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CONTENTS

Foreword	7
1. Anna BLUSZCZ, Anna MANOWSKA, Martin BOROŠ, Katarzyna TOBÓR-OSADNIK – Security management of geoinformatic systems – case study	9
2. Monika BOLEK, Anna PLUSKOTA, Michał SOLIWODA – The indebtedness of companies listed on the WSE in light of the health market crisis	27
3. Adam BOSOWSKI, Adam GUMIŃSKI – Human resource management – personality traits and psychological profiles and the choice of a career path	49
4. Robert GOLEJ, Anna CIERNIAK-EMERYCH – Shaping safe and hygienic working conditions from the perspective of implementing the assumptions of the lean manufacturing concept	63
5. Anna GÓRSKA, Anna MAZURCZAK – Affordability of rental apartments in Poland in comparison to selected European Union countries	85
6. Lena GRZESIAK – From theory to practice: Polish pay and labour law professionals' views on the pay transparency and the EU directive	105
7. Jacek JAKIEŁA, Joanna ŚWIĘTONIOWSKA, Joanna WÓJCIK – Level up sustainability – game-based learning in modern higher education	121
8. Kinga JARZĄBEK – Macroeconomic shocks and the effectiveness of central banks' interest rate policies	141
9. Sylwia JASEK, Maria BERNAT – Impact of foreign direct investment on innovation in the construction materials industry	159
10. Patrycja KABIESZ – The impact of safety training frequency on the level of safety ...	181
11. Ryszard KATA, Małgorzata WOSIEK, Agnieszka BRELIK – Non-agricultural business activity as a source of income of farmers' households in Poland	201
12. Joanna KIZIELEWICZ, Katarzyna SKRZESZEWSKA, Magdalena WINIARSKA – Trends in environmental management in cruise seaports	215
13. Maria KOCOT, Małgorzata GOLIŃSKA-PIESZYŃSKA, Artur KWASEK – Determinants of organizational agility in the area of personnel management	235
14. Maria KOCOT, Andrzej OLAK – Employee engagement in decision-making processes in an agile organization	251
15. Maria KOCOT, Joanna ROGOZIŃSKA-MITRUT, Artur KWASEK – Factors supporting the development of an agile organization	269
16. Sławomir KOCZUBIEJ, Marzena NOWAKOWSKA, Paweł STĄPÓR, Paweł ŚWIETLIK, Damian WALCZYK – Automatic deployment of a repository of digital didactic documents at universities	287

17. Anna KONSTANCIAK, Łukasz NOGAŁA – The analysis of no-cost solutions for toxic waste reduction at the commercial chemistry plant	301
18. Kamila KOWALIK – Customer service process and the financial condition of the enterprise – case study of a courier company	319
19. Slawomir KOWALSKI – Analysis of social media user segments as part of content marketing in sport	333
20. Artur KRAUS, Ryszard HALL – Innovative food products based on edible insects ...	347
21. Krzysztof KUBICKI – Efficiency and quality of the aluminium alloy welding process depending on the method used	363
22. Sylwia ŁĘGOWIK-ŚWIĄCIK, Jadwiga KOSTRZEWSKA – Understanding customer needs in shaping socially responsible enterprises in inter-organizational networks	375
23. Judyta MATUSZEK, Katarzyna MARKOWSKA, Beniamin STECUŁA, Daud KHAN, Patrycja KABIESZ, Agata MARKOWSKA, Mohamad GHEIBI – Changes in the functioning of passenger rail transport in Poland due to the Covid-19 pandemic	391
24. Dorota MIŁEK, Paulina NOWAK – Inequalities in the social development of European countries	417
25. Daria MOSKWA-BĘCZKOWSKA – Green transition in Poland – opportunities and threats	439
26. Agnieszka MROZIŃSKA – The structure and effectiveness of applying for EU funds in Polish voivodship cities – comparison of the financial perspectives 2007-2013 and 2014-2020	451
27. Rafał NIEDBAŁ, Marzena PYTEL-KOPCZYŃSKA – Analysis of the employee sentiment as the tool to build positive working environment	465
28. Marzena PAPIERNIK-WOJDERA, Anna MISZTAL – Long-term solvency and sustainable development of logistics sector – evidence from Poland	477
29. Dariusz PAUCH, Anna BERA, Jamila JAGANJAC – Insurance crime as a dysfunction of the insurance market – in the light of the results of an expert interview	491
30. Bogdan PLISZKA – Human capital as a manager's challenge. Generation Z on the labor market	505
31. Hadiya RAHMAN, Liliana HAWRYSZ, Małgorzata FIAŁKOWSKA-FILIPEK – Implementing circular economy in healthcare – challenges and strategic solutions	523
32. Rafał RUMIN, Jerzy DUDA, Jędrzej BLAUT, Dawid PEKAŁA, Thomas MEROLLA – Utilizing artificial intelligence for energy-efficient route planning in hyperloop low-pressure capsule transit: a study in alignment with sustainable development goals	541
33. Bruno SCHIVINSKI, Giulio MANCUSO, Magdalena BRZOZOWSKA-WOŚ – Exploring the role of brand experience in driving consumer emotions and engagement with sports brands in Australia	553

