Engineering Project and Production Management*, 10(1), 27-34.
80. Sandstø, R., Remeness, C. (2021). Agile practices and impacts on project success. *Journal of Engineering Project and Production Management*, 11(3), 255-262.

81. Scheffer, D.M., Soares, T.C. (2023). The effect of knowledge management, project governance, benefits management, and project success on organizational performance. *Revista de Gestão e Projetos*, 14(2), 76-98.
82. Scoleze Ferrer, P.S., Galvão, G.D.A., de Carvalho, M.M. (2020). Tensions between compliance, internal controls and ethics in the domain of project governance. *International Journal of Managing Projects in Business*, 13(4), 845-865.
83. Selvakumar, J.J., Suganya, G., Arthi, T.S., Pachiyappan, S. (2024). Does risk management components influence project success? Evidence from IT sector. *Journal of Project Management (Canada)*, 9(3), 269-276.
84. Serra, C.E.M., Kunc, M. (2015). Benefits realisation management and its influence on project success and on the execution of business strategies. *International Journal of Project Management*, 33(1), 53-66.
85. Serrador, P., Turner, R. (2015). The Relationship between Project Success and Project Efficiency. *Project Management Journal*, 46(1), 30-39.
86. Shafiei, N.A., Puttanna, K. (2022). Critical success factors for international development projects in Afghanistan: An exploratory factor analysis. *Journal of Project Management (Canada)*, 7(4), 217-228.
87. Silvius, A.J.G., Schipper, R. (2016). Exploring the relationship between sustainability and project success: Conceptual model and expected relationships. *International Journal of Information Systems and Project Management*, 4(3), 5-22.
88. Strang, K.D., Vajjhala, N.R. (2023). Mining project failure indicators from big data using machine learning mixed methods. *International Journal of Information Technology Project Management*, 14(1).
89. Svejvig, P., Geraldi, J., Grex, S. (2019). Accelerating time to impact: Deconstructing practices to achieve project value. *International Journal of Project Management*, 37(5), 784-801.
90. Tam, C., Moura, E.J.D.C., Oliveira, T., Varajão, J. (2020). The factors influencing the success of on-going agile software development projects. *International Journal of Project Management*, 38(3), 165-176.
91. Thomas, G., Fernández, W. (2008). Success in IT projects: A matter of definition? *International Journal of Project Management*, Vol. 26, No. 7, 733-742.
92. Turner, J.R., Xue, Y. (2018). On the success of megaprojects. *International Journal of Managing Projects in Business*, Vol. 11, No. 3, 783-805.
93. Urton, D., Murray, D. (2021). Project manager's perspectives on enhancing collaboration in multidisciplinary environmental management projects. *Project Leadership and Society*, 2, 100008.
94. Vaez-Alaei, M., Deniaud, I., Marmier, F., Cowan, R., Gourc, D. (2024). How partners' knowledge base and complexity are related to innovative project success: The roles of trust

- and trust capability of partners. *International Journal of Project Management*, 42(1), 102557.
95. Varajão, J. (2018). The many facets of information systems (and projects) success. *International Journal of Information Systems and Project Management*, 6(4), 5-13.
96. Varajão, J., Fernandes, G., Amaral, A. (2023). Linking information systems team resilience to project management success. *Project Leadership and Society*, 4, 100094.
97. Varajão, J., Pereira, J.L., Trigo, A., Moura, I. (2021). Information systems project management success. *International Journal of Information Systems and Project Management*, 9(4), 62-74.
98. Vlahov Golomezić, R.D., Posinković, T.O. (2023). A systematic literature review of Industry 4.0 and project management. *European Project Management Journal*, 13(2), 51-62.
99. Volden, G.H., Welde, M. (2022). Public project success? Measuring the nuances of success through ex post evaluation. *International Journal of Project Management*, 40(6), 703-714.
100. Williams, T. (2016). Identifying success factors in construction projects: A case study. *Project Management Journal*, 47(1), 97-112.
101. Woodier, D., Thuesen, C. (2024). Distributed leadership and the shaping of infrastructure project portfolios. *Project Leadership and Society*, 5, 100146.
102. Xu, S.M., Bogers, M.L.A.M. (2024). Imperfections-as-practice: Projects as becoming processes of imperfections. *Project Management Journal*, 55(2), 151-166.
103. Zaman, U., Florez-Perez, L., Khwaja, M.G., Abbasi, S., Qureshi, M.G. (2021). Exploring the critical nexus between authoritarian leadership, project team member's silence and multi-dimensional success in a state-owned mega construction project. *International Journal of Project Management*, 39(8), 873-886.
104. Zhang, Y., Sun, J., Yang, Z., Wang, Y. (2018). Mobile social media in inter-organizational projects: Aligning tool, task, and team for virtual collaboration effectiveness. *International Journal of Project Management*, 36(8), 1096-1108.
105. Zwikael, O. (2024). Benefits classification to enhance project value creation. *International Journal of Project Management*, 42(2), 102574.

HYBRIDITY OF STRATEGIC ORIENTATION OF MICRO, SMALL AND MEDIUM-SIZED ENTERPRISES OPERATING IN TECHNOLOGY PARKS IN POLAND: A PERFORMANCE PERSPECTIVE

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Purpose: The purpose of the research presented in the article was to identify (in)direct relationships between strategic orientation and firm performance, where market dynamism acts as a moderator. The article is the answer to the needs for systematic research of models between enterprises' strategic orientations and their performance.

Design/methodology/approach: The article is the answer to the needs for systematic research of models between learning orientation and firm performance. It is also guided by the dynamic capabilities (DCs) framework. The research sample included MSMEs operating in technology parks in Poland. PAPI and CATI were two methods applied during the empirical research, while the methods of statistical description and inference were used for the analysis of collected data.

Findings: The conducted research has proved that in the sample group of MSMEs operating in technology parks in Poland, the strategic orientation is a factor stimulating their performance, while market dynamism has not been classified as a moderator of the strategic orientation-firm performance relationship.

Practical implications: The practical results suggest that strategic orientation may be considered as managerial tool for profiling firm performance.

Originality/value: This article presents arguments which allow for recognising learning orientation as a strategic organisational factor shaping firm performance.

Keywords: strategic orientation, market dynamism, firm performance, micro, small and medium - sized enterprises (MSMEs).

Category of the paper: research paper.

1. Introduction

During this decade, the nature of the economic environment of almost every enterprise has evolved at an unprecedented pace (Alqahtani et al., 2024). Enterprises therefore have a real problem with understanding environmental conditions and incorporating them into their

strategic orientations (Hailu et al., 2025). This indicates that ubiquitous environmental turbulence (Widjaja, Sugiarto, 2022) may pose a significant difficulty (disorientation) for enterprises in their long-term orientation. In these conditions, especially micro, small and medium-sized enterprises (MSMEs) face a difficult choice: survive or expand their business (Heikkilä et al., 2018; Mayr, Lixl, 2019). As a rule, their limited resources make them more responsive and reactive, and therefore, less proactive and less bold in making business progress. In turn, they are not facing the future (Tang, 2016). It turns out that many of them focus solely on short-term survival projects. This does not mean, however, that they cannot develop. To ensure future business growth, these enterprises need to achieve better results by adopting specific SOs that make them interact with the market and stakeholders (Widjaja, Sugiarto, 2022). In general, there is a growing consensus that one OS does not fit all organisations, as they vary in size and have a heterogeneous set of resources and capabilities (Du, Kim, 2021; Morgan, Anokhin, 2020). Therefore, organisations choose some strategic orientation (SO) which is a combination of market orientation (MO), learning orientation (LO), and entrepreneurial orientation (EO) (Melesse, Knatko, 2024). Moreover, different organisational contexts may lead to different manifestations of SO (Hernández-Linares et al., 2018). It is worth mentioning that despite repeated efforts by researchers, knowledge about what SO should be like in various environments still remains insufficient (Hakala, 2011; Alqahtani et al., 2024). Most of the subject-matter literature focuses on the effects of a single strategic orientation because few studies have examined the relationships among the three strategic orientations (Gnizy et al., 2014; Wilson, Liguori, 2023; Alqahtani et al., 2024). Research to date indicates that a single orientation may be insufficient to effectively achieve expected firm performance (FP). This suggests that combining the above-mentioned strategic orientations may enable organisations to achieve better business results (Wales et al., 2020). Following the trend of research that considers enterprises' strategic orientations to be hybrid, this article poses two main research questions (RQ):

RQ1. How is strategic orientation related to firm performance?

RQ2. Are the links between strategic orientation and firm performance contingent on the degree of market dynamism?

Hence, the objectives of this article are twofold: first, to establish how strategic orientation is related to firm performance; and second, to identify how market dynamism (MD) moderates the relationship between strategic orientation and firm performance.

The article is structured as follows. The second section describes each enterprise's strategic orientations in somewhat more detail and develops hypotheses. The third section describes the sample, data collection, and measures used. The fourth section presents the findings and discussion, and practical implications. Finally, limitations and directions of research are indicated.

2. Theory and Hypotheses

2.1. Conceptualisation of enterprises' strategic orientations in the literature

The subject-matter literature defines strategic orientations in various ways. Strategic orientation is a guide designed to help an enterprise improve its market performance and ensure long-term survival (Hakala, 2011), and the principles it contains provide a framework for strategic decisions (M'zungu et al., 2017). SO therefore refers to enterprise's proactivity and future orientation (Elbanna, Elsharnouby, 2025). While the first of these attributes relates to how quickly a given enterprise seeks opportunities in its target market, the second relates to the long-term horizon for which this enterprise plans its operations. In both cases, the SO is based on a deeply rooted set of values reflected in enterprise's operating philosophy. SO is also understood as the principles that guide and influence enterprise's actions and generate behaviours aimed at ensuring profitability and other business outcomes (Gatignon, Xuereb, 1997; Hakala, 2011). One of the features of such an SO is enterprise's focus on identifying, collecting and analysing information in order to generate new knowledge considered necessary for innovation (Adams et al., 2019). Grisseman et al. (2013) emphasise that an inherent aspect of SO is openness to new ideas, which requires an organisational culture and employee involvement favouring the introduction of innovative products. Hence, some researchers see SO as a representation of the adaptive culture of an organisation that guides its interaction with the environment (Hakala, 2011). In a slightly different approach, SO is reflected in the beliefs and mental models of senior management (Hitt et al., 1997), which guide the strategic direction implemented by a given enterprise to create the right behaviours for continuous improvement of business results (Gatignon, Xuereb, 1997).

The subject-matter literature indicates that there are several overarching strategic orientations (e.g. MO, LO, EO). Therefore, each of the above-mentioned orientations is presented in turn below.

Market orientation. The market orientation construct was introduced in the 1990s by Narver and Slater (1990), who argue that MO reflects the actions taken by enterprises to implement customer orientation, including a set of behaviours and the organisational culture that supports them. In this perspective, MO refers to strategic inclination and enterprise-level activities directed at the generation of superior value for customers. This approach is based on combining the dimensions of customer orientation, competitive orientation, and cross-functional coordination. Its orientation is based on shared values and employees' behaviours, as well as the successful integration of organisational resources (Jian et al., 2024). Thanks to MO, an enterprise can effectively use its capabilities to enter new markets and outperform competitors. Another equally recognised conceptualisation of MO among researchers was presented by Jaworski and Kohli (1993) who relates MO to the generation and dissemination of market information throughout an organisation and the accompanying organisational

responses. To be effective, MO requires an enterprise to proactively acquire, disseminate, and utilise market intelligence when developing marketing strategies and tactics (Gnizy et al., 2014). As MO reflects an outside-in approach, it is strongly affected by the dynamics of the external environment, which means the frequency of changes in this environment due to demand, competitors, technology, and regulations (Melesse, Knatko, 2024). These changes trigger opportunities and thus have significant implications for determining enterprises' strategic responses, including the formulation of their strategies and the configuration of organisational capabilities. Thanks to MO, an enterprise gains the ability to sense changing customer needs and respond effectively in a dynamic environment. MO therefore strives to understand environmental changes in order to proactively respond to customer needs. Previous research largely confirms that customers are more satisfied with the products and services provided by a market-oriented enterprise and increase loyalty to that enterprise. By empowering, disseminating and using customer and market information, MO enables enterprises to tailor their activities to target markets, anticipate and respond to customer needs, as well as build competitive advantage (Wales et al., 2020). Importantly, empirical research has shown that enterprises scoring high on MO often tended to be more entrepreneurial-oriented; while those adopting both MO and EO - achieved better performance (Liu, Huang, 2020). Tajeddini et al. (2013) argue that implementing MO alone may lead to a failure to anticipate future and latent needs. According to the researchers (Widjaja, Sugiarto, 2022), MO requires strengthening EO, thanks to which an enterprise may be able to improve and maintain its competitive advantage by exploring new opportunities to develop new products for future markets. Moreover, according to Ho et al. (2017), the development of both MO and EO may indicate how an enterprise can utilise its SO in its efforts to achieve competitive advantage.

Entrepreneurial orientation. EO has been one of the most important constructs in the theory of entrepreneurship and strategic management since the 1980s (Putnins, Sauka, 2020; Wales et al., 2021). In his seminal work, Miller (1983) argues that EO consists of three main dimensions, such as risk-taking, proactiveness, and innovativeness (Gnizy et al., 2014). This EO perspective was introduced into research practice by Covin and Slevin (1989) and gradually gained significant support (Anderson et al., 2009). Although EO has been measured using additional factors over the years (Lumpkin, Dess, 1996), the components used by Covin and Slevin (1989) are considered fundamental. In their opinion, EO refers to strategic tendencies in decision-making and behavioural actions of organisations, most often characterised by innovation, proactivity and risk-taking aimed at exploiting future business opportunities (Covin, Lumpkin, 2011). At its core, EO is a reflection of an enterprise-level commitment to entrepreneurial behaviours, strategies, and philosophies (Anderson et al., 2009). Enterprises that embody this orientation engage themselves in the exploration of new products and services, as well as adopt forward-looking and somewhat risky courses of action (Rauch et al., 2009). EO describes an enterprise's tendency to experiment, generate new ideas, commercialise them as new products and services, and make significant investments in research

and development. Overall, adopting EO, by highlighting innovative, proactive and risk-taking activities, can enable and help identify new ways of achieving firm performance (Wales et al., 2020). However, conceptual and empirical support for the EO-performance relationship focuses primarily on the financial aspects of these outcomes (Rauch et al., 2009). However, some researchers have questioned the significant positive relationship between EO and firm performance, showing that entrepreneurial orientation has no influence on it (Diabate et al., 2019), especially with respect to risk (Jian et al., 2024).

Learning orientation. LO is conceptualised as a set of organisational values that influence enterprise's propensity to create and use knowledge (Sinkula et al., 1997). LO represents the extent to which organisational learning and integration of acquired knowledge can occur within an enterprise, and beliefs and existing assumptions can be challenged. Gnizy et al. (2014) understand LO as the ability of firms to proactively surface, reconcile and, if necessary, change the market-based beliefs that anchor strategic and tactical decision making. In other words, LO reflects enterprise's willingness to learn, adopt a shared vision and be open, which in turn is related to the continuous questioning of existing assumptions and beliefs about its business and environment and the ability to introduce organisational change (Wilson, Liguori, 2023). By learning from their environment, such enterprises are able to provide quick solutions to various environmental challenges. In this way, learning orientation helps such enterprises to create sustainable competitive advantages and improve their business results (Wales et al., 2020). Researchers argue that LO is generative because enterprise's desire to learn is a catalyst for seeking, interpreting, and implementing market information (Mavondo et al., 2005). Therefore, LO is extremely important for enterprise's competitiveness and results (Wilson, Liguori, 2023).

Despite numerous attempts, research on the relationship between LO and firm performance has not led to clear findings. While some researchers (e.g. Haryanto et al., 2017) found empirical support for the impact of LO on firm performance, indicating that LO is the key to this performance. In light of other research findings, LO mediates the relationship between MO and performance, while still other research suggests that the relationship between LO and performance is moderated by MO (Wilson, Liguori, 2023). The reason for these divergent roles assigned to LOs is probably the concept of organisational learning and learning orientation at the organisational level (Wilson, Perepelkin, 2022).

In sum, MO, EO and LO influence enterprise's learning priorities. MO is a specific form of learning organised around the goal of customer satisfaction. EO is a specific type of learning organised around the goal of identifying and exploiting new market opportunities. LO reflects enterprise's overall commitment to proactive learning (Gnizy et al., 2014).

Strategic orientation. The three central strategic orientations can be combined to create SO, namely MO, EO and LO. These three orientations share an outside-in market perspective, require and promote effective market-based learning, and reflect a proactive approach to operating in the marketplace to build competitive advantage. MO and EO establish binding

priorities in the field of learning, while LO influences the quality and dynamism of the learning process (Gnizy et al., 2014).

The advantage of combining these orientations into a single higher order construct lies in the fact that each promotes slightly different, but related market-based performance objectives and each requires slightly different, but related market-based learning (Alqahtani et al., 2024; Anwar et al., 2025). Therefore, it is worth examining the integrative effects of all three constructs with a general insight that these constructs are related in the sense that they focus on market learning (Gnizy et al., 2014). This does not mean, however, that the independent effects of these three constructs should be aggregated in every case. In studies aimed at examining the impact of SO on the performance of MSMEs, it is reasonable to aggregate the above-mentioned lower-order constructs into one higher-order construct.

2.2. Hypotheses development

Research on the SO-performance relationship is based either on the resource-based view (RBV) (Anwar et al. 2025), according to which SO plays a key role as an organisational resource supporting competitive advantage and firm performance, or on the dynamic capabilities view (DCV), according to which each of the above-mentioned orientations facilitates the (re)configuration of capabilities designed to improve firm performance (Gnizy et al., 2014). Slater et al. (2006) depict higher order orientations associated with strategy making capability as key dynamic capabilities (DC). This study is based on DCV.

Although enterprises operating in the same environment or industry face similar challenges, their responses to those challenges can differ significantly. This variability is influenced by the SO of each enterprise (Elbanna, Elsharnouby, 2025). Therefore, the reasons for the differences in the performance of MSMEs can be found in their strategic orientations (Soomro, Shah, 2020). How and when SO can positively influence high performance remains a topic of debate, as there is still no consensus among scientists on this issue. Hernández-Perlines et al. (2021) and Soomro and Shah (2020) argue that SO has a positive impact on financial performance, but not on non-financial performance. Some researchers even question the significant positive relationship between SO and FP (Bhattacharya et al., 2019). That is why, the following hypothesis has been proposed:

H.1. Strategic orientation has a positive effect on firm performance.