34. Ewa STAWIARSKA, Zuzanna KLASA, Julia WONS – Methods of managing multigenerational human resources in the era of the fourth industrial revolution – research results	575
35. Marta SZCZEPAŃCZYK, Michał DZIADKIEWICZ – Social inequalities and discrimination against women in access to high-level positions	597
36. Grzegorz SZOJDA – The development of the e-culture market: perspectives from polish consumers	609
37. Magdalena TOMALA – Environmental marketing of the provincial cities in Poland ..	625
38. Agnieszka WIKARCZYK, Adam ZAJĄC – A loan financing of micro-enterprises (retail sector) during economic fluctuations	643
39. Danuta WITCZAK-ROSZKOWSKA – Differentiation in the development of the cultural and creative sector in European countries	663
40. Magdalena ZUBIEL, Hanna WALIGÓRSKA, Magdalena SZYSZKO, Agnieszka SPRINGER – The impact of sentiment and tropes in media communication on the formation of economic perception	681
41. Paulina ŻMIJOWSKA – Areas of use of artificial intelligence in enterprise strategy. selected issues	695

FOREWORD

Presented number of Silesian University of Technology. Scientific Papers. Organization and Management Series. Contemporary management. Presented papers contain result of researches conducted by various universities. The number consists of 41 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: security management, crisis management, human resource management, lean manufacturing, sustainable development, economics, production management, safety management, environmental management, service management, the impact of COVID-19 pandemic on management, human capital, healthcare management, marketing and the usage of artificial intelligence in management.

Radosław Wolniak

SECURITY MANAGEMENT OF GEOINFORMATIC SYSTEMS – CASE STUDY

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Purpose: The aim of this article is to identify methods for securing data developed in geoinformation systems and published on websites where data is stored in the cloud.

Design/methodology/approach: The study used GIS tools to identify the level of selected natural hazards. The PHA method was then used to determine the magnitude of the emergency risk. The functionality of GitHub for secure cloud storage was then analysed.

Findings: The result of the analysis presents a selected IT tool for geodata cybersecurity.

Practical implications: The article presents the most important functionalities of the QGIS software, such as the process of generating web maps. It has been shown that IT tools are currently an integral part of critical infrastructure management processes. The most important issue of publishing confidential information is ensuring an appropriate level of security of IT systems. These aspects were also presented extensively in the work in the form of strongly developing tools based on biometric authentication.

Originality/value: The article is a valuable material both for theoreticians in the field of security engineering and computer science, as well as for practitioners who come into contact with the issues of geoinformatics tools and cybersecurity in their daily work. The article is addressed to people dealing with the area of knowledge related to crisis management, IT and cybersecurity.

Keywords: critical infrastructure, cybersecurity, crisis management, IT tools.

Category of the paper: research paper.

1. Introduction

The instability of national security due to the dynamic geopolitical situation poses a number of challenges for crisis management in European countries (Bluszcz et al., 2023). Stable economic development of European countries is possible if, among other things, it is ensured:

- national security (Van Damme, 2022), which is based on securing critical infrastructure, including networks communication, energy networks (Xiao et al., 2019) or transport systems and many others,
- cybersecurity to protect critical infrastructure against cyber-attacks, which is crucial as such attacks can disrupt services and threaten national security (Mead, 2022),
- economic stability (Levytska, 2023), which can only function when financial institutions and markets operate on a safe and reliable infrastructure for transactions, trade and banking services (Zwiech, 2024; Bluszcz, 2017),
- stability in the trade area, where infrastructure such as ports (Żywucka-Kozłowska, Broniecka, 2024), railways and highways support the flow of goods and services, facilitating domestic and international trade,
- the sustainability of public health and safety (Gourevitch et al., 2022), where health care systems such as hospitals, emergency and pharmaceutical services,
- and supply chains, as well as reliable water supply and waste management systems (Tzanakakis et al., 2020), depend on resilient infrastructure to provide health care and protect health public.

All these aspects of society are exposed to dynamic and unpredictable crisis situations. These include, for example, dynamic weather changes, snow storms, floods, tornadoes or pandemics, population migrations (Bluszcz et al., 2023) or cyberattacks (Manowska et al., 2024). All such unpredictable events create crisis situations, causing chaos in the functioning of many sectors of the economy and having drastic consequences for the population and the economy. Crisis situations often cannot be completely eliminated. The only way is preventive action, which can be prepared in many areas at the same time in order to minimize losses for society.

Geographical information systems (GIS) play a key role in emergency management, providing essential spatial data that improves decision-making and resource allocation in emergencies. GIS record and analyse geographic data, enabling authorities to understand the spatial dynamics of crises, such as natural disasters or public health threats (Greenough, Nelson, 2024).

Using GIS tools makes it easier to manage critical infrastructures, such as transport and utilities, by providing real-time data to aid response (Alhaj, Abdalla, 2022). Using GIS data, stakeholders can develop early warning systems and standardised protocols for better preparedness for adverse events (Boumahdi et al., 2020).

While GIS offers significant benefits in emergency management, challenges such as data integration and privacy issues remain. Addressing these issues is essential to maximise the effectiveness of GIS in future emergency scenarios.

The aim of this article is to identify methods for securing data developed in geo-information systems and published on websites where data is stored in the cloud. The process of achieving the objective was carried out in successive stages. First, the use of geoinformatics tools such as QGIS was presented to identify examples of critical infrastructure objects in Poland. In the next stage, the methodology of risk analysis for the selected type of threat for the surveyed objects was presented. In the next step, a method was presented whereby, with the help of a web map plugin, it is possible to generate files representing input data to a website containing compiled critical infrastructure data together with a risk assessment. In order to publish such maps, it is common to use, among other things, repositories in the Git Hub service, which allow multiple users to access such elaborated data in QGIS. In the Git Hub service, the data is stored in the cloud. Due to this fact, publishing confidential data in particular requires the use of selected database security measures.

Security is based on methods that combine encryption, access control and data integrity measures. Encryption techniques include:

- Hybrid cryptography: combining AES with code-based cryptography, such as the McEliece cryptosystem, increases security against quantum threats while providing efficient data encryption (Peng et al., 2023).
- Advanced encryption protocols: The use of hyperchaotic encryption and hash functions can greatly enhance the confidentiality and integrity of data, making it resistant to various attacks (Jain, Singhal, 2024).

Access control and authentication is achieved through:

- Precise access control: Techniques such as identity-based and attribute-based encryption enable secure data sharing, ensuring that only authorised users have access to sensitive information (Mishra, Verma, 2020).
- User authentication: The implementation of robust authentication protocols is crucial to verify legitimate users before granting access to data stored in the cloud (Zargar et al., 2021).

At the same time, data integrity and auditing are important:

- Integrity protocols: Digital signatures and hash functions facilitate data authentication, allowing users to verify the integrity of their data (Mahida, 2024).
- Auditing mechanisms: Third-party auditing allows data owners to periodically check the integrity of their data without having to download it altogether (Garg et al., 2020).

While these strategies greatly enhance the security of data in the cloud, challenges remain, especially when it comes to balancing usability and security. As cloud environments evolve, security measures will need to be continually adapted to counter emerging threats.

The article describes the importance of the critical infrastructure identification process for the risk classification process for individual systems in relation to various threats. Then, the IT tools used were indicated, as well as selected IT tools to protect confidential data.

2. Critical infrastructure review

Critical infrastructures (CI) are the real and cyber systems (facilities, equipment or installations) necessary for the minimum functioning of the economy and the state (Petersen, 2020).

There is a variety of critical infrastructure. The article presents selected critical infrastructure facilities in Poland, which include, among others:

- Energy Sector: Bełchatów Power Station: One of the largest thermal power plants in Europe, crucial for Poland's electricity supply, Polskie Sieci Elektroenergetyczne (PSE): The national electricity transmission system operator, Gdańsk Refinery: Operated by Grupa Lotos, a key refinery for petroleum products, LNG Terminal in Świnoujście: Vital for natural gas imports and energy security.
- Water Supply and Management: Włocławek Dam: Important for water management, hydroelectric power, and flood control on the Vistula River, Warsaw Waterworks: Ensuring the water supply for the capital city and its metropolitan area.
- Transportation: Frederic Chopin Airport (Warsaw): The largest and busiest airport in Poland, a key hub for international and domestic flights, Port of Gdańsk: One of the largest seaports in the Baltic Sea region, critical for trade and transportation, A4 Motorway: A major east-west highway connecting the German border to Ukraine, facilitating transportation and logistics.
- PKP Intercity: National railway operator providing long-distance passenger rail services.

Due to the fundamental importance of critical infrastructure for the stable economic functioning of European countries, all measures are necessary to protect identified critical infrastructure facilities (Chowdhury, Gkioulos, 2021).

Critical Infrastructure Protection (CIP) involves the measures and strategies necessary to safeguard essential systems, assets, and networks from threats and ensure their resilience and reliability (Yigit, 2024). Here's a detailed overview of CIP:

- Identification and Prioritization.
 - Asset Identification: Determine which assets are critical to national security, public health and safety, economic stability, and public confidence.
 - Risk Assessment: Evaluate the risks to these assets from natural disasters, cyber-attacks, terrorism, and other threats.
 - Prioritization: Rank critical assets based on their importance and the severity of potential impacts from their disruption.
- Risk Management.
 - Threat Analysis: Continuously monitor and analyze potential threats to infrastructure.
 - Vulnerability Assessment: Identify weaknesses that could be exploited by these threats.
 - Mitigation Strategies: Develop and implement strategies to reduce vulnerabilities and manage risks.
- Security Measures.
 - Physical Security: Install barriers, surveillance systems, access controls, and other physical security measures to protect critical infrastructure.
 - Cybersecurity: Deploy firewalls, intrusion detection systems, encryption, and other cybersecurity tools to protect against cyber threats.
 - Personnel Security: Conduct background checks, training, and other measures to ensure that employees do not pose a security risk.
- Resilience and Recovery.
 - Continuity Planning: Develop and maintain business continuity and disaster recovery plans to ensure that critical services can be maintained or quickly restored after a disruption.
 - Redundancy: Implement redundant systems and networks to provide backup in case of failure.
 - Response and Recovery: Establish protocols for rapid response and recovery efforts following an incident.
- Information Sharing.
 - Public-Private Partnerships: Foster collaboration between government agencies and private sector stakeholders to share information and resources.
 - Intelligence Sharing: Share threat intelligence and best practices among different sectors and organizations.
 - Public Awareness: Educate the public about the importance of critical infrastructure and ways to contribute to its protection.