According to Wales et al. (2020) and Baker et al. (2022), research exploring strategic orientations can examine the role of various aspects of the external environment, including market dynamism, to better explain when individual strategic orientations improve firm performance. It is worth emphasising that market dynamism refers to speed of change in technology and competition, unpredictability of change in technology and competition, and uncertainty of customer behaviour (Wang et al., 2015). However, existing studies have often overlooked the influence of this moderator (Elbanna, Elsharnouby, 2025).

In highly dynamic market environments characterised by rapid changes in customer preferences, technological advances, competitive actions and regulatory changes, MSMEs face significant challenges in anticipating and responding effectively to these changes. In such circumstances, achieving a competitive advantage requires constant modification of products and services. MD therefore impacts the operations of MSMEs and requires them to adapt quickly to maintain high performance. In this context, MSMEs may rely more on established sets of SOs and their incremental improvements than on their radical reconfiguration. This is due to the fact that the changes taking place in this market may, on the one hand, make it difficult to predict the scenarios that MSMEs may encounter; and on the other hand, they may generate opportunities that can strengthen their market potential. In high-MD environments, enterprises need to make rapid changes to their products or services to remain competitive in the market. Therefore, MD is considered to be the primary determinant of enterprise's strategic orientations (Parra Requena et al., 2023). However, several studies suggest that this positive effect may decrease with high levels of MD because SO may be an excessively risky behaviour in such situations (Ritala, 2012). This approach implies that excessive MD can generate a decrease in strategic confidence, and thereby increasing the difficulty in making accurate forecasts. In such a situation, especially in the case of MSMEs, the search for new opportunities, which is limited by the resources used in proven products and services, becomes increasingly unprofitable (Kreiser et al., 2020). This indicates that MD may create both incentives and disincentives for the development of SO. At low or moderate MD, its positive impact on SO can be expected to outweigh its negative impact because incentives outweigh perceived risk. However, at a high level of MD, after exceeding a certain threshold, the negative impact of such a level on SO, which weakens the relationship, begins to dominate. Therefore, excessive MD generates a high level of risk and limits SO, thus negatively affecting firm performance. This indicates that the replications and extensions of the previous study should also be directed to investigate the indirect effect of learning orientation on firm performance via moderating variables. The rationales indicated above constitute the basis for a better insight into the indirect relationship between SO and FP, where MD plays the role of a moderator. This leads to the hypothesis:

H.2. Market dynamism moderates the strategic orientation - firm performance relationship.

The above discussion is summarized by the conceptual model appears in Figure 1. It depicts the study's constructs and the expected relationships.

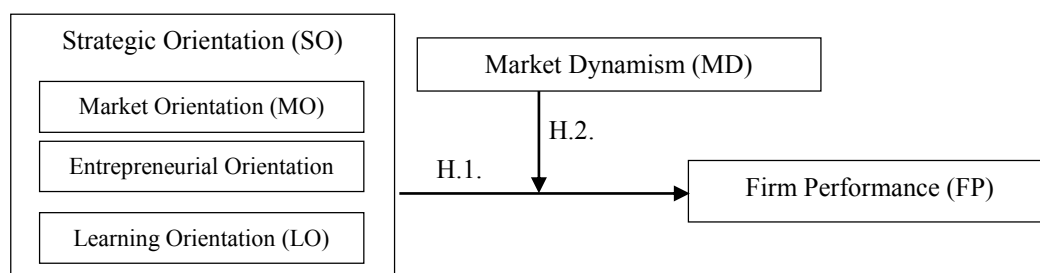


Figure 1. The research model and hypotheses.

Source: own elaboration.

The object of research is market dynamism which may be a moderator and better explain the analysed strategic orientation-firm performance relationship. Therefore, it was decided to continue research work related to the analysis of the strategic orientation-firm performance relationship in the conditions of existing intermediary variable affecting this relationship. That is why, the hypotheses were verified by a linear regression models in the next step.

3. Methodology

3.1. Research sample, data collection and research methods

This study is based on the study of MSMEs (Entrepreneurs' Law, Act of 6 March 2018, Polish Journal of Laws 2021, item 162, art. 7) which were operating in technology parks in Poland. Because each strategic orientation influences organisational learning priorities and the associated knowledge they produce – key success factors for enterprises in general and MSMEs in particular (Hult et al., 2003). Using the contact details provided in the contact databases most often found on TPs' websites, a list of 1,568 TPs' tenant enterprises was prepared. However, this list did not allow for determining the structure of the general population (statistical population) according to the size of enterprises defined by the number of employees. Therefore, the selection of enterprises belonging to the MSME sector was possible only after the respondents wishing to participate in this study had completed the survey questionnaire. Thus, a full study was conducted which covered all enterprises operating in TPs in Poland. The survey was being carried out from March 2017 to December 2018. Empirical research was conducted using PAPI (Paper over Pencil Interview) and CATI (Computer Assisted Telephone Interviewing) techniques. The survey was participated by 225 respondents out of 1568 surveyed enterprises, representing 14% of the total study population. At this stage of empirical research, the metric data collected from respondents allowed for the exclusion of the self-employed, large enterprises and the youngest entities operating on the market for less than a year from the research group. Therefore, the effective number of surveyed enterprises (tenants) was smaller. The exclusion of self-employment from the research sample was dictated by the use of an SO measurement tool intended for enterprises that employ at least one employee (Gnizy et al., 2014). At the same time, the analysis was based on the survival rate of enterprises, which is higher in the subsequent years of running a business (most enterprises go bankrupt in the first year of operation) (Zakrzewski, Skowrońska, 2019, pp. 19-20). In addition, five large enterprises were excluded from the overall research sample. Therefore, the effective research sample included only those MSMEs operating in TPs in Poland that, at the time of the study, continued their operations in the following years and employed at least one employee. This narrowed the research group to 12% of the study population. The basis for statistical

analyses was data obtained from 182 tenant enterprises employing at least one employee but no more than 249 employees. The research sample included 51.1% micro-enterprises ($N = 93$; excluding self-employment). Small enterprises ($N = 68$) constituted 37.4%, while medium-sized enterprises ($N = 21$) constituted 11.5% of all enterprises included in the research sample. The sample is not representative. Therefore, the study findings can only be applied to the research sample. The methods of description and statistical inference were used to analyse empirical data. The analytical procedure was started with the assessment of the reliability of individual scales (Cronbach's alpha test). The purpose of testing the reliability of scales, in this case, was to verify whether the reliability of the questionnaire, in the analysed sample, was similar to that provided by its authors, and whether the selection of the sample did not affect the level of reliability of the questionnaire itself.

Theoretical constructs (SO, FP, MD) were subjected to reliability analysis. The reliability indices of the construct scales obtained in this study were similar to those obtained by the authors of the original form of the questionnaire. Values of Cronbach's alpha coefficients for the measurement tools of the three above-mentioned constructs were higher than 0.70. It is assumed that the factor determining whether a tool is reliable should be at least 0.70 (Nunnally, 1978). Cronbach's alpha coefficients for the above-mentioned measurement tools are presented in the following section.

3.2. Measures

All primary measures were based on existing scales in the subject-matter literature.

Strategic orientation. The construct was conceptualised as a combination of all three orientations (linear sum of its equal weightings indicators) where each of the three addresses aspects that cannot be substituted by others. Hence, the SO construct was operationalised as a higher-order construct comprised of three lower-order constructs: MO, LO, and EO. To diagnose SO, the questionnaire used by Gnizy et al. (2014) was used. The reliability analysis of the adapted SO questionnaire in the sample indicates a high reliability of this scale ($\alpha = 0.872$).

Firm performance. A well-established scale ($\alpha = 0.892$) developed by Keh et al. (2007) was used to measure FP. This construct measured through the use of three items evaluating the level of firm performance including changes in profitability, sales revenue, and market share relative to their main competitor(s). Values obtained using Cronbach's alpha values ($\alpha = 0.901$) showed very good reliability of this variable.

Market dynamism. The construct was measured using the work of Wang et al. (2015). The market dynamism scale measured changes in technology, competition and customers (Keh et al. (2007). MD was operationalised using a six-item scale ($\alpha = 0.856$). Therefore, in the research sample, the reliability of the questionnaire was similar to that provided by its authors and the sample selection did not affect the level of its reliability.

4. Results And Discussion

4.1. Correlations among variables

Statistical calculations for the purposes of this article were performed using the R 3.5 program. Correlations among the variables appearing in the research model were being analysed, as well. The correlation table of variables was prepared using Spearman's rank-order correlation coefficient. The following values of the Spearman's rank-order correlation coefficient were used to determine the strength of correlations (Wójcik-Karpacz et al., 2021; Karpacz et al., 2024):

$0.00 \leq |r_s| \leq 0.29$ – no correlation – weak correlation,

$0.30 \leq |r_s| \leq 0.49$ – moderate correlation,

$0.50 \leq |r_s| \leq 0.69$ – strong correlation,

$0.70 \leq |r_s| \leq 1.00$ – very strong correlation.

It was assumed that only statistically significant relationships would be analysed. The results of correlations among the analysed variables are presented in Table 1.

Table 1.

Correlations among the analysed variables with significance value.

		SO	EO	MO	LO	MD	FP
SO	r_s	1.000	0.613	0.885	0.649	0.189	0.377
	p-value	–	0.000	0.000	0.000	0.011	0.000
MO	r_s	0.885	0.257	1.000	0.488	0.176	0.328
	p-value	0.000	0.000	–	0.000	0.018	0.000
LO	r_s	0.649	0.249	0.488	1.000	0.151	0.207
	p-value	0.000	0.001	0.000	–	0.043	0.005
EO	r_s	0.613	1.000	0.257	0.249	0.068	0.299
	p-value	0.000	–	0.000	0.001	0.360	0.000
MD	r_s	0.189	0.068	0.176	0.151	1.000	0.016
	p-value	0.011	0.360	0.018	0.043	–	0.829
FP	r_s	0.377	0.299	0.328	0.207	0.016	1.000
	p-value	0.000	0.000	0.000	0.005	0.829	–

Note: r_s – Spearman's rank-order correlation coefficient.

Source: own elaboration.

The analysis of the data in Table 1 indicates that strategic orientation positively correlates with firm performance ($r_s = 0.377$; $p = 0.000$). This means that there is a statistically significant correlation between these two variables. This relationship is moderately strong, as it is in the range of 0.30 - 0.49, and positive, i.e. an increase in strategic orientation is accompanied by an average moderate increase in firm performance.

The correlations between the three dimensions of strategic orientation and firm performance were also positive and statistically significant. The results of the correlation analysis indicated a moderate positive correlation between the SO dimension called market orientation and firm performance ($r_s = 0.328$; $p = 0.000$), and statistically significant. Therefore,

the growth of market orientation is accompanied by an average moderate growth of firm performance. It turned out that the remaining two dimensions of SO, called entrepreneurial orientation and learning orientation, also positively correlate with firm performance, although both variables correlate slightly weaker than market orientation. The correlation between entrepreneurial orientation and firm performance is positive, weak, and statistically significant ($r_s = 0.299$; $p = 0.000$). This indicates that the increase in entrepreneurial orientation is accompanied by an average small increase in firm performance. The correlation of the next dimension of SO called learning orientation is also positive, but it is slightly weaker than the above-mentioned one and statistically significant ($r_s = 0.207$; $p = 0.005$). This means that the increase in learning orientation is accompanied by, on average, a slight increase in firm performance. At the same time, it is clear that some of the independent variables are also moderately related to each other (e.g. the correlation coefficient between MO and LO is 0.488) or weakly related to each other (e.g. the correlation coefficient between EO and LO is 0.249).

There was also a positive, although weak ($r_s = 0.189$; $p = 0.011$) correlation between market dynamism and strategic orientation, which was statistically significant. Therefore, an increase in market dynamism is accompanied on average by a negligible increase in strategic orientation. However, the correlations between market dynamism and firm performance were not statistically significant.

Correlation analysis is therefore the basis for further knowledge, understanding and explanation of the strategic orientation-firm performance relationship in the context of market dynamism in the research sample.

4.2. Results of research hypotheses verification

Linear regression models were used to verify the hypotheses H.1 and H.2. The values of coefficients obtained for permanent effects in this model inform about how much the expected value of explanatory variable changes along with the unitary growth of a given predictor. The explanatory variable (predictor) is a variable in a statistical model on the basis of which the response variable is calculated. In the model 1 there is one explanatory variable (strategic orientation); while in the model 2 there are two explanatory variables (strategic orientation, market dynamism). The response variable is firm performance. The statistical significance of these coefficients was verified by a test based on the t statistics. For all the mentioned tests, $p < 0.05$ indicated the statistical significance of the analysed relationships. The evaluation of the impact of strategic orientation on firm performance is dictated by the H.1 hypothesis verification. The evaluation of the impact of the dynamism of the market in which MSMEs operate on explaining the impact of strategic orientation on firm performance is dictated by the verification of hypothesis H.2.

Models 1 and 2 in Table 2 were estimated based on the Akaike Information Criteria (AIC). The AIC for both models was similar, i.e. 551.20 for the first model and 553.25 for the second one. AIC levels for both models indicated acceptable matching levels. The lower the value of AIC, the better the predictive values of the model (Burnham, Anderson, 2002, pp. 261-304).

The results of testing the H.1 and H.2 hypotheses are presented in Table 2.

Model 1 explained 21.2% of data variability ($R^2 = 0.212$), while Model 2 explained 22.0% of data variability ($R^2 = 0.220$), which is just a little more than in the case of Model 1. The analysis of the models presented in Table 2 has led to several conclusions. In Model 1, strategic orientation was positively associated with firm performance. However, only 21.2% of the variation of the dependent variable (firm performance) is explained by the independent variable (strategic orientation) in Model 1, the remaining 78.80% (100% - 21.20%) of the variation remains unexplained by Model 1. Therefore, strategic orientation has a small, although statistically significant, impact on firm performance (coefficient: 0.52; $p = 0.00$). The linear regression model (Model 1) confirms the thesis about the positive impact of strategic orientation on firm performance. It may therefore be assumed that increasing the score for strategic orientation by one point will result in an increase in the average firm performance by 0.52.

Table 2.
Regression models

	Model 1			Model 2		
	Adjustment measurements					
Akaike Information Criteria (AIC)	AIC = 551.2			AIC = 553.25		
Degree of dependent variable explanation (Firm Performance) (R ²)	R ² = 0.212			R ² = 0.220		
Model's parameters (dependent variable – Firm Performance, FP)						
Predictor	Coefficient	Range of confidence	p-value	Coefficient	Range of confidence	p-value
Absolute term	2.01	1.5-3.46	0.00	4.23	1.38-7.08	0.00
Strategic orientation (SO)	0.52	0.33-0.71	0.00	0.10	-0.54-0.74	0.75
Market Dynamism (MD)	-	-	-	-0.45	-1.16-0.26	0.21
Moderation effects (moderator: Market Dynamism)						
SO:MD*	-	-	-	0.11	-0.05-0.27	0.18

* colon sign between SO and MD means the interaction between the factors (strategic orientation, market dynamism) included in the H2 hypothesis.

Source: own elaboration.

The linear regression model (Model 2), in turn, did not confirm the thesis about the moderating role of market dynamism on the strategic orientation-firm performance relationship. None of the predictors showed statistical significance ($p < 0.05$) in Model 2. What is more, taking the market dynamism variable into account affects the quality of the model, and market dynamism itself adopts negative prediction indicators, which means that better firm performance in responding to changes in the level of market dynamism deteriorates the overall

firm performance. Additionally, Model 3 (multi-factor model) was considered, taking into account independent variables (three first-order constructs) that are components of strategic orientation (a higher-order construct) (Table 3).

Table 3.

Regression model divided into strategic orientation components

	Model 3: Adjustment measurements		
Akaike Information Criteria, AIC)	AIC = 560.6		
Degree of dependent variable explanation (Firm Performance) (R ²)	R ² = 0.216		
Model's parameters (dependent variable – Firm Performance, FP)			
Predictor	Coefficient	Range of confidence	p-value
Absolute term	2.50	1.38-3.63	0.00
Market Orientation (MO)	0.22	0.06-0.37	0.01
Learning Orientation (LO)	0.09	-0.17-0.36	0.50
Entrepreneurial Orientation (EO)	0.20	0.06-0.34	0.01

Source: own elaboration.

Analysis of the results (Table 3) also shows that Model 3 has a slightly better fit to the data ($R^2 = 0.216$) compared to Model 1. During the data analysis, it was noticed that firm performance is characterised mainly by two components of strategic orientation, i.e.: market orientation and entrepreneurial orientation. By interpreting the estimated value of the regression coefficient (0.22) for MO, it can be stated that increasing the market orientation score by one point may result in an increase in the average firm performance by 0.22. The obtained value of the regression coefficient (0.20) for EO allows for concluding that increasing the entrepreneurial orientation score by one point may result in an increase in the average firm performance by 0.20. These findings indicate that MO has a positive impact on firm performance. The values calculated for MO in Model 3 (multi-factor model) have similar parameters to those obtained for EO. Therefore, the impact of EO on firm performance was also confirmed by the linear regression model (Model 3).

4.3. Discussion and conclusions

This study is an attempt to empirically develop knowledge about the (in)direct relationship between SO and FP, in which MD acts as a moderator and contributes to strategic management and entrepreneurship literature.

Based on the statistical results, it can be stated that SO is a predictor of FP. It has been proven a statistically significant but minor role of SO in shaping FP; however, only in those enterprises operating in TPs, which were included in the research sample. Nevertheless, the variability in the range of SO explained only 21.2 % of the variability in the subjective assessment of performance achieved by a given enterprise.

Furthermore, the results of this study show that MO, EO, and LO are complementary orientations whose combined influence on FP is greater than that of each of them individually. This means that removing one orientation would change the SO domain, which is consistent

with the conclusions of Gnizy et al. (2014) and confirms the hybrid nature of enterprise's strategic orientations.

These findings align well with the need to aggregate orientations embodying the complementary effects of MO, EO, and LO (Gnizy et al., 2014; Widjaja, Sugiarto, 2022). Since the influence of SO is stronger than the influence of any first-order component, SO can be treated as a strategic organisational factor shaping firm performance. Based on the dynamic capabilities - based view, this can be explained by the fact that a strong OS employs the capabilities of organisation to achieve better business results. This is an important point because it informs about organisational characteristics which may affect firm performance. Therefore, SO is a tool that can be used to improve the performance of MSMEs, i.e.: profitability, sales revenue and market share, as these measures were used to assess the performance of the MSMEs included in the research sample. The desired trend in the values of these measures is an upward trend.

Moreover, findings from the comparative strength of the three firm performance orientations (Model 3; Table 3) indicate that while MO and EO were found to have a predominantly positive relationship with performance, the effect of LO on performance appears to be less stable. This confirmed the findings of Liu and Huang (2020) that enterprises which had adopted both MO and EO, also achieved better performance. It is worth emphasising that EO had positive correlations with financial and non-financial performance measures across numerous environmental contexts (Rauch et al., 2009). This also reinforces the approach of Wales et al. (2020) who argue that instead of relying on a single strategic orientation, it is prudent to combine (or amalgamate) different orientations that can provide the strongest basis for increasing firm performance and growth.

What is more, Baker et al. (2022) argues that strategic orientations are organisational priorities which guide enterprises' approach to pursuing competitive advantage priorities. It turned out to be true also in this empirical findings with regard to SO, as well as its two components, i.e. MO and EO.

This study demonstrated the primacy of MO in a set of strategic orientations, as previously suggested by Widjaja and Sugiarto (2022). However, the above-mentioned superiority of MO over EO is insignificant. This shows that MO is not the only possible strategic orientation for MSMEs and that other orientations may also influence the performance of organisations of such size. These effects were also well supported by Alqahtani et al. (2024) who argue that enterprises may find it more useful to combine MO with other strategic orientations such as EO mentioned above. The literature indicates that enterprises combining MO with other orientations perform better than enterprises adopting MO only (He et al., 2024). The literature suggests that in the case of MSMEs, MO should be perceived as the ability to meet current customer needs (Alqahtani et al., 2024). EO, on the other hand, can be seen as enterprise's tendency to generate innovations, quickly respond to its business environment and implement them, and to boldly enter unknown markets (Dai et al., 2016).

The conclusions of this study also support the findings of Boso et al. (2013) who believe that MO provides an effective means for implementing entrepreneurial activities. This provides a basis for establishing complementarity between MO and EO in the strategic orientations developed by MSMEs. In particular, market-oriented and entrepreneurial MSMEs strive to meet expressed and latent customer needs, pursue market expansion as they are identified, and capitalise on emerging opportunities. This reveals that MO is particularly important for entrepreneurial MSMEs and new ventures because in the early stages it enables them to learn and adapt to the environment, quickly responding to opportunities and threats (Liu, Huang, 2020).

An attempt was also made in order to determine if there was a moderator in the mentioned relationship (Model 2). However, the verification of the H2 hypothesis did not provide an answer regarding how SO explains FP when a moderator like MD is involved.

4.4. Practical implications

The results of our research also have important practical implications. Above all, this research shows that the effects of each SO dimension need to be carefully interpreted in relation to the FP as well as in relation to other dimensions of SO. From a practical point of view, managers can use MO, EO and LO as managerial tools. It should be emphasized that prioritizing MO/EO or LO at the expense of the other may not be a practical approach for achieving success. This can be explained by the fact that combining MO, EO and LO may enable MSMEs to achieve better business results. For this reason, managers should encourage employees to exhibit behaviors that align with SO. Implementing reward systems and providing resources and support can help promote congruency between these orientations.

5. Limitations and suggestions for further research

The sample of entities studied was not representative and this limitation bounds the degree of generalisability. Therefore, one interesting follow-up study would involve collecting data from a random sample of enterprises. Moreover, this quantitative empirical research did not analyse the actual performance of the surveyed MSMEs, but only the respondents' subjective assessment of their enterprises' performance compared to their main competitors. Therefore, these findings may be either overstated or understated. This is a disadvantage typical of subjective measures (Wójcik-Karpacz, 2019). However, the use of such measures in this study was justified because objective measures could not be used to measure the performance of the analysed MSMEs (Khan et al., 2019). The third limitation is the adoption of a cross-sectional snapshot in the study of the temporal nature of strategic orientation in an enterprise. Therefore,

it is recommended to conduct a series of longitudinal studies in enterprises of various sizes and in various contexts in the field of SO and its relationship with financial and non-financial results.

References

1. Adams, P., Freitas, B.I.M., Fontana, R. (2019). Strategic orientation, innovation performance and the moderating influence of marketing management. *Journal of Business Research*, Vol. 97, No. 4, pp. 129-140, doi: 10.1016/j.jbusres.2018.12.071
2. Alqahtani, N., Uslay, (Shen) Yenyurt C.S. (2024). Comparing the moderated impact of entrepreneurial orientation, market orientation, and entrepreneurial marketing on firm performance. *Journal of Small Business Management*, Vol. 62, No. 6, pp. 2741-2778, doi: 10.1080/00472778.2023.2272267
3. Anderson, B., Covin, J., Slevin, D. (2009). Understanding the relationship between entrepreneurial orientation and strategic learning capability: An empirical investigation. *Strategic Entrepreneurship Journal*, Vol. 3, No. 3, pp. 218-240, doi: 10.1002/sej.72
4. Anwar, J., Butt, I., Ahmad, N. (2025). SMEs' strategic orientation through Miles and Snow typology: a synthesis of literature and future directions. *Management Research Review*, Vol. 48, No. 2, pp. 258-286, doi: 10.1108/MRR-12-2023-0914
5. Baker, W.E., Mukherjee, D., Perin, M.G. (2022). Learning orientation and competitive advantage: A critical synthesis and future directions. *Journal of Business Research*, Vol. 144, pp. 863-873, doi: 10.1016/j.jbusres.2022.02.003
6. Bhattacharya, A., Misra, S., Sardashti, H. (2019). Strategic orientation and firm risk, *International Journal of Research in Marketing*, Vol. 36, No. 4, pp. 509-527, doi: 10.1016/j.ijresmar.2019.01.004
7. Boso, N., Story, V.M., Cadogan, J.W. (2013). Entrepreneurial orientation, market orientation, network ties, and performance: study of entrepreneurial firms in a developing economy, *Journal of Business Venturing*, Vol. 28, No. 6, pp. 708-727, doi: 10.1016/j.jbusvent.2013.04.001
8. Covin, J.G., Lumpkin, G.T. (2011). Entrepreneurial orientation theory and research: Reflections on a needed construct. *Entrepreneurship Theory and Practice*, Vol. 35, No. 5, pp. 855-872, doi: 10.1111/j.1540-6520.2011.00482.x
9. Covin, J.G., Slevin, D.P. (1989). Strategic management of small firms in hostile and benign environments. *Strategic Management Journal*, Vol. 10, No. 1, pp. 75-87. <https://doi.org/10.1002/smj.4250100107>
10. Dai, Y., Roundy, P.T., Chok, J.I., Ding, F., Byun, G. (2016). Who knows what?' in new venture teams: Transactive memory systems as a micro-foundation of entrepreneurial

- orientation. *Journal of Management Studies*, Vol. 53, No. 8, pp. 1320-1347. Doi: 10.1111/joms.12211
11. Diabate, A., Sibiri, H., Wang, L., Yu, L. (2019). Assessing SMEs' sustainable growth through entrepreneurs' ability and entrepreneurial orientation: an insight into SMEs in Cote d'Ivoire. *Sustainability*, Vol. 11, No. 24, pp. 1-26, doi: 10.3390/su11247149
 12. Du, Y., Kim, P.H. (2021). One size does not fit all: Strategy configuraitons, complex environments, and new venture performance in emergin economies. *Journal of Business Research*, Vol. 124, pp. 272-285, doi: 10.1016/j.jbusres.2020.11.059
 13. Elbanna, S., Elsharnouby, T.H. (2025). Practical relevance of innovativeness: a mixed-method field study on the role of strategic orientation and strategic learning in the hospitality industry. *Management & Sustainability*, Vol. 4, No. 2, pp. 362-382, doi: 10.1108/MSAR-04-2024-0028
 14. Gatignon, H., Xuereb, J.M. (1997). Strategic orientation of the firm and new product performance. *Journal of Marketing Research*, Vol. 34, No. 1, pp. 77-90, doi: 10.1177/002224379703400107
 15. Gnizy, I., Baker, W.E., Grinstein, A. (2014). Proactive learning culture: A dynamic capability and key success factor for SMEs entering foreign markets. *International Marketing Review*, Vol. 31, No. 5, pp. 477-505, doi: 10.1108/IMR-10-2013-0246
 16. Grisseemann, U., Plank, A., Brunner-Sperdin, A. (2013). Enhancing business performance of hotels: the role of innovation and customer orientation. *International Journal of Hospitality Management*, Vol. 33, No. 6, pp. 347-356, doi: 10.1016/j.ijhm.2012.10.005
 17. Hailu, A.A., Kero, Ch.A., Dagne Z.L. (2025). The effect of strategic orientation on performance of agribusiness firms in Ethiopia: the mediating role of innovation capability. *Cogent Business & Management*, Vol. 12, No. 1, 2511284, doi: 10.1080/23311975.2025.2511284
 18. Hakala, H. (2011). Strategic orientations in management literature: Three approaches to understanding the interaction between market, technology, entrepreneurial and learning orientations. *International Journal of Management Reviews*, Vol. 13, No. 2, pp. 199-217, doi: 10.1111/j.1468-2370.2010.00292.x
 19. Haryanto, A.T., Haryono, T., Sawitri, H.S. . (2017). Market orientation, learning orientation and SMEs performance: The mediating role of innovation. *International Review of Management and Marketing*, Vol. 7, No. 1, pp. 484-491.
 20. He, K., Bouncken, R.B., Kiani, A., Kraus S. (2024). The role of strategic orientations for digital innovation: When entrepreneurship meets sustainability. *Technological Forecasting & Social Change*, Vol. 205, No. 8, 123503, doi: 10.1016/j.techfore.2024.123503
 21. Heikkilä, M., Bouwman, H., Heikkilä, J. (2018). From strategic goals to business model innovation paths: an exploratory study. *Journal of Small Business and Enterprise Development*, Vol. 25, No. 1, pp. 107-128; doi: 10.1108/JSBED-03-2017-0097
 22. Hernández-Linares, R., Kellermanns, F.W., López-Fernández M.C. (2018). A note on the relationships between learning, market, and entrepreneurial orientations in family and

- nonfamily firms. *Journal of Family Business Strategy*, Vol. 9, No. 3, pp. 192-204, doi: 10.1016/j.jfbs.2018.08.001
23. Hernández-Perlines, F., Covin, J.G., Ribeiro-Soriano, D.E. (2021). Entrepreneurial orientation, concern for socioemotional wealth preservation, and family firm performance. *Journal of Business Research*, Vol. 126, pp. 197-208, doi: 10.1016/j.jbusres.2020.12.050
 24. Hitt, M., Dacin, T., Tyler, B., Park, D. (1997). Understanding the differences in Korean and US executives' strategic orientations. *Strategic Management Journal*, Vol. 18, No. 2, pp. 159-167, doi: 10.1177/01492063990250
 25. Ho, K.L.P., Nguyen, C.N., Adhikari, R., Miles, M.P., Bonney, L. (2017). Exploring market orientation, innovation, and financial performance in agricultural value chains in emerging economies. *Journal of Innovation Knowledge*, Vol. 49, No. 3, pp. 1-12, doi: 10.1016/j.jik.2017.03.008
 26. Hult, T., Snow, C., Kandemir, D. (2003). The role of entrepreneurship in building cultural competitiveness in different organizational types. *Journal of Management*, Vol. 29, No. 3, pp. 401-426, doi: 10.1016/S0149-2063(03)00017-5
 27. Jaworski, B.J., Kohli, A.K. (1993). Market orientation: Antecedents and consequences. *Journal of Marketing*, Vol. 57, No. 3, pp. 53-70, doi: 10.2307/1251854
 28. Jian, Z., Javaid, M., Liao, S. (2024). Strategic orientation, strategic flexibility and firm performance: the important role of strategic human resource management. *Chinese Management Studies*. Advance online publication, doi: 10.1108/CMS-02-2024-0112
 29. Karpacz, J., Wójcik-Karpacz, A. (2024). The relationship between learning orientation, firm performance and market dynamism in MSMEs operating in technology parks in Poland: an empirical analysis. *Central European Management Journal*, Vol. 32, No. 2, pp. 216-232, doi: 10.1108/CEMJ-02-2023-0079
 30. Keh, H.T., Nguyen, T.T.M., Ng, H.P. (2007). The effects of entrepreneurial orientation and marketing information on the performance of SMEs. *Journal of Business Venturing*, Vol. 22, No. 4, pp. 592-611, doi: 10.1016/j.jbusvent.2006.05.003
 31. Kreiser, P.M., Anderson, B.S., Kuratko, D.F., Marino, L.D. (2020). Entrepreneurial orientation and environmental hostility: A threat rigidity perspective. *Entrepreneurship Theory and Practice*, Vol. 44, No. 6, pp. 1174-1198, doi: 10.1177/1042258719891389
 32. Liu, Ch.-H.S., Huang, Ch.-E. (2020). Discovering differences in the relationship among social entrepreneurial orientation, extensions to market orientation and value co-creation: The moderating role of social entrepreneurial self-efficacy. *Journal of Hospitality and Tourism Management*, Vol. 42, No. 3, pp. 97-106, doi: 10.1016/j.jhtm.2019.12.002
 33. Lumpkin, G.T., Dess, G.G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *The Academy of Management Review*, Vol. 21, No. 1, pp. 135-172, doi: 10.2307/258632
 34. M'zungu, S., Merrilees, B., Miller D. (2017). Strategic hybrid orientation between market orientation and brand orientation: guiding principles. *Journal of Strategic Marketing*, Vol. 25, No. 4, pp. 275-288, doi: 10.1080/0965254X.2015.1076880

35. Mavondo, F.T., Chimhanzi, J., Stewart, J. (2005). Learning orientation and market orientation. *European Journal of Marketing*, Vol. 39, No. 11/12, pp. 1235-1263, doi: 10.1108/03090560510623244
36. Mayr, S., Lixl, D. (2019). Restructuring in SMEs – a multiple case study analysis. *Journal of Small Business Strategy*, Vol. 29, No. 1, pp. 85-98, ISSN: 1081-8510 (Print) 2380-1751 (Online)
37. Melesse, H.S., Knatko D.M. (2024). The contingent effects of strategic orientations and strategic capabilities on competitive performance: Evidence from Ethiopian manufacturing enterprises. *Heliyon*, Vol. 10, e35497, doi: 10.1016/j.heliyon.2024.e35497
38. Miller, D. (1983). The correlates of entrepreneurship in three types of firms. *Management Science*, Vol. 29, No. 7, pp. 770-791, doi: 10.1287/mnsc.29.7.770
39. Morgan, T., Anokhin, S.A. (2020). The joint impact of entrepreneurial orientation and market orientation in new product development: Studying firm and environmental contingencies. *Journal of Business Research*, Vol. 113, No. 5, pp. 129-138, doi: 10.1016/j.jbusres.2019.06.019
40. Narver, J., Slater, S. (1990). The effect of a market orientation on business profitability. *Journal of Marketing*, Vol. 54, No. 4, pp. 20-35, doi: 10.2307/1251757
41. Nunnally, J. (1978). *Psychometric theory*. McGraw-Hill.
42. Parra Requena, G., Ruiz-Ortega, M.J., Rodrigo-Alarcón J. (2023). The role of absorptive capacity and market dynamism in shaping the firm's entrepreneurial orientation, innovation. *Organization & Management*, Vol. 25, No. 2, pp. 153-176, doi: 10.1080/14479338.2021.1999247
43. Putnins, T.S., Sauka, A. (2020). Why does entrepreneurial orientation affect company performance? *Strategic Entrepreneurship Journal*, Vol. 14, No. 4, pp. 711-735, doi: 10.2139/ssrn.3394367
44. Rauch, A., Wiklund, J., Lumpkin, G.T., Frese, M. (2009). Entrepreneurial orientation and business performance: An assessment of past research and suggestions for the future. *Entrepreneurship Theory and Practice*, Vol. 33, No. 3, pp. 761-787, doi: 10.1111/j.1540-6520.2009.00308
45. Ritala, P. (2012). Coopetition strategy-when is it successful? Empirical evidence on innovation and market performance. *British Journal of Management*, Vol. 23, No. 3, pp. 307-324, doi: 10.1111/j.1467-8551.2011.00741.x
46. Sinkula, J.M., Baker, W.E., Noordewier, T. (1997). A framework for market-based organizational learning: Linking values, knowledge, and behavior. *Journal of the Academy of Marketing Science*, Vol. 25, No. 4, pp. 305-318, doi: 10.1177/0092070397254003
47. Slater, S.F., Olson, E.M., Hult, G.T.M. (2006). The moderating influence of strategic orientation on the strategy formation capability-performance relationship. *Strategic Management Journal*, Vol. 27, No. 12, pp. 1221-1231, doi: 10.1002/smj.569

48. Soomro, B.A., Shah, N. (2020). Entrepreneurial orientation and performance in a developing country: strategic entrepreneurship as a mediator. *Business Strategy and Development*, Vol. 3, No. 4, pp. 567-577, doi: 10.1002/bsd2.122
49. Tajeddini, K., Elg, U., Trueman, M. (2013). Efficiency and effectiveness of small retailers: The role of customer and entrepreneurial orientation. *Journal of Retailing and Consumer Services*, Vol. 20, No. 5, pp. 453-462, doi: 10.1016/j.jretconser.2013.05.004
50. Tang, T.W. (2016). Making innovation happen through building social capital and scanning environment. *International Journal of Hospitality Management*, Vol. 56, No. 7, pp. 56-65, doi: 10.1016/j.ijhm.2016.04.002
51. Wales, W.J., Kraus, S., Filser, M., Stockmann, C., Covin, J.G. (2021). The status quo of research on entrepreneurial orientation: Conversational landmarks and theoretical scaffolding. *Journal of Business Research*, Vol. 128, No. 5, pp. 564-577, doi: 10.1016/j.jbusres.2020.10.046
52. Wales, W.J., Beliaeva, T., Shirokova, G., Stettler, T.R., Gupta, V.K. (2020). Orienting toward sales growth? Decomposing the variance attributed to three fundamental organizational strategic orientations. *Journal of Business Research*, Vol. 109, pp. 498-510, doi: 10.1016/j.jbusres.2018.12.019
53. Wang, C.L., Senaratne, Ch., Rafiq, M. (2015). Success traps, dynamic capabilities and firm performance. *British Journal of Management*, Vol. 26, No. 1, pp. 26-44, doi: 10.1111/1467-8551.12066
54. Widjaja, A.W., Sugiarto (2022). Strategic orientation's dilemma of batik retailers in Jakarta. *Heliyon*, Vol. 8, No. 6, e09622, doi: 10.1016/j.heliyon.2022.e09622
55. Wilson, G.A., Liguori, E. (2023). Market orientation, failure learning orientation, and financial performance. *Journal of Small Business Management*, Vol. 61, No. 6, pp. 3027-3045, doi: 10.1080/00472778.2022.2051177
56. Wilson, G.A., Perepelkin, J. (2022). Failure learning orientation, entrepreneurial orientation, and financial performance among U.S. biotechnology firms. *Journal of Small Business Management*, Vol. 60, No. 4, pp. 786-804, doi: 10.1080/00472778.2020.1816434
57. Wójcik-Karpacz, A. (2019). *Zdolności organizacyjne w kontekście wyników przedsiębiorstwa. Aspekty teoretyczne i wyniki badań empirycznych*. Warszawa: PWN, pp. 148-153.
58. Wójcik-Karpacz, A., Karpacz, J., Rudawska, J. (2021). The impact of market orientation on the performance of MSMEs operating in technology parks: The role of market dynamism. *Journal of Entrepreneurship, Management and Innovation*, Vol. 17, No. 2, pp. 29-52, doi: 10.7341/20211722
59. Zakrzewski, R., Skowrońska, A. (eds.). (2019). *Raport o stanie sektora małych i średnich przedsiębiorstw w Polsce*. Warszawa: Polska Agencja Rozwoju Przedsiębiorczości.