- Policy and Regulation.
 - Legislation: Enact laws and regulations to mandate the protection of critical infrastructure and establish standards.
 - Compliance and Enforcement: Ensure compliance with regulations through inspections, audits, and penalties for non-compliance.
 - Funding and Incentives: Provide funding and incentives for infrastructure protection initiatives.

3. Results

3.1. Identification selected objects of critical infrastructure in Poland using QGIS

Identification of critical infrastructure facilities is possible using many different IT programs. The study used the available free version of the QGIS program, which is an excellent geoinformatics tool (Flenniken, 2022). The article presents layer views in which exemplary critical infrastructure facilities in Poland were identified. It should be noted that this is the first stage of preventive measures to protect critical infrastructure.

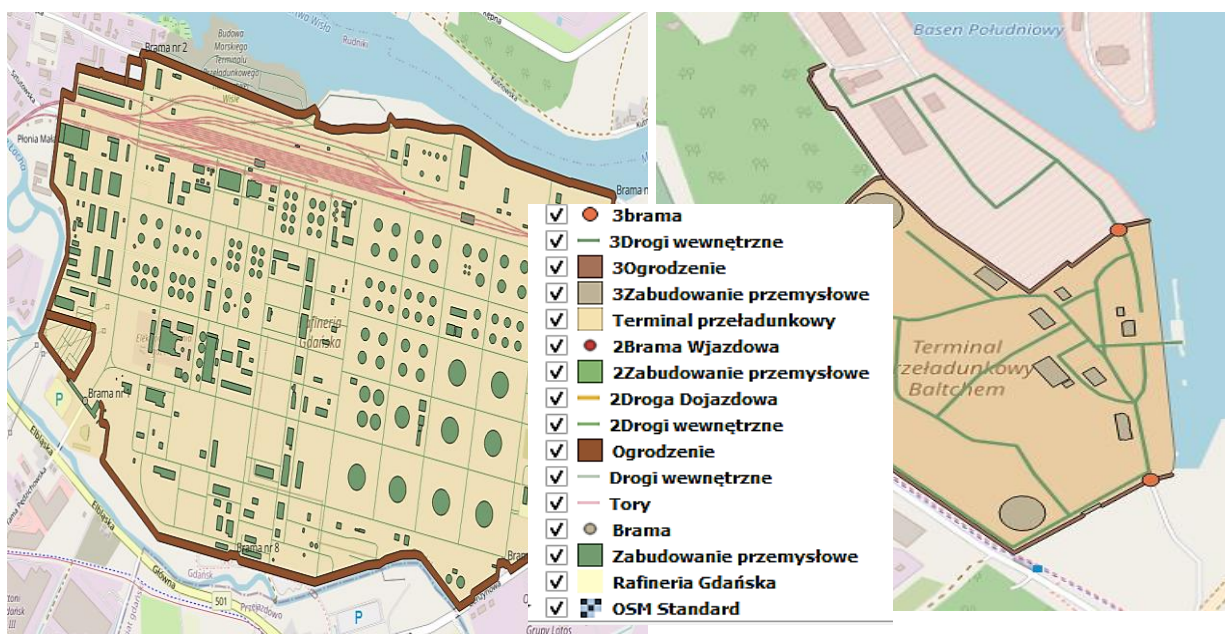


Figure 1. Energy critical infrastructure in Poland: Gdańsk Refinery and the Baltchem Transhipment terminal.

Source: own elaboration using QGIS program.

Refineries, such as the one in Gdańsk are crucial for processing crude oil into valuable products like gasoline and diesel. They contribute to energy security, economic stability, and job creation in strategic locations. The significance of a refinery lies in its impact on the

local and international supply chain, logistical efficiency, and its role in a country's critical energy infrastructure. Advanced technologies and environmentally friendly practices in refineries can also drive innovation and sustainability in the industry. For the latest information on the importance of the Gdańsk refinery, it is recommended to check recent and reliable sources. Second examples of energy critical infrastructures in Poland is the Baltchem Transshipment Terminal which holds significance for several reasons. Firstly, strategically located in a key port, it facilitates efficient transshipment of goods, enhancing regional and international trade. Secondly, the terminal's handling capacity contributes to the smooth flow of bulk commodities, including chemicals, fostering economic growth. Thirdly, its advanced infrastructure and equipment promote operational efficiency, reducing turnaround times for vessels. Additionally, the terminal's adherence to environmental standards and safety protocols ensures responsible handling of goods.