MANAGING ENERGY SECURITY IN TIME OF WAR – AN ANALYSIS OF THE UKRAINIAN EXPERIENCE

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Purpose. To examine, identifies key strategies and provides insights into how nations can build more resilient, sustainable energy systems in the face of modern warfare. This article based on the case study of the current situation in Ukraine.

Design/methodology/approach: The study is based on a systematic review of peer-reviewed literature, policy documents, and case studies. Comparative and thematic analyses are applied to identify key trends, challenges, and best practices in integrating energy strategies into local economic policies.

Findings. The results show that energy-saving measures stimulate the development of sustainable production, support the expansion of green technologies, and attract environmentally oriented investments, all of which positively influence public health and foster regional economic growth. According to the organization Vision of Humanity “in 2025 we have 56 armed conflicts in the world”. The Global Peace Index 2024 reveals that “the world is at crossroads. Without a concerted effort, there is a risk of a surge in major conflicts”. The invasion of Ukraine by Russia has made European countries realize that war in the heart of Europe intensify a serious security crisis in Europe. In addition, it is alarming that war not only results in loss of life but also causes widespread damage to essential systems such as transportation, communication, water supply and energy. In the present days wars have become more destructive by using weapons dedicated to destruction in a precise and targeted manner.

Research limitations/implications. The study’s conclusions are formed within the confines of the previous studies’ availability and scope because it only employs secondary sources. There is a need for additional empirical research in order to assess the direct impacts of conservation strategies on specific territorial communities. How dependent are modern societies on electrical power? Are we prepared for a blackout? Life without electricity in today’s world would be challenging. Our daily lives – whether it’s using the internet, phones, medical services, transport or schools – rely on access to electricity in nearly every aspect. Considering that European countries must employ strategic instruments supporting national energy security.

Originality/value. By combining knowledge from various sources, this study gives stakeholders and policymakers an extensive understanding of how to restore Ukraine’s electrical infrastructure during martial law and ensure the implementation of innovative tools and alternative energy sources.

Keywords: critical infrastructure; decentralization; energy security, managing energy security.

Category of the paper: research paper.

JEL: Q41, Q42, Q48, Q54, H56, O44.

1. Introduction

Before Russia's aggression against Ukraine in 2022, the energy sector was a substantial contributor to the national economy, generating significant revenues, particularly from electricity exports to neighboring countries in Europe. For example, electricity exports to Poland, Hungary, and Slovakia provided critical foreign exchange inflows, particularly in the nuclear and hydropower sectors (Assessment of damages and losses to Ukraine's energy sector due to Russia's full-scale invasion, 26.06.2024).

The originality of the presented material lies in the fact that, despite the growing number of analytical reports assessing wartime damage to Ukraine's energy sector, there is still a lack of academic studies that systematically classify the mechanisms of infrastructure destruction, compare traditional and modern warfare tools, and analyse their cascading impacts on interconnected infrastructure systems. This article offers a novel and integrated analytical approach by combining these elements into a coherent framework and by proposing a structured typology of threats to energy infrastructure during contemporary armed conflicts. Unlike existing assessments that mainly quantify losses, this study focuses on identifying causal mechanisms, vulnerabilities, and technologically driven protective strategies, thus filling a significant research gap in the current literature.

However, the ongoing war has dramatically altered the energy landscape. Destruction of energy infrastructure in conflict zones, has led to a reduction in energy production and, consequently, financial losses, which consequently made life very difficult for Ukrainians. It's not just about lighting, cooking or heating, but also communication issues Internet and phones, also, for example, modern hospitals, schools, banks depend heavily on electricity.

Additionally, in modern societies, infrastructure systems are becoming increasingly interconnected and complex. Power grids, water supply systems, transportation networks and communications systems are often interdependent, meaning that damage to one system can have a cascading effect on others. For example, a power outage caused by the destruction of a substation can result in the shutdown of water pumps and the interruption of Internet and telephone services. These interconnections make infrastructure more vulnerable to widespread disruption during wartime.

The rise of air-launched precision guided munitions and drones has led to more targeted strikes on infrastructure. While this theoretically limits collateral damage, it also means that adversaries can focus their efforts on specific, high-value targets like power plants (Kunertova, 2023).

The drone strikes on Saudi Aramco oil facilities in 2019, which temporarily crippled the country's oil production, demonstrated the potential for precision strikes to inflict severe economic damage with relatively few resources (Hafner et al., 2023). The protection of civilian infrastructure during wartime is governed by international humanitarian law, particularly the Geneva Conventions which prohibit attacks on civilian objects unless they are being used for military purposes (Luigi, 2024). However, the distinction between civilian and military infrastructure is often blurred in modern conflicts. Dual-use infrastructures such as bridges, power plants, and telecommunications networks—can be used by both civilian and military forces, leading to ethical and legal dilemmas when such targets are attacked (Protecting the Environment during Armed Conflict, 16.10.2024).

This paper explores the mechanisms through which war destroys energy infrastructure, with a focus on both traditional and contemporary methods of warfare. It also examines strategies for safeguarding infrastructure during wars, including technological approaches that can mitigate the damage and ensure the continuity of essential services. By understanding the threats posed to infrastructure and how to protect it, governments, international organizations, and other stakeholders can better prepare for and respond to the challenges and consequences of modern warfare.

This article does not address the role of public and private entities. Also, this article does not address ethical or political issues. It is not intended to discuss the topic of managing the reconstruction of the energy infrastructure in Ukraine.

2. Materials and Methods

Data for this study were collected through a comprehensive review of governmental reports, policy papers, and official communications from Ukrainian authorities, including the Ministry of Energy of Ukraine (*Annual Report on the Operation of the Ukrainian Energy System*, 18.09.2024) and the State Emergency Service (*State Emergency Service Report*, 18.09.2024). Additional materials were drawn from international organizations such as the United Nations (UN, *Transforming Our World: The 2030 Agenda for Sustainable Development*, 10.09.2024), the World Bank (World Bank Group, 10.09.2024), and the International Energy Agency (IEA, 11.09.2024). These sources were complemented by analytical assessments and damage evaluation reports (*Brief Ukrainian Energy Sector Evaluation and Damage Assessment*, 10.10.2024), as well as academic and policy-oriented literature examining best practices in energy security, infrastructure resilience, and wartime energy system management.

The literature review provided the theoretical foundation for the research, identifying key variables, indicators, and structural characteristics relevant to assessing Ukraine's energy system performance before and during the war. It also enabled the formulation of analytical

categories related to infrastructure resilience, diversification of energy sources, grid vulnerability, and the role of decentralised and renewable energy solutions in enhancing national energy security.

Despite the increasing number of descriptive and sectoral reports, the systematic review of academic sources revealed a clear research gap: existing studies tend to focus either on quantifying wartime damage or on proposing general policy recommendations, but they rarely analyse the mechanisms of infrastructure destruction, their cascading effects across interdependent systems, and the technological options for mitigating such impacts in an integrated manner. Current literature thus lacks a comprehensive analytical framework that links wartime threat typologies with infrastructure vulnerabilities and protective strategies.

This gap highlights the need for an analytical study that connects mechanisms of wartime infrastructure disruption with their systemic consequences. Therefore, the aim of this article is to systematize the mechanisms through which war affects energy infrastructure and to identify technological and organizational approaches that may enhance the resilience of energy systems under extreme conditions.

The following research questions arise from this gap:

1. What mechanisms of energy infrastructure destruction are characteristic of modern armed conflicts?
2. How do disruptions in one segment of the energy system generate cascading effects in other interconnected sectors?
3. Which technological and structural solutions can enhance the resilience of energy systems during wartime?
4. How can lessons learned from international cases inform Ukraine's strategy for protecting critical energy infrastructure?
5. To ensure methodological rigor, the study employed a mixed qualitative-analytical approach. First, a *documentary analysis* was conducted to extract quantitative and qualitative information from official statistics, technical reports, and policy documents. Second, a *comparative analytical method* was applied to evaluate Ukraine's energy infrastructure in relation to international benchmarks and established models of energy resilience and post-crisis recovery. Third, *triangulation* of data from multiple independent sources was used to validate findings and minimize potential bias arising from incomplete wartime reporting.
6. In addition, the study incorporated elements of *system analysis* to assess interdependencies between different segments of the energy sector—nuclear, thermal, hydropower, renewable energy, and transmission networks – and to determine how wartime disruptions affected overall system functionality. This approach made it possible to evaluate not only the physical condition of energy infrastructure but also the institutional, regulatory, and operational capacities shaping Ukraine's ability to maintain and restore electricity supply under extreme conditions.

7. Collectively, these methodological steps established a robust empirical and analytical basis for examining Ukraine's wartime energy challenges and identifying strategic directions for reconstruction, modernization, and long-term transformation of the national energy sector.

3. Literature Review

Energy security is one of the key strategic goals of any state, particularly in times of war when access to resources is restricted, and infrastructure is under threat. The Ukrainian experience in this context provides a unique case study of how energy resource management can be adapted during war.

In the study by (Adenso-Díaz et al., 2017), the focus is on resource management under dynamic pricing, which allows for revenue optimization and waste reduction. While the article primarily deals with the management of perishable goods, its principles can be adapted to energy resource management during wartime. For example, in situations where resources are limited, the use of dynamic models can help optimize electricity distribution among consumers. The adaptability of these models to resource constraints is highly relevant for Ukraine during wartime, where energy shortages may become critical. Bernow (Bernow et al., 2001) emphasizes mechanisms for clean development in the context of climate policy. They analyze how clean technologies and strategic planning in the energy sector can contribute to reducing environmental impact. In Ukraine's case, which is highly dependent on fossil fuels, these approaches could be valuable for the development of alternative energy sources during wartime. By reducing reliance on imported energy supplies, Ukraine could strengthen its energy independence and ensure a more resilient energy infrastructure under conflict conditions.

The energy policy of the European Union, as discussed in the European Commission's report (2024), plays a crucial role for Ukraine as it integrates into the European energy market. The policy focuses on increasing energy efficiency and developing renewable energy sources, which becomes especially relevant during military conflicts when traditional energy sources may be destroyed or disrupted. For Ukraine, aligning with EU energy goals can help build a more secure and sustainable energy future. The Polish National Action Plan for Renewable Energy Sources (Polish Ministry of Climate and Environment, 2020) presents an interesting model for Ukraine. Poland's proactive policies aimed at reducing dependence on imported energy could serve as a valuable lesson for Ukraine during its own energy crisis caused by war. By diversifying energy sources quickly, Ukraine can reduce its vulnerability to external disruptions.

Statistical data provided by Eurostat (2024) underline the importance of accurately tracking energy consumption and the import/export balance. For Ukraine, this could be critical in evaluating its capabilities during wartime, when energy supply channels are disrupted or threatened. Such monitoring helps policymakers make informed decisions on energy resource management, especially when external supply lines are compromised.

Some authors rightly highlight the challenges of fossil fuel dependency. For example, Liu (Liu et al., 2019) explore coal consumption in China and its impact on achieving carbon goals. For Ukraine, which also relies heavily on fossil fuels, China's experience could be useful in identifying pathways to energy independence during armed conflicts, particularly by reducing carbon emissions and transitioning to renewable energy sources. By shifting away from fossil fuels, Ukraine could also mitigate the environmental consequences of wartime energy usage. Many authors stress the importance of corporate responsibility and innovation in energy management. For instance, Porter & Kramer (2006) highlights the significance of Corporate Social Responsibility (CSR). In times of war, energy companies in Ukraine could utilize CSR approaches to enhance the resilience of their operations, particularly in ensuring the supply of energy to critical infrastructure.

The Ukrainian experience can also be enriched by the research of Yakymchuk et al. (2024), which focuses on the importance of developing alternative energy sources and using natural resources to support the economy during wartime. Specifically, they emphasize the need for Ukraine to advance its environmental policies and diversify energy sources to reduce the strain on conventional energy systems during and after the war. A further strand of contemporary research highlights the growing militarisation of critical energy systems and the increasing relevance of hybrid threats, including cyberattacks, drone warfare, and precision-guided strikes. Studies on critical infrastructure resilience (Kunertova, 2023; Hafner et al., 2023) emphasise that modern conflicts blur the boundary between military and civilian targets, creating complex interdependencies that magnify the effects of physical and digital disruptions. Although these works provide valuable insights into threat typologies, they rarely integrate these insights with the broader debates on energy transition, decentralisation, or wartime resource allocation. As a result, the literature remains fragmented, with security-focused analyses and energy-policy analyses developing in parallel rather than informing one another.

Another relevant body of scholarship concerns the role of decentralised and renewable energy systems in enhancing national security under conditions of instability. Research on microgrids, distributed generation, and adaptive repair capacities suggests that decentralisation not only reduces vulnerability to targeted attacks but also supports faster restoration of essential services during crises. Yet, while these studies offer promising technological solutions, they seldom include the Ukrainian case or consider the specific operational constraints of an active war zone. This reinforces the research gap identified in the present paper: there is a lack of integrated analyses that connect threat environments, systemic vulnerabilities, technological pathways, and emergency management strategies into a single conceptual model applicable to countries experiencing full-scale military aggression.

4. Energy infrastructure in Ukraine before the outbreak of war in 2022

Before the war in 2022, Ukraine had a diverse energy generation portfolio that included nuclear power plants (NPPs), thermal power plants (TPPs), renewable energy sources (RES), and hydroelectric power plants (HPPs). Below is an overview of the locations and capacities of these energy sources.

Nuclear power plants (NPPS). Ukraine is notable for its nuclear energy sector, which, before Russia's invasion of Ukraine the year 2022, accounted for **2.6%** of the world's nuclear energy capacity. With four major nuclear power plants, including the Zaporizhzhia Nuclear Power Plant (the largest in Europe), Ukraine has been an important player in both regional energy security and the global nuclear landscape. Ukraine had a significant reliance on nuclear energy, which accounted for more than half of its electricity production before the conflict in 2022. There were four active nuclear power plants, all located in the central and southeastern parts of the country, with a total installed capacity of about 13.8 gigawatts (GW).

Zaporizhzhia NPP: Located near the city of Enerhodar in southeastern Ukraine, Zaporizhzhia was the largest nuclear power plant in Europe and one of the ten largest in the world, with an installed capacity of 6000 megawatts (MW) (6 reactors, 1000 MW each).

Rivne NPP: Located in northwest Ukraine, near the city of Varash, this plant had a total capacity of 2835 MW (4 reactors: two 1000 MW reactors and two smaller reactors of 440 MW).

Khmelnyskyi NPP: Situated in western Ukraine near the town of Netishyn, Khmelnyskyi NPP had an installed capacity of 2000 MW (2 reactors of 1000 MW each). Plans for two additional reactors were in progress but were not completed by 2022. **South Ukraine NPP:** Located near Yuzhnoukrainsk in southern Ukraine, the South Ukraine NPP had an installed capacity of 3000 MW (3 reactors of 1000 MW each).

To further strengthen the methodological framework, the study also employed contextual and temporal analysis to track how Ukraine's energy system evolved under the pressure of wartime conditions. This included examining the sequence of attacks on critical energy infrastructure, the timing of system failures, and the government's emergency response measures. Such temporal mapping allowed for the identification of critical vulnerabilities and bottlenecks in the energy supply chain, including disruptions in fuel logistics, damage to high-voltage substations, and instability in regional power balancing.

Additionally, geospatial analysis was used to assess the territorial distribution of damage and the resilience of specific energy assets. By correlating regional attack patterns with the location of key generating facilities – such as thermal power plants, hydropower dams, and renewable energy clusters – the study identified areas of highest systemic risk and regions where decentralised energy solutions could offer the most strategic value. Although high-resolution satellite data were not used directly, the analysis relied on publicly available geospatial incident mapping from Ukrainian authorities and partner organizations.

Finally, the methodological design incorporated an expert-based interpretative component. Insights from energy professionals, policy analysts, and international partners – obtained through publicly available expert interviews, briefings, and think-tank publications – were used to contextualize the empirical findings and validate assumptions about system resilience, reconstruction priorities, and post-war energy policy directions. This interpretative layer ensured that the study accounts not only for technical indicators but also for strategic considerations shaping Ukraine's ongoing energy transition.

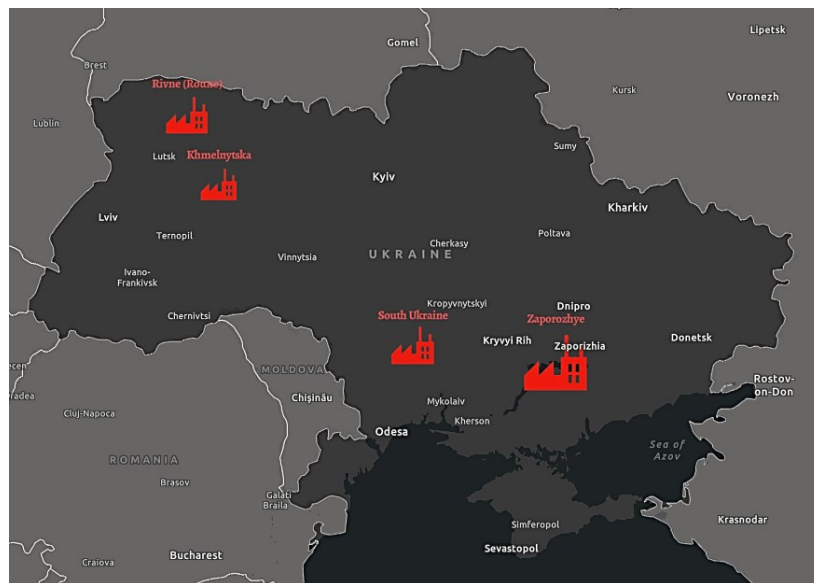


Figure 1. Nuclear Power Plants in Ukraine 2022.