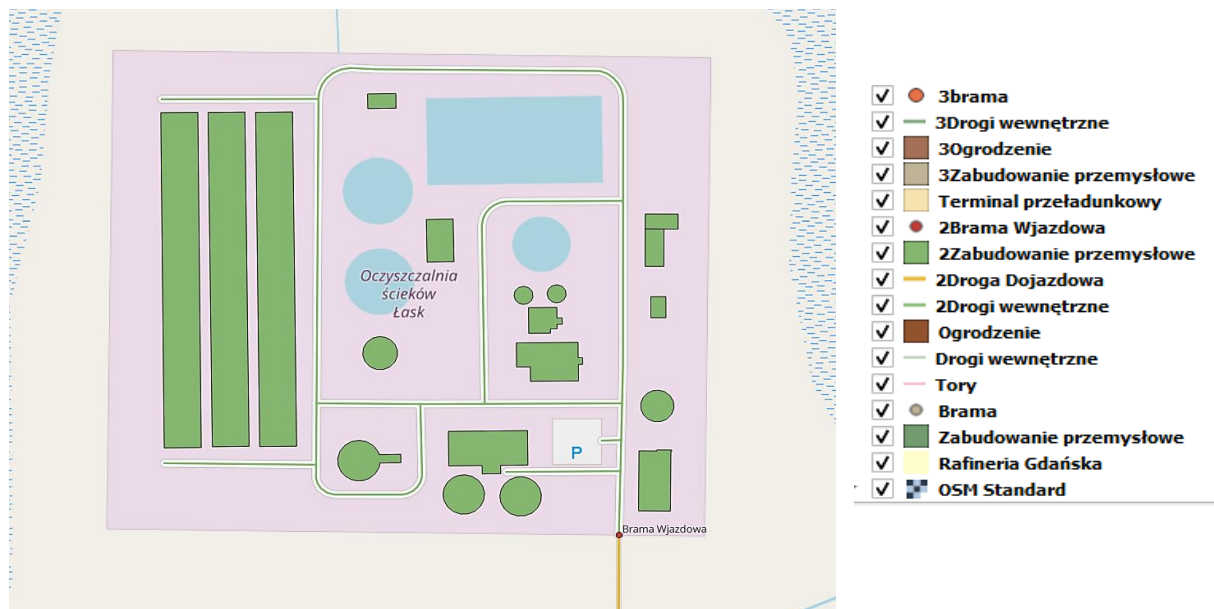


Figure 2. Public health protection systems as an example of critical infrastructure in Poland: Łask Sewage Treatment Plant.

Source: own elaboration using QGIS program.

The Łask Sewage Treatment Plant holds crucial importance for several reasons. Firstly, it plays a pivotal role in environmental conservation by treating wastewater, preventing pollution, and safeguarding local water bodies. Secondly, its operation ensures public health by treating sewage before its discharge, minimizing the risk of waterborne diseases. Thirdly, the plant's adherence to strict environmental standards contributes to sustainable water management practices in the region. Moreover, the Łask Sewage Treatment Plant supports urban development by providing essential infrastructure for growing communities. In summary, the plant's functions extend beyond wastewater treatment, encompassing environmental protection, public health, and sustainable urban planning.



Figure 3. Transports systems as an example of critical infrastructure in Poland: Warsaw Chopin Airport. Source: own elaboration using QGIS program.

Warsaw Chopin Airport holds significant importance for various reasons. Firstly, as Poland's largest and busiest airport, it serves as a crucial international gateway, connecting the country to a wide array of global destinations. Secondly, it plays a pivotal role in supporting the nation's economy by facilitating business travel, tourism, and trade. The airport's strategic location within Europe positions it as a key transportation hub, contributing to regional connectivity and economic growth. Thirdly, Warsaw Chopin Airport is a vital asset for the capital city, serving as a major transportation center for governmental, diplomatic, and cultural exchanges. Additionally, its modern facilities and services contribute to Poland's overall competitiveness in the global aviation industry. Lastly, the airport's role in cargo transportation enhances trade and commerce, facilitating the movement of goods and strengthening Poland's economic ties with the rest of the world.

3.2. Risk assessment

The next stage of the research was a risk assessment for selected threats to the examined critical infrastructure facilities categorized for the corresponding risk scale. Risk, according to the Polish standard ISO 31000:2012, means the influence of internal and external factors on the uncertainty of achieving the set goals (Olkiewicz, 2020). In relation to emergencies, risk can be defined as an identified undesirable event that may occur with a certain probability. To quantify risk (the probability of a specific effect occurring at a specific time or in a specific situation) in crisis management, the formula is used (Ładysz, 2015):

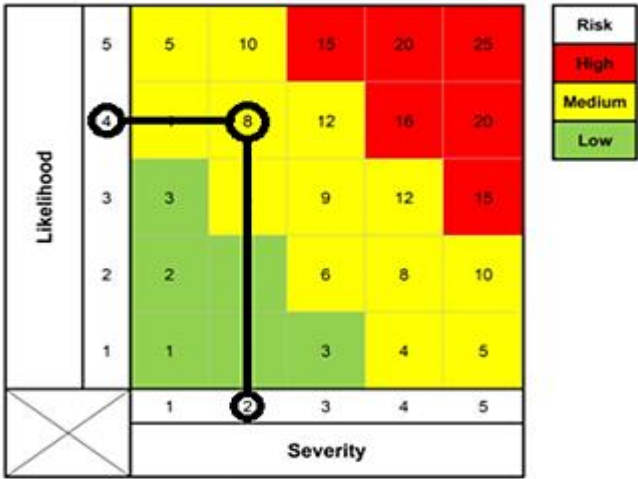
R = P x S (1)

where:

R – risk,

P – probability of occurrence of a crisis situation,

S – value of potential losses, estimated destruction after the occurrence of a crisis situation.



Severity: 2
 Likelihood: 4
 PHA: 2 x 4 = 8
 Risk: Medium

Figure 4. Risk assessment using PHA methodology for liquid fuel base Świnoujście.

Source: own elaboration using QGIS program.

As an example of risk analysis, the PHA method was used to calculate flood risk for a critical infrastructure facility. When building crisis management scenarios, dedicated actions are planned for a specific level of risk. IT tools for crisis management services provide wide opportunities to create specifications in the examined area and work on selected data layers. Attribute tables for data additionally constitute a database of information that can be displayed on maps and managed accordingly.

3.3. Cyber security tools

Critical infrastructure facilities may be exposed to various types of threats, which include:

- natural hazards (floods, strong winds, drought, intense snowfall, epidemics),
- technical hazards (breakdown of equipment and damage to structures),
- terrorism (direct attacks, cyber-terrorism).

Based on the completed risk assessment stage, taking into account selected threats to the assessed critical infrastructure facilities, it is possible to select adequate measures to protect these facilities.

Effective cyber security management requires the implementation of advanced technologies and strategies that minimize the risk of attacks and ensure continuity of systems. These include:

- **Advanced Threat Detection and Response Systems (SIEM):** A SIEM system integrates data from a variety of sources, enabling the detection of anomalies and potential threats in real time. An example of the application of SIEM in power grids can be found in research on power grid security monitoring and analysis (Zhang et al., 2018).
- **Applications of Artificial Intelligence (AI) and Machine Learning (ML):** AI and ML can be used to predict and prevent threats. An example of the use of AI and ML in analysing network traffic patterns and identifying threats can be found in the literature on critical infrastructure cyber security (Hodo et al., 2017).
- **Multi-Factor Authentication (MFA) mechanisms:** MFA adds additional layers of protection by requiring users to confirm their identities with more than one factor. An example of the use of MFA in healthcare infrastructure can be found in research on securing patient data (Gomathi et al., 2020).
- **Data Encryption:** Encryption provides protection for sensitive information stored and transmitted within critical infrastructure. An example of the use of encryption in water systems can be found in the literature on data security in SCADA systems (Fernandez et al., 2014).
- **Regular Penetration Tests and Security Audits:** Regular penetration tests and security audits help identify vulnerabilities in information systems. An example of the use of penetration testing in the financial sector can be found in the literature on security assessment of banking systems (Jouini et al., 2014).
- **Incident Management and Disaster Recovery Plans (DRPs):** The preparation of disaster recovery and business continuity plans is crucial for the rapid restoration of critical system functions after an incident. An example of the application of DRP in energy systems can be found in the research on incident management (Wang, 2016).

As an example of preventive activities that concern information published on various websites available via the Internet, the article focuses on selected aspects of cybersecurity of geoinformatic data.

In one well-documented case, there was a cyber-attack on navigation systems in the Black Sea in 2017. Ships equipped with GPS systems began to report navigation problems, resulting in their locations being incorrectly indicated. This incident attracted the attention of security experts, who suspected that this was the result of GPS signal interference (GPS spoofing).

Attack Methodology: Attackers used a technique known as ‘GPS spoofing’, which involves sending false GPS signals that interfere with the correct signals coming from satellites. As a result, the GPS receivers on the ships received false information about their position, leading to erroneous navigation. This type of attack can be carried out using relatively cheap hardware and software available on the market, making it a serious threat to the safety of maritime navigation.

Nowadays, geo-information data plays a key role in critical infrastructure management, spatial planning and emergency response. Their availability and accuracy are important, but the publication of this data on various online platforms is associated with a number of cyber threats. Selected aspects of cyber security that are key to protecting geoinformatics data are discussed below.

Figures 5 and 6 show examples of geoinformatics data publications on GitHub, presenting a web map data repository covering sample critical infrastructure data along with risk assessments of selected sites. Such repositories require the identification of a strict group of users and their access levels to the data. The use of tools in data protection, data encryption, data integrity protection, incident management and threat response therefore becomes essential.