Source: <https://clemson.maps.arcgis.com/apps/dashboards/cd37c198d1b448aa95e8e59d033b03c0>

Thermal power plants (TPPS). Ukraine also has thermal coal and gas-fired power plants. Although this accounts for only 0.6% of the global thermal power generation, it remains a vital component of Ukraine's energy mix and industrial output.

Thermal power plants, primarily fueled by coal and natural gas, played a major role in Ukraine's energy mix, providing around 30-35% of the country's electricity. The most significant plants were concentrated in the eastern and central parts of Ukraine, near coal deposits.

Burshtyn TPP: Located in western Ukraine, this plant had an installed capacity of **2335 MW** and was part of the "Burshtyn Energy Island," which was connected to the European grid, allowing for electricity exports to EU countries.

Zmiivska TPP: Situated in Kharkiv Oblast, northeastern Ukraine, Zmiivska TPP had a capacity of **2270 MW** and was one of the largest in the country.

Kryvyi Rih TPP: Located in Dnipropetrovsk Oblast, this plant had an installed capacity of **1600 MW** and was primarily coal-fired.

Vuhlehirska TPP: Located in Donetsk Oblast, Vuhlehirska had an installed capacity of **3600 MW**, but its operations were frequently disrupted due to the conflict in the Donbas region, which began in 2014.

Ladyzhyn TPP: Located in Vinnytsia Oblast, Ladyzhyn TPP had an installed capacity of **1800 MW**.

Trypilska TPP: Located near Kyiv, this power plant had a capacity of **1800 MW**.

In addition to these large plants, there were several other smaller TPPs spread across the country.

Thermal power plants (TPPs) constituted another essential pillar of Ukraine's pre-war energy architecture. Although Ukraine accounted for only 0.6% of global thermal power generation, thermal facilities – primarily coal – and natural gas-fired – remained a critical component of the national energy mix, supplying approximately 30-35% of total electricity production. Their strategic significance extended beyond electricity generation, as TPPs supported industrial output, district heating systems, and regional energy security, particularly in the eastern and central oblasts traditionally associated with coal mining and heavy industry.

Before the escalation of the war in 2022, Ukraine operated several large thermal power plants with substantial installed capacity. Among the most important was the Burshtyn TPP (2335 MW), located in western Ukraine, which formed the core of the “Burshtyn Energy Island” – a unique energy zone synchronised with the European grid, facilitating electricity exports to EU member states. Zmiivska TPP in Kharkiv Oblast (2270 MW) ranked among the country's largest facilities and played a key role in maintaining energy stability in northeastern Ukraine. Similarly, the Kryvyi Rih TPP (1600 MW) and Ladyzhyn TPP (1800 MW) provided essential baseload capacity for industrial regions in central Ukraine, relying predominantly on coal-fired units.

In eastern Ukraine, the Vuhlehirska TPP (3600 MW) was one of the most significant power stations prior to the full-scale invasion; however, its operations had already been repeatedly disrupted by conflict since 2014. The Trypilska TPP, located near Kyiv with an installed capacity of 1800 MW, served as a major source of electricity and district heating for the capital region. Beyond these major facilities, numerous smaller thermal power plants were distributed across the country, contributing to local grid balancing and providing reserve capacity.

Despite their importance, Ukraine's TPPs faced longstanding structural and environmental challenges, including aging infrastructure, dependence on fossil fuels, fluctuating coal supply chains, and relatively high emissions compared with other energy sources. The outbreak of full-scale war significantly exacerbated these vulnerabilities, as many thermal plants became primary targets of missile and drone attacks, resulting in severe physical damage, operational disruptions, and fuel shortages. As a consequence, the resilience of the thermal generation sector has emerged as a central issue in the broader discussion on Ukraine's post-war energy recovery, modernization, and transition to cleaner and more decentralized energy systems. The full-scale invasion dramatically intensified the systemic vulnerabilities inherent in Ukraine's thermal generation sector. Since early 2022, TPPs have been among the primary targets of Russian missile and drone attacks, resulting in large-scale destruction of generating units, transformer substations, and auxiliary infrastructure. Damage to coal mines, fuel depots,

and railway logistics corridors further disrupted the supply chains essential for continuous TPP operation. In several regions, repeated strikes led not only to temporary shutdowns but also to the complete loss of generation capacity, significantly reducing the country's ability to maintain a stable baseload. As a result, the share of functional thermal generation sharply declined, placing increased pressure on nuclear, hydropower, and decentralized renewable systems to compensate for supply deficits.

At the same time, the war underscored the dual strategic value of thermal power plants. On the one hand, they are highly vulnerable, centralized assets that can be incapacitated by targeted attacks; on the other, they provide indispensable grid-balancing services, rapid ramp-up capabilities, and critical winter heating for densely populated and industrialized areas. This creates a challenging policy dilemma: while thermal generation must be preserved in the short term to ensure energy security under wartime conditions, it simultaneously requires long-term modernization, partial decarbonization, and technological diversification to align with Ukraine's commitments to EU energy standards.

Looking ahead, the modernization of Ukraine's thermal power sector is expected to follow several strategic directions. These include retrofitting selected TPPs with cleaner and more flexible technologies, such as high-efficiency gas turbines, biomass co-firing systems, and carbon-capture-ready infrastructure where feasible. Additionally, enhancing cyber-physical protection, decentralizing auxiliary systems, and integrating thermal units into smart-grid and energy-storage frameworks will be crucial for improving resilience. International support—from the EU, the World Bank, and bilateral energy partnerships—will also play a central role in financing reconstruction and accelerating the transition toward a more sustainable, adaptive, and less fossil-fuel-dependent thermal generation landscape in post-war Ukraine.

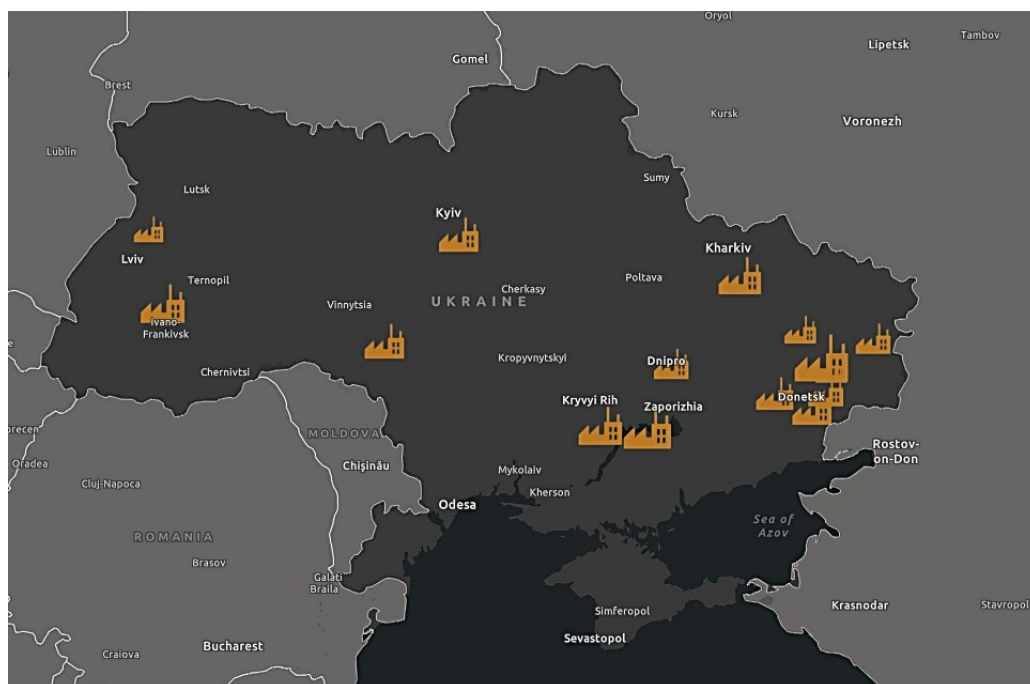


Figure 2. Thermal power plants in Ukraine 2022.

Source: <https://clemson.maps.arcgis.com/apps/dashboards/cd37c198d1b448aa95e8e59d033b03c0>

Renewable energy sources (RES). Renewable energy sources (RES) constituted an increasingly important component of Ukraine's pre-war energy landscape. Although the country's share in global renewable capacity remained modest compared to EU member states, Ukraine demonstrated notable progress, particularly in the solar sector, which accounted for approximately 1.2% of global photovoltaic capacity by 2022. Wind energy, while developing at a slower pace, represented 0.2% of global output, whereas hydropower contributed about 0.4% of global hydroelectric capacity. By 2022, renewable energy sources produced an estimated 7-8% of Ukraine's electricity, supported by more than 9 GW of installed capacity across solar, wind, biomass, biogas, and hydropower facilities. Despite this progress, the overall structure of the sector remained highly uneven and regionally concentrated, reflecting both geographical potential and infrastructural constraints.

Ukraine's solar power generation expanded particularly rapidly throughout the 2010s due to favorable climatic conditions and strong investment incentives. The majority of photovoltaic installations were located in the southern and central oblasts—regions characterized by high solar irradiation. Flagship projects included the Nikopol Solar Power Plant (246 MW) and the Pokrovska Solar Plant (approximately 240 MW), both situated in Dnipropetrovsk Oblast. By the beginning of 2022, Ukraine's total installed solar capacity reached nearly 7 GW, making solar energy the dominant component of the nation's renewable energy portfolio.

Wind energy development was concentrated primarily in the coastal regions of southern Ukraine, especially Zaporizhzhia, Kherson, and Mykolaiv Oblasts, where favorable wind conditions enabled the establishment of high-capacity installations. Among the largest facilities were the Primorsk Wind Farm (200 MW) and the Botievo Wind Farm (200 MW), both located in Zaporizhzhia Oblast. In aggregate, installed wind capacity reached around 1.6 GW by 2022, positioning wind power as the second-largest segment of the renewable energy sector.

Biomass and biogas projects, though significantly smaller in scale, played an increasingly important role in supporting rural and decentralized energy production. With around 250 MW of installed capacity, these technologies offered a valuable contribution to local energy resilience, particularly in agricultural regions with substantial biomass resources.

Hydropower remained a stable yet relatively modest contributor to Ukraine's energy system, generating roughly 5-7% of total electricity output. Hydropower facilities were predominantly located along the Dnieper River and its tributaries. Major installations included the Dnieper Hydroelectric Station (DniproHES) in Zaporizhzhia with a capacity of 1570 MW, the Kremenchuk HPP (625 MW), the Kyiv HPP (440 MW), the Kaniv HPP (444 MW), and the Dniester HPP in western Ukraine (702 MW). In addition to these large plants, numerous small hydroelectric stations complemented the generation mix, contributing to regional grid stability and balancing intermittent renewable sources.

Overall, Ukraine's renewable energy sector prior to the full-scale invasion exhibited strong growth dynamics but also remained vulnerable due to geographical concentration, limited storage capacity, and partial integration into the national grid. These structural characteristics

became particularly significant during the war, when energy decentralization and resilience emerged as critical priorities for national security and post-war reconstruction planning.

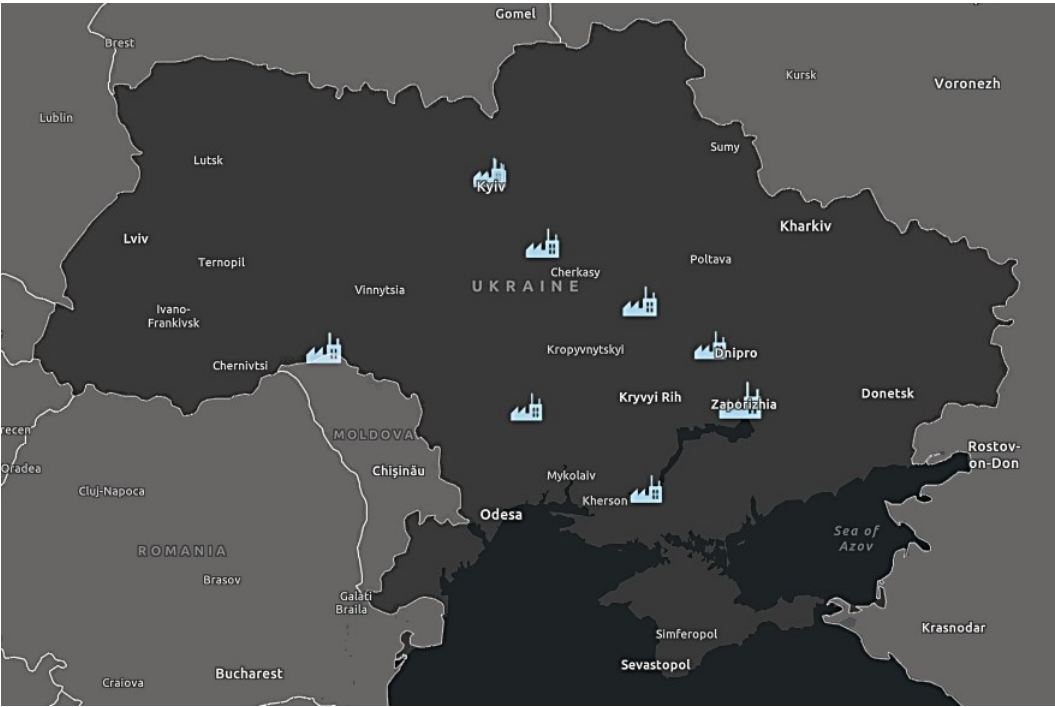


Figure 3. Hydroelectric Power Plants in Ukraine 2022.

Source: <https://clemson.maps.arcgis.com/apps/dashboards/cd37c198d1b448aa95e8e59d033b03c0>

The energy structure and economic efficiency of various energy sources in Ukraine before the outbreak of war in 2022 is provided in Table 1.

Table 1.
Power Capacities of Ukraine’s Power Plants Before the War (up to 2022)

Type of Power Plant	Capacity, GW	Share in Total Energy Mix	Generation Cost, \$/MWh (Ukraine)
Nuclear Power Plants (NPP)	13.8	51-55%	40-50
Thermal Power Plants (TPP)	21.0	30-35%	60-100 (depending on fuel)
Hydroelectric Power Plants (including PSPPs)	5.9	5-7%	30-40
Renewable Energy Sources (including solar and wind)	8.5	10-12%	100-120

Source: authors’ work based on Eurostat (2024), World Nuclear Association (2020), Ministry of Energy of Ukraine (2021; 2024), Polish Ministry of Climate and Environment (2020), IEA (2021), British Petroleum (2021), SAEE (2024), WBA (2017) and European Commission (2024).

Nuclear Power Plants (NPPs) in Ukraine account for a significantly larger share of the energy mix (over 50%) with low generation costs in Ukraine. Thermal Power Plants (TPPs) share in Ukraine is around 30-35%. The generation costs are higher for TPPs due to fuel variability, especially fossil fuels. Hydroelectric Power Plants (HPPs) represent a smaller portion of the energy mix in Ukraine Renewable Energy Sources (RES) in Ukraine accounted for up to 12% of the market by 2022. However, the generation cost of renewables in Ukraine

remains higher due to technological and infrastructure limitations. Before the full-scale invasion in 2022, Ukraine's energy system demonstrated a relatively balanced but structurally vulnerable configuration dominated by nuclear and thermal generation. As shown in Table 1, nuclear power ensured more than half of total electricity production at comparatively low generation costs, while thermal power plants accounted for nearly one-third of the mix and remained highly sensitive to fluctuations in global fossil fuel prices. Hydropower and renewable energy sources held considerably smaller shares, though their strategic importance had been steadily increasing in the years prior to the war.

Despite the progress achieved in diversifying the energy portfolio, the pre-war energy architecture exhibited several systemic weaknesses, including limited grid flexibility, high dependence on aging thermal assets, and insufficient integration of distributed renewable generation. The onset of hostilities in 2022 further aggravated these structural challenges. Targeted attacks on critical infrastructure led to substantial damage to thermal power plants, substations, and transmission lines, significantly constraining the country's generation and distribution capabilities.

The relatively high cost of renewable electricity compared with nuclear and hydropower also reflects pre-war technological and infrastructural constraints, such as limited domestic production of renewable equipment, challenges in grid balancing, and insufficient storage capacity. These limitations became even more pronounced during wartime, as the resilience and decentralization potential of renewables gained strategic relevance for sustaining electricity supply in affected regions.

Overall, understanding the pre-war energy structure is crucial for assessing Ukraine's current needs and formulating effective recovery strategies. The war has demonstrated the urgent necessity of strengthening energy security through diversification, decentralization, and the deployment of innovative energy-saving technologies. Enhancing the share of resilient, low-cost, and decentralized energy systems – including small modular nuclear units, distributed renewables, and smart-grid solutions – represents a key pathway for rebuilding an energy system capable of functioning reliably under the conditions of prolonged military threat and post-war reconstruction.

5. Energy infrastructure in Ukraine in 2024

As of October 1, 2024, it is difficult to estimate the exact scale of the destruction of Ukraine's electrical infrastructure, as such data is not disclosed for strategic security reasons. Additionally, facilities occupied after 2022 can only undergo a comprehensive assessment once they are returned to Ukrainian control. In addition, Russian shelling continues therefore the scene of destruction is growing daily. Based on data reported in the media and reports the

following conclusions can be reached. The Zaporizhzhia Nuclear Power Plant (ZNPP) remains occupied by Russian forces. A revised assessment can only be made after the de-occupation of the Zaporizhzhia (ZNPP). Pivdennoukrainska NPP was shelled. Khmelnytska NPP and Rivnenska NPP were also affected due to attacks on transmission system infrastructure.

In 2023 the Russian forces destroyed the Kakhovka Hydroelectric Power Plants (HPP). The destruction of the Kakhovka dam also caused increased nuclear safety risks due to the ZNPP's disrupted cooling supply from the Kakhovka reservoir. According to official reports, strikes were carried out on Dniprovsk HPP, Dnistrovsk HPP, and Kanivsk HPP. As many as 73% of large Thermal Power Plants (TPP) are destroyed in Ukraine. According to official reports, strikes were carried out on the Burshtynska TPP, Dobrotvirska TPP, Ladyzhynska TPP, Zmiivska TPP, Trypilska TPP. According to the Energy Charter Secretariat, 13% of solar generation capacity is in temporarily occupied territories, and 8% have been damaged or destroyed.