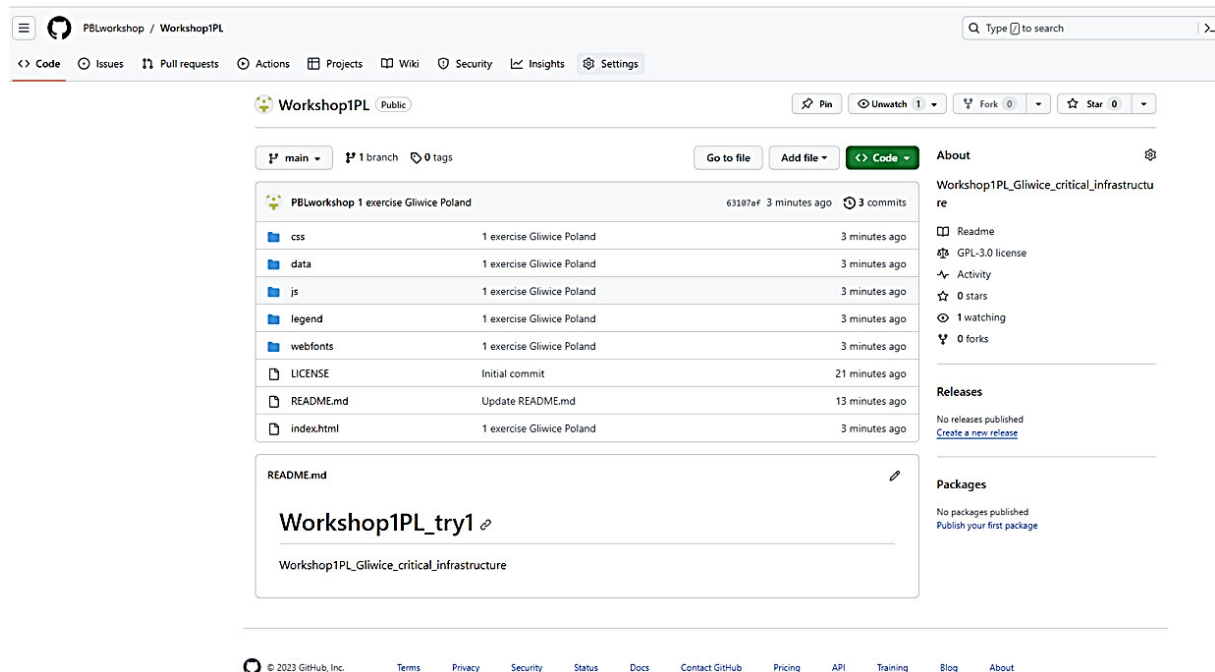


Figure 5. Creation of a new repository for data on identified critical infrastructure facilities along with risk assessment on GitHub.

Source: own elaboration using GitHub.

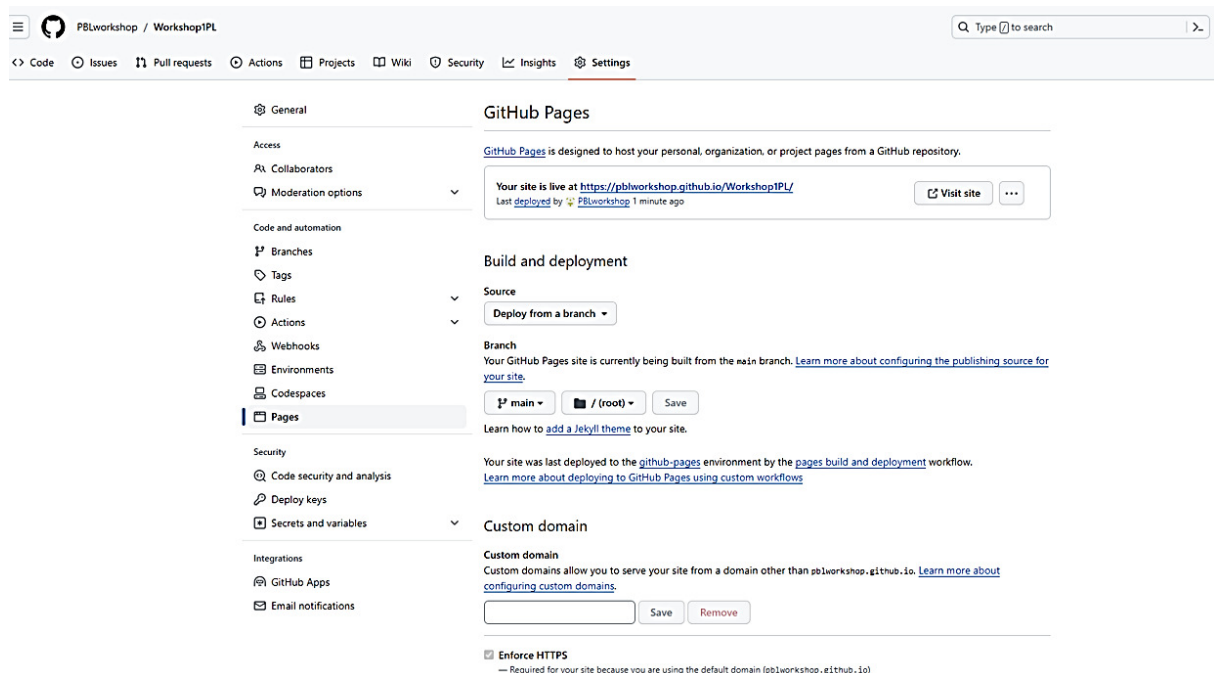


Figure 6. Creation of a new link for web map with identified critical infrastructure facilities along with risk assessment on GitHub.

Source: own elaboration using GitHub.

In order to secure data on the Git Hub service, it is essential to follow key security principles which include:

- **Data Access Protection:** Geoinformatics data are often used by a variety of institutions and users. To protect this data from unauthorized access, multi-factor authentication (MFA) mechanisms are used. MFA increases the level of security by requiring users to confirm their identity with more than one factor, such as a password and a one-time code sent to a mobile phone. This ensures that even if a third party gains access to the password, access to the data will still be protected.
- **Data Encryption:** Encryption is a fundamental part of geoinformatics data protection. This process involves converting data into a form that is unreadable by those without the appropriate decryption key. Encryption should be used both when data is being transmitted over networks and when it is stored on servers. The use of strong encryption algorithms, such as AES (Advanced Encryption Standard), ensures that even if data is intercepted by cyber criminals, it will remain unreadable and unusable.
- **Protecting Data Integrity:** The integrity of geo-information data is crucial to ensure its accuracy and reliability. Techniques such as digital signatures and hash functions can be used to ensure that data has not been modified since its creation. Digital signatures make it possible to verify the authenticity of data and identify its author, which is particularly important in the context of critical data.

- **Incident Management and Threat Response:** Effective management of cyber security incidents requires the development of attack response plans. These plans should include procedures for detecting, analysing and responding to incidents such as data breaches or DDoS (Distributed Denial of Service) attacks. The implementation of disaster recovery procedures and business continuity plans (DRPs and BCPs) ensures the rapid restoration of critical systems functions and minimises the impact of incidents on the organisation's operations.