About 80% of wind generation remains uncontrolled, with some facilities damaged by shelling. At least four biogas plants have been destroyed. Russian missile strikes targeted and destroyed power generation and transmission facilities in the Poltava, Kirovohrad, Lviv, and Ivano-Frankivsk regions. In September 2024, following another Russian attack, 490 settlements across Ukraine were left partially or completely without electricity, with the Dnipropetrovsk region suffering the most damage. A drone strike on a substation triggered a large-scale fire, leading to widespread power outages for both infrastructure and households. Additionally, shelling caused a ground fire that damaged an overhead line, resulting in voltage drops. As a result, Ukrainians are bracing for a harsh winter with frequent power outages and energy conservation measures in place.

The power networks were damaged, resulting in complete blackouts in almost all Ukrainian regions. The scale of the damage in millions of dollars is presented in Table 2.

Table 2.

Damages to the electric power industry in Ukraine (up to May 2024)

Sector	Damage, \$ million
Power distribution	801
Power transmission	2100
Power generation	8462
Nuclear Power Plants	843
Thermal Power Plants	3588
Combined heat and power plants	1433
Hydroelectric power plants	2378
Renewables	282

Source: Kyiv School of Economics.

Currently, 182 cogeneration plants have been installed, of which 83 are already working; the rest will be installed by the end of the year. Energy projects are being implemented in the country, currently, according to the National Bank of Ukraine, an application for 7.9 billion UAH has been approved. NB7 countries provide additional support. The European Commission

allocates 3 million euros for the work of IAEA missions in Ukraine (Russian War Against Ukraine: Energy Dimension, 21.10.2024).

6. Results and Discussion

Despite the many challenges posed by modern warfare, there are several strategies that governments and organizations can implement to preserve infrastructure during conflicts.

Hardened and Resilient Infrastructure: One way to protect infrastructure from attacks is to design and build facilities that are more resistant to damage. In Ukraine, concrete blocks have been used to protect network infrastructure equipment. In preparation for the winter of 2023/2024, Ukrainians reinforced their existing facilities with concrete blocks or even sandbags. This approach would help safeguard equipment from basic threats like shrapnel, which can still cause significant damage to infrastructure. Installing redundant systems: that can take over if primary systems are disabled.

Decentralized energy systems, modernizing power grids to create more decentralized systems – such as microgrids – can enhance resilience in times of conflict. Smart grids, which use digital technology to monitor and manage electricity distribution, can also improve the grid's ability to adapt to disruptions and reroute power around damaged areas. **Rapid Repair and Restoration Teams:** In conflict zones, it is crucial to have specialized teams trained to quickly repair damaged infrastructure. These teams should have the necessary equipment and expertise to restore power services as quickly as possible after an attack. Prepositioning repair equipment and materials near critical infrastructure can significantly reduce the downtime of essential services.

Development of renewable resources according Saulius Rimutis “is important not only in thinking about the future of Ukraine but also in the current situation, and this must be supported by the Ukrainian government. RES resources can help the aforesaid decentralization of the grid, but at the same time, as noted by the United States NREL laboratory, solar power plants can significantly contribute to the longer operation of diesel generators. Managing energy security during wartime requires a comprehensive approach that integrates innovations, alternative energy sources, and flexible resource management methods. The Ukrainian experience demonstrates that success lies in aligning energy policies with international strategies and adapting to changes in the global energy system. By focusing on renewable energy, strategic planning, and corporate responsibility, Ukraine can strengthen its energy security even in the most challenging conditions of war.

7. Conclusions

Since October 2022, Ukrainian citizens have been living under conditions of emergency blackouts. The Ukrainian Government is working on the restoration of the energy sector – on starting as much generation as possible before winter. Work continues the protection of those capacities that have been preserved and those that energy workers are currently restoring. Ukraine is steadily increasing its import of electricity from the European Union: now the maximum possible import is 2.2 GW, but so far, the most that the EU can import politically is 1.7 GW. Therefore, they are currently negotiating with the European Commission to open imports. Ukraine has made progress in decentralizing electricity generation (Lessons of War: Ukraine's Energy Infrastructure Damage, Resilience and Future Opportunities, Eastern Europe Studie Centre, 22.10.2024). Thanks to international partners, Ukraine initiated the creation of a special fund to support the energy industry of Ukraine, where more than 500 million euros have already been collected (Only 27% of large TPPs are operating in Ukraine, 22.10.2024).

The war in Ukraine underscores the significant vulnerability of electricity transmission networks. The destruction of one or more key substations can lead to major disruptions in power supply, largely due to the centralized nature of the network, which relies on a few main substations and has limited backup options. Countries, especially those with electricity infrastructure exposed to artillery threats, such as the Baltic states, should consider expanding their networks not only to meet production and consumption demands but also to enhance resilience. This would ensure that even if a critical component is damaged, the stability of the power system can be maintained.

Moreover, the analysis conducted in this article highlights that the war-induced destruction of Ukraine's energy infrastructure is not only the result of traditional military actions but also a consequence of increasingly precise and technologically advanced methods of warfare. The presented synthesis demonstrates that the interconnectedness of modern infrastructure systems amplifies the scale of disruptions, creating cascading failures across essential public services. By integrating recent evidence from Ukraine and international cases of targeted strikes, the study offers an original perspective on the mechanisms of infrastructure vulnerability under wartime conditions. These insights underscore the urgent need for developing advanced protective technologies and resilience strategies that can ensure continuity of critical services even under high-intensity military threats.

Future research on this topic should be expanded to include Cyber Warfare. As digital and cyber systems become more integral to the operation of critical infrastructure, cyberattacks have become a powerful tool in modern warfare. Power grids, for instance, can be disrupted or disabled through these attacks. A notable example occurred in 2015 when a complex cyberattacks on Ukraine's power grid temporarily cut off electricity to 230,000 people. These types of attacks can immobilize key services without inflicting physical damage, posing a significant challenge for nations with highly digitized infrastructures.

References

1. Adenso-Díaz, B., Lozano, S., Palacio, A. (2017). Effects of dynamic pricing of perishable products on revenue and waste. *Applied Mathematical Modelling*, vol. 45. Elsevier, p. 148-164.
2. *Assessment of damages and losses to Ukraine's energy sector due to Russia's full-scale invasion*. Available online: https://kse.ua/wp-content/uploads/2024/06/KSE_Impact-of-the-war-on-energy_ENG-1.pdf, 26.06.2025.
3. Bernow, S., Kartha, S., Lazarus, M. (2001), Cleaner generation, free-riders, and environmental integrity: clean development mechanism and the power sector. *Climate Policy*, Vol. 1, Iss. 2, pp. 229-249, ISSN 1469-3062, [https://doi.org/10.1016/S1469-3062\(01\)00006-7](https://doi.org/10.1016/S1469-3062(01)00006-7)
4. *Brief Ukrainian energy sector evaluation and damage assessment*. https://euneighbourseast.eu/wp-content/uploads/2022/10/2022_10_24_ua_sectoral_evaluation_and_damage_assessment_version_iii.pdf, 10.10.2024.
5. DiXi Group Alert (2024). *Russian War Against Ukraine: Energy Dimension*. <https://dixigroup.org/en/analytic/russian-war-against-ukraine-energy-dimension-dixi-group-alert-weekly-review-73/>, 21.10.2025.
6. European Commission (2024). *Energy, Climate change, Environment*. https://commission.europa.eu/energy-climate-change-environment_en, 10.09.2025.
7. Eurostat (2024). *Official Site of the European Statistics Service*. <https://ec.europa.eu/Eurostat>, 10.10.2025.
8. Gvozdiy, V. *Why Ukraine should develop distributed generation?* <https://golaw.ua/insights/energy-alert/chomu-ukrayini-varto-rozvivati-rozpodilenu-generacziyu/>, 02.10.2025.
9. Hafner, M., Raimondi, P.P., Bonometti, B. (2023). *Geopolitics of Oil and Gas in the MENA Region*. In: *The Energy Sector and Energy Geopolitics in the MENA Region at a Crossroad. Perspectives on Development in the Middle East and North Africa (MENA) Region*. Cham: Springer. https://doi.org/10.1007/978-3-031-30705-8_5
10. IEA (International Energy Agency) (2021). *Electricity Information 2021*. Paris: OECD Publishing, pp. 50-78. ISBN: 978-92-64-44994-2. <https://www.iea.org/reports/electricity-information-2021>, 11.09.2025.
11. Kunertova, D. (2023). Drones have boots: Learning from Russia's war in Ukraine. *Contemporary Security Policy*, 44(4), 576-591. <https://doi.org/10.1080/13523260.2023.2262792>
12. *Lessons of War: Ukraine's Energy Infrastructure Damage, Resilience and Future Opportunities*, Eastern Europe Studie Centre. <https://www.eesc.lt/en/publication/lessons-of-war-ukraines-energy-infrastructure-damage-resilience-and-future-opportunities/>,

- 22.10.2025.
13. Liu, J., Wang, K., Zou, J., Kong, Y. (2019). The implications of coal consumption in the power sector for China's CO₂ peaking target. *Applied Energy*, 253, 113518, <https://doi.org/10.1016/j.apenergy.2019.113518>
 14. Luigi, D. (2024). Incidentalities of the civilian harm in international humanitarian law and its *Contra Legem* antonyms in recent discourses on the laws of war. *Journal of Conflict and Security Law*, Vol. 29, Iss. 1, pp. 21-54, <https://doi.org/10.1093/jcsl/krae004>
 15. Ministry of Energy of Ukraine (2021). *Annual Report on the Operation of the Ukrainian Energy*. System Ministry of Energy of Ukraine, Kyiv, pp. 60-85. <https://mpe.kmu.gov.ua>, 18.09.2025.
 16. *Only 27% of large TPPs are operating in Ukraine*. <https://suspilne.media/763681-v-ukraini-pracuut-lise-27-velikih-tes-smigal/>, 22.10.2025.
 17. Polish Ministry of Climate and Environment (2020). *National Action Plan for Renewable Energy Sources*. <https://www.gov.pl/web/klimat/krajowy-plan-na-rzecz-energii-i-klimatu-na-lata-2021-2030---wersja-2019-r>, 10.10.2024.
 18. Porter, M.E., Kramer, M.R. (2006). Strategy and society: the link between competitive advantage and corporate social responsibility. *Strategic Direction*, Vol. 23, No. 5. <https://doi.org/10.1108/sd.2007.05623ead.006>
 19. *Protecting the Environment during Armed Conflict*. <https://casebook.icrc.org/case-study/environment-and-international-humanitarian-law>, 16.10.2025.
 20. *State Emergency Service*. <https://saee.gov.ua/en>, 18.09.2024.
 21. United Nations. *Transforming our world: the 2030 Agenda for Sustainable Development*. <https://sdgs.un.org/2030agenda>, 10.09.2025.
 22. World Bank Group (2023). <https://www.worldbank.org>, 10.09.2024.
 23. Yakymchuk, A. (2024). The Carbon Dioxide Emissions: World Footprint: Diagnosis of Perspectives. *Scientific Papers of Silesian University of Technology. Organization and Management Series*, 195, 665-683. <http://dx.doi.org/10.29119/1641-3466.2024.195.41>

ASSESSING LARGE LANGUAGE MODELS IN IT SYSTEMS AUDITING

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Purpose: This study examines the potential of large language models (LLMs) in the field of information systems auditing (ISA). Exploration of LLMs' internal knowledge is one of the most interesting research directions and concerns the range of information, knowledge such agents store without any access to external sources. The foundation of IS audit and control has evolved through the recognition of the need for strong information technology (IT) management by professional organizations, e.g., ISACA, business and government institutions. Other major areas for IS auditors are the issues of security and privacy of IT. The demand by the public and governments have generated concern for the protection of individual rights and business information, as well as the need to supervise the whole organization to ensure effective and efficient management.

Design/methodology/approach: The research applied both quantitative and qualitative evaluation methods using 146 official CISA certification questions to assess the auditing knowledge of seven large language models. The analysis measured model accuracy, inter-agent agreement, and A-bias tendencies, while qualitative examination identified reasoning errors and interpretation patterns in incorrectly answered questions.

Findings: The study found that large language models achieved an average accuracy of 81,8% on CISA certification questions, with Claude Sonnet 4 and Chat GPT-4.1 performing best at 88.4%. Some models showed certain reasoning limitations, such as bias toward specific answer options.

Research limitations/implications: The main limitation of this study is that the evaluation was based solely on multiple-choice CISA certification questions, which may not fully capture the complexity of real-world auditing scenarios.

Practical implications: The study indicates that large language models can enhance the efficiency of audit preparation and training by automating knowledge-intensive tasks.

Originality/value: The paper highlights the growing role of generative artificial intelligence in professional certification and auditing practice.

Keywords: Large Language Models, Information Systems Auditing, Generative AI, Audit Automation, AI Reliability.

Category of the paper: Research paper.

1. Introduction

The growing popularity of generative artificial intelligence, particularly large language models (LLMs), is having a significant effect on the interaction between information systems, users and specialists. According to studies, it has been found that the latest language models can perform scientific literature selection at a human-level, but are still prone to making mistakes (Khraisha et al., 2024). Exploration of LLMs' internal knowledge is one of the most interesting research directions and concerns the range of information, knowledge such agents store without any access to external sources. This type of study reveals the depth of an agent's knowledge and the possible extent of its hallucinations (Huang et al., 2025). Within this area are standards like BELIEF(ICL), which assess model memory (Zhao, Yoshinaga, Oba, 2024), and tools that not only measure model memory, but also tests of factual consistency like TeCFaP. TeCFaP (Temporally Consistent Factuality Probing) adds a temporal dimension to correctness evaluations and expose significant gaps in LLM recall (Bajpai, Goyal, Anwer, Chakraborty, 2024). In addition, the literature includes domain specific knowledge studies such as medical testing evaluations (Huang, Hsiao, Yeh, Wu, Kao, 2024), (Herrmann-Werner et al., 2024). The research presented in this article focuses on assessing agents' knowledge in the field of information systems auditing.

Information systems auditing (ISA) involves a systematic evaluation of the security, integrity and effectiveness of an organisation's IT solutions. Frameworks such as COBIT 2019 and the updated ISO/IEC 27001 2022 standard define catalogues of processes and controls ranging from governance to technical aspects. The benefits of implementing COBIT 2019 have been benchmarked and analysed for their impact in relation to risk management, resource optimisation and operational efficiency (Deagama Antariksa, Perangin Angin, Widodo, 2025). Literature reviews of ISO/IEC 27001 identify five main research themes: relationships with related standards, organisational motivations, implementation challenges, outcomes achieved and contextual factors (Culot, Nassimbeni, Podrecca, Sartor, 2021). There is still a lack of systematic studies examining whether LLMs can accurately handle tasks related to IT auditing, like business continuity control tests and compliance assessments against ISO/IEC 27001. As artificial intelligence permeates audit processes, interest is growing in whether LLMs might support auditors in competencies validated by the Certified Information Systems Auditor (CISA) examination. CISA, administered by ISACA, is the global standard confirming proficiency in five key domains:

- The information systems audit process,
- IT governance and management,
- information systems acquisition, development and implementation,
- information systems operations and business resilience,
- information asset protection.

In this study, CISA certification questions formed the basis of the research methodology applied to selected LLMs, allowing for a rigorous evaluation of their knowledge. The aim of this article is to provide an empirical assessment of the level of understanding demonstrated by these LLMs in the field of IT systems audit. The results are intended to offer practical guidance for auditors, regulators and LLM developers, and to contribute to the development of methods for assessing the reliability of generative AI in specialised technological risk management processes. In the following sections, authors will introduce the theoretical framework for evaluating LLMs, describe the research methodology adopted, present the results obtained across seven LLMs, and discuss their implications.

2. Background and Related Work

Research into the knowledge of generative AI agents focuses on multifaceted benchmarks that assess LLMs' ability to store and reproduce factual information. Zhao et al. (2024) proposed the BELIEF benchmark. BELIEF (Benchmark to Evaluate Language model Internal factual knowledgE and Faithfulness) uses diverse prompting schemes to measure the accuracy, consistency and reliability of fact recall by language models (Zhao, Yoshinaga, Oba, 2024). Their findings indicated that, although LLMs retain large quantities of information, they may struggle to retrieve it compared with human performance. At the same time, larger models may store more information but often exhibit lower response reliability than humans. The authors also showed that including examples of questions and answers within the prompt can yield up to twice as many correct responses as simply posing the question.

Lin et al. (2022) used the TruthfulQA benchmark to evaluate how readily models mimic human false beliefs. They found (across 817 questions) that the models achieved only 58% correct answers compared with 94% for human participants (Lin, Hilton, Evans, 2022). Their results suggest that increasing an LLM's parameter count leads to only small improvements in truthfulness. This means that smaller, less resource-heavy models might perform almost equally well. Bajpai et al. (2024) proposed the time oriented TC Probe methodology (Temporally Consistent Factuality Probe). This methodology uses a range of time-based questions to identify information, knowledge gaps in large language models (LLMs). In line with previous findings, they noted that embedding example answers in the prompt improves the quality of the model's outputs.

In addition to examining the general knowledge of large language models, researchers have also focused on their understanding of specific domains. Huang et al. (2024) tested GPT-4 based on medical licensing exam questions (in Taiwan). During this analysis GPT-4 achieved a general accuracy of 87.8%. Their study indicated that LLMs have potential for theoretical questions but researchers recognised LLMs' problems with more detailed questions.

This analysis demonstrated strong potential in multiple-choice settings, where LLMs must select one or more preset answers.

Herrmann-Werner et al. (2024) applied Bloom's Taxonomy (a classification of cognitive skills) to examine how well GPT-4 can respond to medical questions. The authors classified each question based on its cognitive level and recognised patterns indicating that most mistakes occurred at the lowest cognitive level questions. While GPT-4 delivered very high overall scores, the authors observed that it still tended to omit critical details in complex subject matter.

In the field of IT auditing, research remains sporadic. Fotoh and Mugwira (2025) conducted preliminary analyses of ChatGPT's role in external audits. Researchers highlighted benefits in automating routine tasks alongside risks from hallucinations and incorrect outputs. They showed that LLMs may falter in providing sufficient depth of audit-standard interpretation, may rely on outdated information, and may hallucinate, all of which can undermine audit assessments. They further emphasised challenges related to preserving auditor objectivity and professionalism, ensuring client confidentiality and data security, and maintaining clear lines of accountability.

Based on the conducted literature analysis, the authors decided to examine various language models, including models of different sizes. To determine the usefulness of LLMs in the selected area, the agents were evaluated in terms of their information, knowledge of information systems auditing. The study combined both quantitative and qualitative approaches, focusing in particular on identifying the most frequent types of agent hallucinations.

3. ISACA Credentials and AI usage

In business organizations, the role of information technology control and audit has become a critical mechanism for ensuring the integrity of information systems and the reporting of organizational finances for managerial decisions. Traditionally, auditing contributes knowledge on internal control practices and the overall control philosophy. Henri Fayol identified five functions of management, i.e., planning, organizing, leading, coordinating, and control. These functions constitute a framework for managers for their decision making on the material resources, processes, employees, and their performance. The control focuses on setting the business goals, monitoring the goals' achievement, and taking corrective actions in situations of discrepancies among goals and activities for their achievements (Senft, Gallegos, 2009).

The information system auditing is an integral part of the audit functions because it supports the auditor's judgement on the quality of the information processes supported by computer systems. The information system auditor's role has evolved to provide assurance that adequate and appropriate controls are in organizations. An information system auditor as a counselor must take an active role in developing policies on auditability, control, testing, and standards.

Auditors must convince end-users and IT personnel about the need for a controlled IT environment. IS auditors are partners of top management. Decisions concerning the need for a system traditionally belong to top management, however, when allocating funds for new technology, management has to rely on the computer personnel judgement verified by the IS auditor. Top management needs the support of a skilled computer staff that understands the organization's requirements, and IS auditors are in such a position to provide that information. The IS auditors can verify suitability of all alternatives for a given IT project. All the risks are to be accurately assessed, the technical hardware and software solutions are to be assured as correct. Beyond that, the IS auditors can work as an investigator, because the knowledge, awareness and use of computer-assisted tools and techniques in performing forensic support work have provided new opportunities for the IS auditors and IT security managers. Nowadays, the auditing data analytics and LLMs support auditing processes, by providing process data for decision making as well as by simplification of the knowledge management process.

In the information-based business environment, business professionals, who are technically competent in IT or IT specialists, who understand the accounting, management, and financial operation are highly demanded for IS auditing careers. IS auditors must continuously receive education to upgrade their knowledge, skills, and abilities. IS auditors' competences are required in the following fields: legal issues and their impact on IT, computer-assisted audit tools and techniques, ethical issues and professional standards, IT governance, management of processes and architectures, risk management, quality management, financial management, IT project management, software development and implementation, IT sourcing, application control and maintenance, change management, service management, security and service management, e-business and enterprise resource planning (ERP) systems. This set of technologies is not finished and lately the business organization digital transformation forces IT auditors to learn the new technologies, e.g., data science, LLMs, or blockchain solutions. The rapid development of artificial intelligence creates the requirement to provide explainable solutions to business, to manage artificial intelligence (AI) supported business models as well as AI risk.

Information Systems Audit and Control Association (ISACA) (www.isaca.org) is a community of information systems and information technology (IS/IT) professionals, involved in creating information systems in safe, secure, and accessible ecosystems. ISACA continuously recognizes the technology challenges and provides lifetime learning and career development opportunities. ISACA is a leader in career development credentials. The credentialing is a particular way to validate professional knowledge and information communication technology (ICT) skills. ISACA offers the following certificates:

- The Certified Information Systems Auditor (CISA), recognized as a standard of achievement for people who audit, control, monitor, and assess business information technology and business information systems.

- The Advanced in AI Audit (AAIA), which permits IT professionals to recognize the complexities of AI, assess risks, identify opportunities, and ensure compliance with standards. This certification confirms competencies in conducting AI-focused audits, AI integration, and enhancing AI-driven audit processes.
- The Certified Information Security Manager (CISM), which confirms competencies in information security governance, incident management and risk management. This certificate is particularly suitable for senior managers in IT security and control.
- The Advanced in AI Security Management (AAISM), which acknowledges the experience and knowledge of CISM holders concerning AI specific security issues.
- The Certified in the Governance of Enterprise IT (CGEIT), which is to confirm the professional mindset to assess, design, implement, and manage enterprise IT governance systems aligned with general business strategy.
- The Certified in Risk and Information Systems Control (CRISC), which confirms expertise in identification and management of business – IT risk, and implementation and maintaining the information system control. This certificate is suitable for managers focused on IT and cyber risk and control.
- The Certified Data Privacy Solutions Engineer (CDPSE), which is required for successful implementation of privacy by design and by default into IT systems, networks and applications. The privacy control managers are working with software engineers, system and networks engineers, application and databases administrators, and with the project managers.
- The Certified Cybersecurity Operations Analyst (CCOA), which is provided for development of technical skills to evaluate threats, identify vulnerabilities, and prevent cyber incidents.
- The Cybersecurity Practitioner Certification (CSX-P) certification for confirming one's ability to perform globally validated cybersecurity skills covering security functions, i.e., Identify, Protect, Detect, Respond, and Recover derived from the NIST Cybersecurity Framework.

The CISA certification is one of the most sought-after and highest-paying IT certifications. This certification is strongly required by the professionals in the banking sector. The CISA certification addresses innovations like AI and blockchain, and as such is an evidence of human competencies to apply a risk-based approach to audit engagements. The CISA certificate is to confirm competencies to cope with challenges in the following domains: information systems auditing process, governance and management of information technology, governance and management of information technology, information systems acquisition, development, and recommendation, information systems operations and business resilience, and protection of information assets. To the certification, ISACA provides all necessary materials, with the additional guidance and expert instruction. ISACA distributes the online courses,

on-demand instruction and in-depth exam preparation, as well as exam questions, answers, and explanations. ISACA provides a comprehensive reference guide that helps candidates prepare for the CISA exam and permits them to understand their roles and responsibilities as information systems auditors.

The exam course materials are elaborated by subject matter experts and volunteers to align with actual practices and technologies. ISACA distributes course materials in printed and electronic versions. Beyond that, the candidates have opportunities to participate in various training online and in place. Learning based on ISACA course materials is absolutely necessary to pass the exams and receive certificates. Actually, ISACA does not provide AI-supported teaching nor examinations. Exams are conducted online or in place. However, according to ISACA requirements, the CISA certification requires not only passing the CISA exam, but next applying for certification within the five year period of time, five years of IS audit, control, assurance or security work experience, experience in at least one of the five CISA job practice domain areas, and verification of work experience.

Responding to the future needs concerning AI technology usage and learning, an increasing number of professional institutions have recently implemented a model of certifications. The ICT companies as well as professional associations are interested in open-ended and real-life teaching. The market of vocational education institutions is developing, although one of the primary objectives of higher education is to produce specialized human resources with the necessary and actual competencies for the challenges in a complex business environment. Nowadays, the educational processes are supported by AI solutions. The particular place belongs to GenAI, which primarily comprises technologies, such as deep learning, natural language processing (NLP), generative adversarial networks (GANs), and transformer architectures (Al-Thani, Ahmad, 2025).

Mostly, at higher educational institutions (HEIs), GenAI supports administrative work, however, GenAI is increasingly popular in supporting examining processes. For instance, ChatGPT-3.5 and ChatGPT-4o are utilised in the Japanese National Dental Examination, to assess the clinical reasoning skills and dental knowledge to determine their practical usefulness in dental education (Uehara et al., 2025). GenAI is expected to revolutionize medical education. Salman et al. (2025) admit that AI-generated answers exam questions were reviewed by pharmacology experts. These authors admitted that ChatGPT, Copilot, and Gemini demonstrate high accuracy scores for questions on intermediate levels. Yoon et al. (2024) argue that ChatGPT has been tested in health care, including the US Medical Licensing Examination and specialty exams, showing near-passing results. However, these authors emphasize the need for cautious application and further refinement, particularly in non-English medical contexts. Although the AI results are promising, their careful evaluation by human beings is required to ensure acceptable performance. Similar conclusions were formulated by Liu et al. (2024), who revealed that over 2 years, researchers have used various medical licensing examinations to test whether ChatGPT possesses proper medical knowledge. Unfortunately, they concluded

that due to the ChatGPT insufficient accuracy and inconsistent performance, the ChatGPT-4 is not yet suitable for use in medical education. Similar arguments have been provided by Hong et al. (2024), who said that while ChatGPT did not yet meet the passing criteria for the Intermediate Professional Technical Qualification Examination in Ultrasound Medicine, it has potential as a supplementary tool in medical education. Wang et al. (2023) add that although ChatGPT cannot pass the examination, it can be improved quickly through deep learning.

GenAI is expected to be used in various ways in education, e.g., to assess students (Chen et al., 2020; Baidoo-Anu, Ansah, 2023), to provide feedback to students and learners (Chen et al., 2020), for personalized intelligent teaching (Wang et al., 2021), for learning analytics, language correction, for assistance of students with special educational needs (Kalnina et al., 2024). Generally, the GenAI convergence education methods are systematically researched and they will be implemented in the future. Farber (2024) indicated that GenAI complements traditional teaching and examination methods, even providing a personalized and practical learning experience. Fotoh and Mugwira (2025) highlight that ChatGPT can generate coherent and contextually relevant prompts on a wide scope of topics, but it possesses limitations, weaknesses, and risks in terms of security, bias, hallucinations, and accuracy. The weaknesses of the GenAI cover outdated information and insufficient depths in interpretations of the auditing standards (Munoko et al., 2020).

4. Research Methodology

The methodological framework of this study is based on the fact-probing approach introduced by Zhao et al. (2024) and on experiments evaluating LLMs in specialised tests (Huang et al., 2025).

The first step involved obtaining the CISA certification questions in PDF format. One hundred and forty-six test questions (from the eleventh test edition, all in English) were verified for completeness. Their content was then extracted into a JSON structure that captured each question, its possible answers and the correct option. This enabled automated validation of the LLMs' outputs. Custom Python scripts were developed to query seven selected LLMs via the API. These were:

- Chat GPT 4.1 and GPT 3.5 Turbo – developed by OpenAI. GPT 4.1 was released in April 2025 and has been compared with GPT 3.5, which was introduced in 2022.
- Claude Sonnet 4 – created by Anthropic and released in May 2025. It falls into the medium-sized model category, with approximately 50-100 billion parameters (unverified data).

- DeepSeek V3 – developed by the Chinese company DeepSeek AI and first presented in December 2024. It has 671 billion parameters.
- Llama 3 (70B-Instruct) – created by Meta Platforms Inc. (Meta AI). It has 70 billion parameters.
- Gemma 3 (27b-it) – created by Google in March 2025. This model comprise 27 billion parameters.
- Phi 4 – developed by Microsoft in December 2024. It has 14 billion parameters.

For each model, a uniform prompt template containing the question and answer was used. API parameters (temperature, max_tokens and top_p) were chosen based on vendors' recommendations and generation stability literature (Bajpai, Goyal, Anwer, Chakraborty, 2024). To eliminate randomness, each experiment was run five times for each model and the most frequently given answer was taken as the final response.

From the perspective of inter-system communication, access through application programming interfaces (APIs) to appropriate versions of LLM models is a significant characteristic. It is particularly important for the use of LLMs in the cloud computing model. In the initial version of the article, the authors intended to analyse eight models, including two versions of the Gemma model: Gemma 3 (27b-it) and Gemma 2 (27b-it). The results obtained for both versions of the model were identical. Information received from the provider indicated that, rather than disabling access to the deprecated Gemma 2 (27b-it) model, its API was redirecting queries to the Gemma 3 (27b-it) model.

5. Analysis and Results

To examine the selected models, the following quantitative analyses were conducted:

- LLM Accuracy – this analysis evaluates LLMs' accuracy in answering the test questions. The benchmark consisted of 146 single-choice questions, and the average accuracy across the analysed dataset was 81.8%.
- Inter-Agent Agreement Heatmap – this analysis assesses the similarity of responses across different agents.
- A-Bias vs. Accuracy – this analysis examines the relationship between A-Bias and overall accuracy.
- A-Bias in Errors – this analysis measures A-Bias considering only the cases where the LLMs answered incorrectly.

Based on the analysis, the most accurate LLMs were Claude Sonnet 4 and GPT-4.1, both achieving 88.4% correct answers. The lowest performance was observed for GPT-3.5, with 70.3% correct answers. The full results are presented in Figure 1.

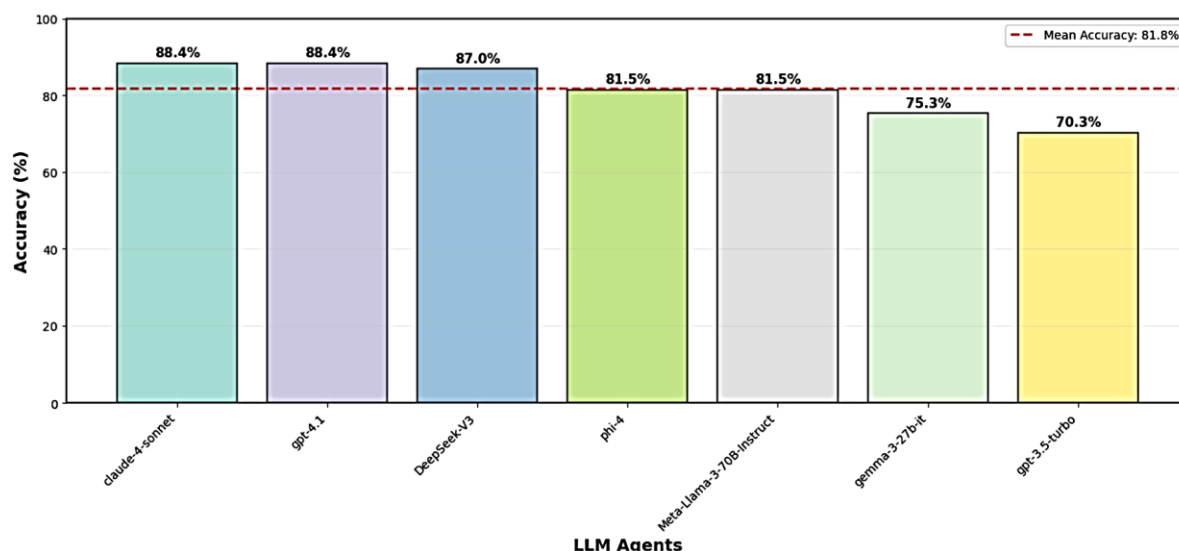


Figure 1. LLM Agents Accuracy Comparison.

Source: own elaboration.

The second analysis was conducted to evaluate the similarity of answers generated by the analysed agents. Figure 2 presents a heatmap illustrating the degree of similarity. The highest similarity scores were observed between Claude Sonnet 4 and DeepSeek V3 (88%), and between Llama 3 70B-Instruct and Claude Sonnet 4 (87%). In contrast, GPT-4.1 and GPT-3.5 showed only 70% similarity.

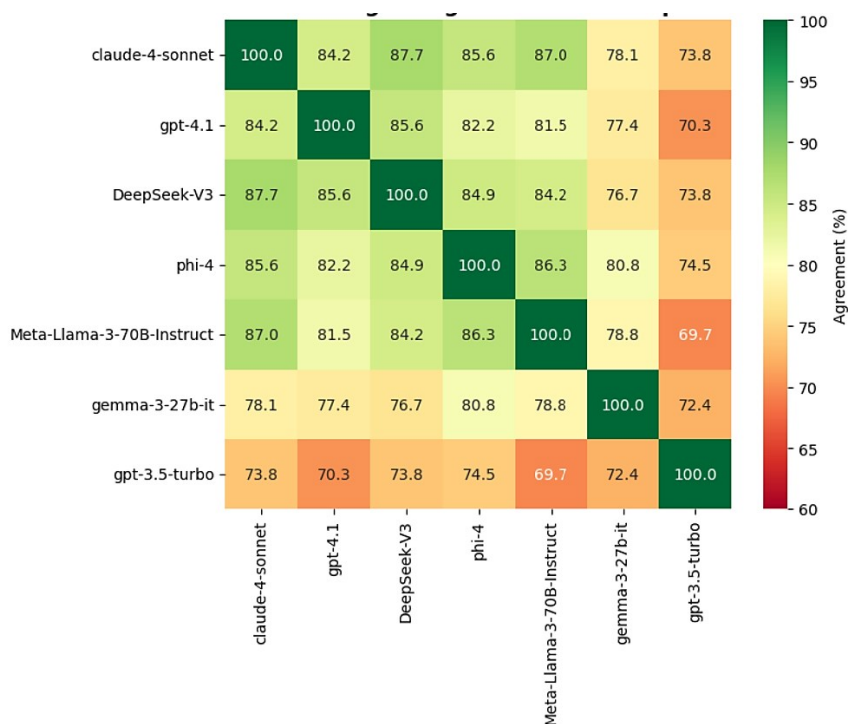


Figure 2. Inter-Agent Agreement Heatmap.

Source: own elaboration.

The next analysis focused on the A-Bias effect. LLMs tend to select option A more frequently when answering multiple-choice questions, especially in cases where they are uncertain about the correct answer. Figure 3 presents a comparison between A-Bias (measured as the deviation from the expected baseline frequency of option A) and model accuracy. For reference, the distribution of correct answers in the analysed dataset was: A – 25.3%, B – 24.0%, C – 29.5%, and D – 21.2%, which serves as the baseline for bias estimation. As shown in Figure 3, Claude Sonnet 4 achieved the highest accuracy with low bias, while Phi-4 demonstrated the strongest A-Bias combined with moderate accuracy.

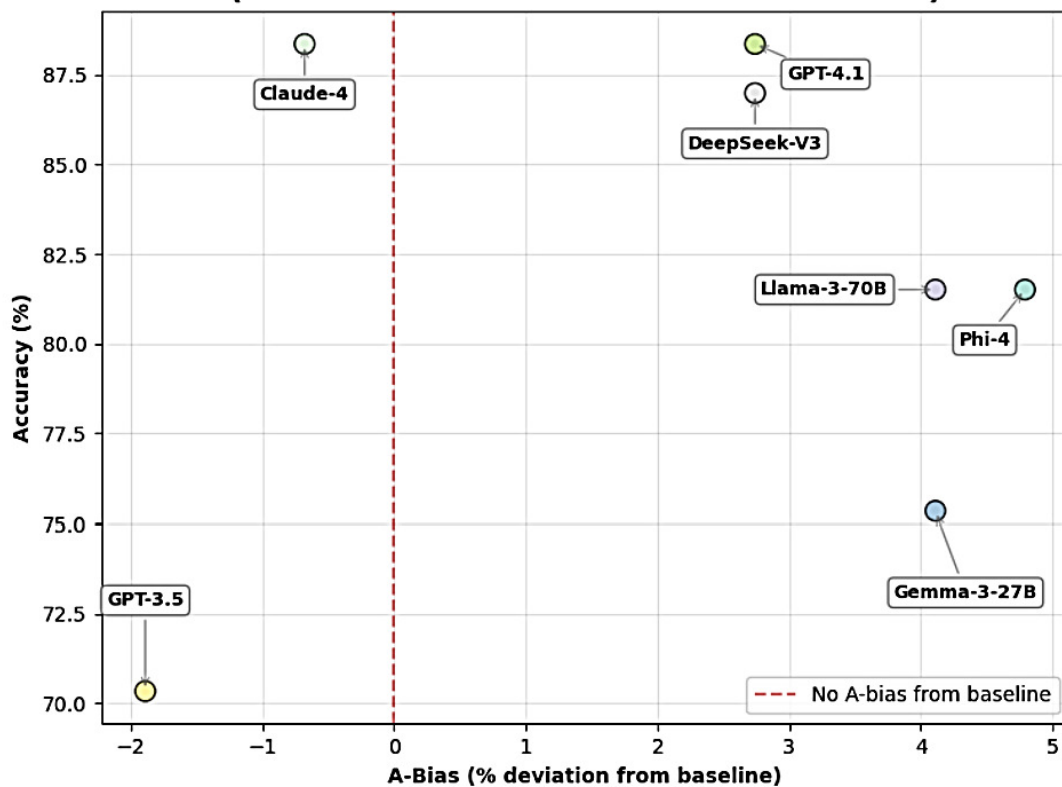


Figure 3. A-Bias vs. Accuracy.

Source: own elaboration.

To better understand the A-Bias problem in the selected LLMs, an additional analysis was performed where A-Bias was calculated only for the incorrect answers (Figure 4).

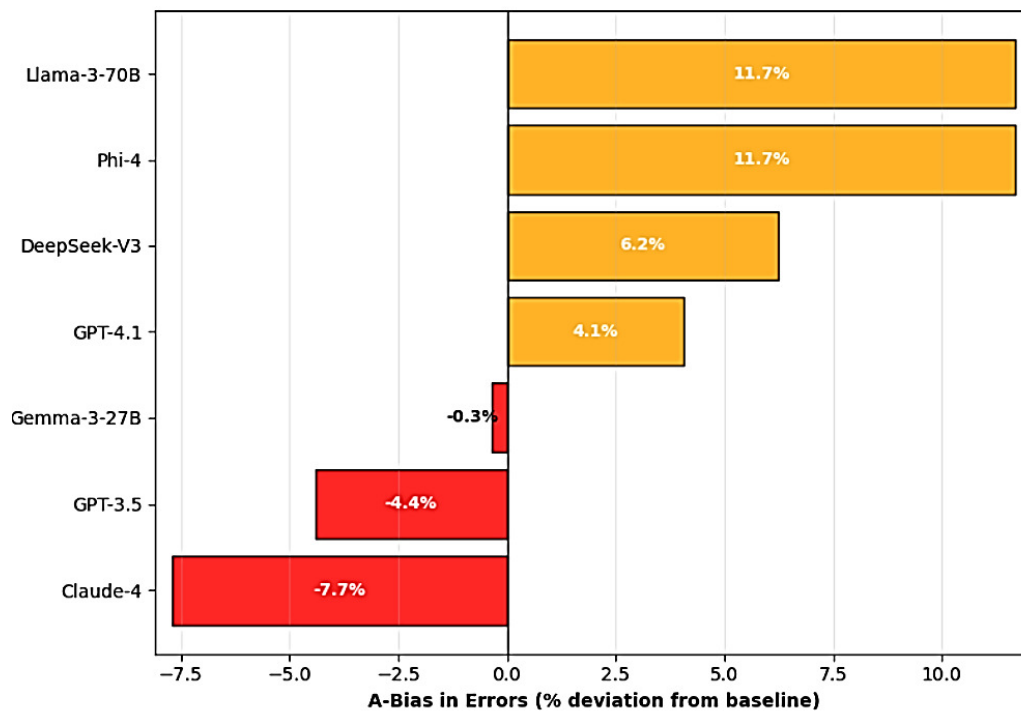


Figure 4. A-Bias in Errors.

Source: own elaboration.

This analysis explains how often agents tend to choose option A when they do not know the correct answer. In this case, Llama 3 70B-Instruct and Phi 4 showed the highest bias values (11.7%). Claude Sonnet 4 and GPT-3.5 exhibit negative A-Bias in errors, indicating that in their incorrect responses, they selected option A less frequently than expected from the baseline distribution.

6. Discussion

Summarising the analyses, 3 out of 7 LLMs achieved accuracy above the overall average. The best-performing models were Claude Sonnet 4 and GPT-4.1. Nevertheless, their answers were similar in 84% of the cases. GPT-4.1 clearly outperformed its predecessor GPT-3.5 (88.4% vs. 70.3%). The analysis further demonstrated that some questions were not answered correctly by any of the LLMs. In total, four such questions were identified:

- Question 38 – “Which of the following forms of evidence would an IS auditor consider the MOST reliable?”
- Question 75 – “Which of the following would an IS auditor use to determine if unauthorised modifications were made to production programs?”
- Question 92 – “Which of the following will MOST successfully identify overlapping key controls in business application systems?”

- Question 126 – “During an IS audit, which is the BEST method for an IS auditor to evaluate the implementation of segregation of duties within an IT department?”

In question 38, all agents answered D – “A confirmation letter received from an outside source,” whereas the correct answer was B – “The results of a test performed by an external IS auditor”. GPT-4.1 was asked for an explanation, and the authors received the following response:

B. The results of a test performed by an external IS auditor: This is reliable, but not as strong as direct confirmation from an independent third party. D. A confirmation letter received from an outside source: This is the most reliable because it is independent, objective, and comes from a third party. External, independent evidence is always considered the most reliable in auditing.

This outcome indicates that the LLM assigns greater reliability to a confirmation letter than to the results of procedures performed by an external auditor.

In question 75, all agents answered A – “System log analysis”, whereas the correct answer was B – “Compliance testing”. GPT-4.1 was asked again for an explanation, and the authors received the following response:

System log analysis involves reviewing logs that record changes to production programs, such as version control logs, change management logs, or audit trails. These logs can show who made changes, when, and what was changed, helping the auditor identify unauthorized modifications. Compliance testing checks if controls and procedures are being followed, but does not directly identify unauthorized changes.

The incorrect answer may have resulted from the models’ tendency to focus on technical solutions rather than on audit procedures.

In question 92, all agents answered A – “Reviewing system functionalities that are attached to complex business processes”, whereas the correct answer was C – “Replacing manual monitoring with an automated auditing solution”. GPT-4.1 was subsequently asked again for an explanation, and the authors received the following response:

Reviewing system functionalities that are attached to complex business processes. This approach allows you to map out where controls exist within the business application and identify if multiple controls are addressing the same risk (i.e., overlapping controls). By understanding the functionalities and their relationship to business processes, you can see where controls may duplicate or overlap. C. Replacing manual monitoring with an automated auditing solution This is a method of monitoring, not of identifying overlapping controls. The most successful way to identify overlapping key controls is to review system functionalities attached to complex business processes (Option A), as this provides a holistic view of where controls are implemented and if there is redundancy.

The incorrect answers were likely caused by excessive keyword matching and overreliance on semantic similarity between the question and the answer.

In question 126, two agents answered D – “Evaluate the organizational structure” (GPT-3.5 and Claude Sonnet 4) and five answered B – „Review the job descriptions of the IT functions” whereas the correct answer was A – “Discuss it with the IT managers”. GPT-4.1 was re-prompted for an explanation, and the authors received the following response:

Reviewing job descriptions allows the auditor to see the specific roles, responsibilities, and access levels assigned to each position. This directly reveals whether critical duties are appropriately segregated to prevent conflicts of interest, fraud, or error. Discussing with IT managers (A) may provide insights, but it is subjective and may not reflect actual practices or documented responsibilities.

The incorrect answer likely resulted from the model’s excessive reliance on textual information sources and its lack of deeper understanding of the audit context.

The application of LLMs in examination processes is mostly noticed at medical science schools. Medical science teaching and learning require systematic studying, therefore maybe other disciplines, i.e., chemistry, food production, or biology will be soon supported by AI in the examination process. Auditing is developed in management and computer science studies, but in these disciplines application of AI in examination is not popular. The ISACA association is observed as a rather traditionally thinking people society. During the ISACA conferences and summits in Europe, in other continents’ countries, as well as in the ISACA Headquarters in Chicago, USA, auditors discuss the impact of AI on the auditing processes as well as on other business processes. They promote rational actions and regulative procedures to manage risks and challenges connected with an implementation of AI and LLMs in and for business companies. The ISACA experts work on management of models and reports generated by the GenAI solutions. These issues are included in the certificated exam questions. However, on the other side, ISACA does not offer AI-supported courses. The teaching and examinations are conducted in a traditional way. Beyond the courses based on the ISACA original course materials, there are plenty of small business enterprises (SMEs), who offer materials, lecturing, and exam preparation. That business units are usually located in the cities, where ISACA chapter boards are placed. Hence, the provided course teaching is a source of additional support to the local chapter budget. Some materials needed to take the exam, i.e., CISA, CISM etc. are available for ISACA members on the Internet for free. Availability of course questions and answers is always an opportunity for the Internet bots to collect data and use in the LLMs. From one side, it is very good for knowledge popularization and making it easier to pass the exams and receive the certificates, however, from the other side the knowledge is not hidden as the internal knowledge of the ISACA chapters. Therefore, there is a risk that this inter-society developed knowledge will soon be freely revealed. The interpretation of the certificate exam answers also belongs to the ISACA experts, but also here, there is a risk that this information will soon be available on the Internet. The ISACA exam passing is not a trivial issue, therefore the learners are constantly looking for available materials to prepare for exams. In their own interest, the ISACA can soon implement their own GenAI bots supporting the auditing and security knowledge and information about the learners capabilities and competencies.

7. Conclusions

The obtained results confirmed the high level of knowledge demonstrated by the examined large language models (LLMs) in the field of information systems auditing. The performance of smaller models, such as Phi 4, did not differ significantly from that of the larger ones. In the case of GPT, a clear improvement in answer quality was observed between versions 4.1 and 3.5. Most LLMs exhibited the A-bias effect reported in the literature. A detailed analysis of the responses revealed four questions that require further investigation. The next stage of the presented research may involve building a society of agents, in which the system's response would be generated based on the cooperation of several models simultaneously.

This research revealed some issues important from the point of view of AI usage for teaching auditors. There is the opportunity to compare publicly available agents' answering results as well as to develop a system for various agents' deliberation and concluding. On the other side, there is still an open question as to how to provide ISACA courses and how to distribute learning materials. For sure that association needs to monitor the risk of unprotected distribution of course materials. Successfully, ICT development encourages ISACA to constantly renew the courses' materials, so questions and answers (Qs&As) are changeable. Therefore, there is the question of revealing or not revealing the questions and answers. There are business organizations, which enable learners access to the exam answers, because they believe that the final exam is the rational verification of the acquired competences. The exam for driving licence is the best example in this case. However, there are also organizations, which argue that new sets of questions and answers are to be better and better protected, because the association wants to control the examination process.

References

1. Al-Thani, N.J., Ahmad, Z. (2025). Learning through “research cognitive theory”: A new framework for developing 21st-century research skills in secondary school students. *Heliyon*, 11(2), e41950. <https://doi.org/10.1016/j.heliyon.2025.e41950>
2. Baidoo-Anu, D., Ansah, L.O. (2023). Education in the era of generative artificial intelligence (AI): understanding the potential benefits of ChatGPT in promoting teaching and learning. *Journal of AI*, 7, 52-62, doi: 10.61969/jai.1337500
3. Bajpai, A., Goyal, A., Anwer, A., Chakraborty, T. (2024). *Temporally consistent factuality probing for large language models*. Proceedings of the 2024 Conference on Empirical Methods in Natural Language Processing (EMNLP 2024), 15864-15881. <https://doi.org/10.18653/v1/2024.emnlp-main.887>

4. Chen, L., Chen, P., Lin, Z. (2020). Artificial intelligence in education: a review. *IEEE Access*, 8, 75264-75278, doi: 10.1109/ACCESS.2020.2988510
5. Culot, G., Nassimbeni, G., Podrecca, M., Sartor, M. (2021). The ISO/IEC 27001 information security management standard: Literature review and theory-based research agenda. *The TQM Journal*, 33(7), 76-105. <https://doi.org/10.1108/TQM-09-2020-0202>
6. Deagama Antariksa, M., Perangin Angin, M., Widodo, A.P. (2025). COBIT 2019 framework in IT governance: A systematic literature review of implementation challenges and benefits across various industry sectors. *Journal of Renewable Energy, Electrical, and Computer Engineering*, 5(1), 99-105. <https://doi.org/10.29103/jreece.v5i1.19501>
7. Farber, S. (2024). Harmonizing AI and human instruction in legal education: a case study from Israel on training future legal professionals. *International Journal of the Legal Profession*, 31(3), pp. 349-363, <https://doi.org/10.1080/09695958.2024.2430018>
8. Fotoh L.E., Mugwira, T. (2025). Exploring Large Language Models in external audits: Implications and ethical considerations. *International Journal of Accounting Information Systems*, Vol. 56, 100748, <https://doi.org/10.1016/j.accinf.2025.100748>
9. Herrmann-Werner, A., Festl-Wietek, T., Holderried, F., Herschbach, L., Griewatz, J., Masters, K., Zipfel, S., Mahling, M. (2024). Assessing ChatGPT's mastery of Bloom's taxonomy using psychosomatic medicine exam questions: Mixed-methods study. *Journal of Medical Internet Research*, 26(1), e52113. <https://doi.org/10.2196/52113>
10. Hong, D.-R., Huang, C.-Y. (2024). The performance of AI in medical examinations: an exploration of ChatGPT in ultrasound medical education. *Frontiers in Medicine*, 11, 1472006, doi: 10.3389/fmed.2024.1472006
11. Huang, C.-H., Hsiao, H.-J., Yeh, P.-C., Wu, K.-C., Kao, C.-H. (2024). Performance of ChatGPT on Stage 1 of the Taiwanese medical licensing exam. *Digital Health*, 10. <https://doi.org/10.1177/20552076241233144>
12. Huang, L., Yu, W., Ma, W., Zhong, W., Feng, Z., Wang, H., Chen, Q., Peng, W., Feng, X., Qin, B., Liu, T. (2025). A survey on hallucination in large language models: Principles, taxonomy, challenges, and open questions. *ACM Transactions on Information Systems*, 43(2), Article 42. <https://doi.org/10.1145/3703155>
13. Kalnina, D., Nimante, D., Baranova, S. (2024). Artificial intelligence for higher education: benefits and challenges for pre-service teachers. *Frontiers in Education*, 9, 1501819. doi: 10.3389/feduc.2024.1501819
14. Khraisha, Q., Put, S., Kappenberg, J., Warraitch, A., Hadfield, K. (2024). Can large language models replace humans in systematic reviews? Evaluating GPT-4's efficacy in screening and extracting data from peer-reviewed and grey literature in multiple languages. *Research Synthesis Methods*, 15(4), 616-626. <https://doi.org/10.1002/jrsm.1715>
15. Lin, S., Hilton, J., Evans, O. (2022). *TruthfulQA: Measuring How Models Mimic Human Falsehoods*. Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics (ACL 2022), 3211-3225. <https://doi.org/10.18653/v1/2022.acl-long.229>

16. Liu, M., Okuhara, T., Chang, X., Shirabe, R., Nishiie, Y., Okada, H., Kiuchi T. (2024): Performance of ChatGPT Across Different Versions in Medical Licensing Examinations Worldwide: Systematic Review and Meta-Analysis. *Journal of Medical Internet Research*, vol. 26, e60807, doi: 10.2196/60807
17. Munoko, I., Brown-Liburd, H.L., Vasarhelyi, M. (2020). The ethical implications of using artificial intelligence in auditing. *Journal of Business Ethics* 167(2), 209-234. <https://doi.org/10.1007/s10551-019-04407-1>
18. Salman, I.M., Ameer, O.Z., Khanfar, M.A., Hsieh, Y.-H. (2025). Artificial intelligence in healthcare education: evaluating the accuracy of ChatGPT, Copilot, and Google Gemini in cardiovascular pharmacology. *Frontiers in Medicine*, 12, 1495378, <https://doi.org/10.3389/fmed.2025.1495378>
19. Senft, S., Gallegos, F. (2009). *Information Technology Control and Audit*. Boca Raton: CRC Press, Taylor and Francis.
20. Uehara, O., Morikawa, T., Harada, F., Sugiyama, N., Matsuki, Y., Hiraki, D., Sakurai, H., Kado, T., Yoshida, K., Murata, Y., Matsuoka, H., Nagasawa, T., Furuichi, Y., Abiko, Y., Miura, H. (2025). Performance of ChatGPT-3.5 and ChatGPT-4o in the Japanese National Dental Examination. *Journal of Dental Education*, 89(4), pp. 459-466, doi: 10.1002/jdd.13766
21. Wang, S., Wang, H., Jiang, Y., Li, P., Yang, W. (2021). Understanding students' participation of intelligent teaching: an empirical study considering artificial intelligence usefulness, interactive reward, satisfaction, university support and enjoyment. *Interactive Learning Environments*, 31, pp. 5633-5649.
22. Wang, Y.-M., Shen, H.-W., Chen, T.-J. (2023). Performance of ChatGPT on the pharmacist licensing examination in Taiwan. *Journal of the Chinese Medical Association*, 86(7), pp. 653-658.
23. Yoon, S.-H., Oh, S.K., Lim, B.G., Lee, H.-J. (2024). Performance of ChatGPT in the In-Training Examination for Anesthesiology and Pain Medicine Residents in South Korea: Observational Study. *Jmir Medical Education*, 10, e56859, doi: 10.2196/56859
24. Zhao, X., Yoshinaga, N., Oba, D. (2024). *What matters in memorizing and recalling facts? Multifaceted benchmarks for knowledge probing in language models*. Findings of the Association for Computational Linguistics: EMNLP 2024, 13186-13214. <https://doi.org/10.18653/v1/2024.findings-emnlp.771>