Adherence to these principles significantly enhances the security of geo-information data on popular sites including GitHub.

4. Discussion

Data security risks in the cloud are multifaceted, arising from data vulnerabilities, unauthorised access and inadequate encryption practices. Understanding these risks is critical for organisations using cloud services.

Key cloud data security risks include:

- **Unauthorised access:** cloud environments are vulnerable to breaches where unauthorised users can access sensitive data. This risk is exacerbated by weak authentication mechanisms and poor access management practices (Basha et al., 2023).
- **Data leakage:** The potential for data leakage is significant, especially when users share files without proper encryption. This can lead to the exposure of critical information to unintended parties (Roobini et al., 2024).
- **Inadequate encryption:** while encryption is a primary defence, many cloud services do not implement robust encryption protocols. The Advanced Encryption Standard (AES) is recommended, but its effectiveness depends on proper implementation (Basha et al., 2023).
- **Security vulnerabilities in mobile cloud computing:** The growth of mobile cloud computing poses additional risks, as mobile devices may not have the same security measures as traditional computing environments, making them more vulnerable to attacks (Waseem et al., 2016).

Despite these risks, organisations can mitigate them through stringent security protocols, regular audits and the use of advanced encryption techniques to protect data integrity and confidentiality. In order to secure GIS data, the authors proposed a number of methods to limit access by unwanted parties.

5. Conclusions

Security is an aspect that determines stable social development. The dynamic course of technological development, including the development of IT and communication systems, the volume and diversity of types of available data, is characterized by both many advantages and very important threats.

The article attempts to discuss selected aspects of crisis management in terms of critical infrastructure protection. Selected issues were discussed regarding selected IT tools that can provide excellent support for anti-crisis services. The work shows the effects of work in the QGIS program, which used, among others, the open street map plugin to identify critical infrastructure facilities in Poland. Next, the usefulness of generating a web map directly in the software was demonstrated. This method of data preparation has one drawback – it is only available on a specific computer. In order to publish specific data for a wider group of recipients, it is possible to place files regarding the created website on GitHub. This solution, using a new repository, allows you to generate a direct link to the data. This tool, of course, allows to publishing data in an open mode, available to all users or selected ones. The presented material contains many important cognitive aspects that clearly confirm the importance of IT systems in the protection of critical infrastructure.

The results of the research conducted are:

1. Demonstration of QGIS functionality in emergency management:
 - Implementation of vector layers from OpenStreetMap.
 - Geoprocessing tools in the form of multi-level buffers.
 - Webmap plugin.
2. Identification of methods for securing data shared in the cloud:
 - multi-factor authentication (MFA),
 - use of key decryption,
 - digital signatures for access verification,
 - procedures for detecting, analysing and responding to incidents such as data breaches or DDoS (Distributed Denial of Service) attacks.

The article provides practical examples that can be applied to Cyber Security management.

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THE INDEBTEDNESS OF COMPANIES LISTED ON THE WSE IN LIGHT OF THE HEALTH MARKET CRISIS

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Purpose: The article aims to present the indebtedness and factors affecting it in the group of non-financial companies listed on the Warsaw Stock Exchange in light of the health market crisis (HMC) induced by the COVID-19 pandemic.

Design/methodology/approach: Differences, correlations, the impact of variables on debt, and the stability of regression models were examined.

Findings: No differences were found in debt in relation to assets and equity, but differences were identified in other areas of financial management related to capital structure theories.

Research limitations/implications: The vaccine's introduction altered market dynamics. Future research should explore post-vaccine debt level trends and their alignment with value maximization or liquidity-driven risk minimization strategies. During the pandemic, risk reduction likely provided a comparative advantage over profit maximization, reducing capital costs without significantly harming value despite declining cash flow. This warrants further investigation.

Practical implications: The study suggests adjusting debt management strategies according to economic conditions. Post-pandemic research should examine debt evolution, value maximization, and risk minimization, emphasizing stable performance indicators.

Social implications: Stable debt levels enhance economic confidence among employees and consumers. Risk-averse corporate behavior during the pandemic likely preserved jobs. Corporations' access to more debt may increase inequality, impacting job opportunities.

Originality/value: The paper presents the application of capital structure theory by businesses to the health crisis. The added value of the article is the inclusion of changes in the EPS level, which are related to value creation, and Altman's Z-Score, which shows the financial condition and solvency of the company in the light of changes in the market related to Covid-19.

Keywords: liquidity, debt, Warsaw Stock Exchange, Covid-19 pandemic.

Category of the paper: Research Paper.

1. Introduction

Indebtedness in a company is influenced by many factors, both internal and external. Decisions about the optimal capital structure are related not only to the financial strategy but also to the market condition (Korajczyk, Levy, 2003). The theory first proposed by Miller and Modigliani (1958, 1961, 1963) continues to evolve, with an increasing number of circumstances affecting managerial decisions regarding capital structure and indebtedness.

The health market crisis (HMC) related to COVID-19 influenced financial markets and the strategies executed by companies (Donthu, Gustafsson, 2020; Marcu, 2021). Restrictions on businesses accompanied by lockdowns influenced company goals (Junnaid et al., 2020). Before the pandemic, most nonfinancial companies listed on the Warsaw Stock Exchange (WSE) were not overleveraged, even though they had favorable development prospects and were in a good economic situation. However, they were characterized by excess liquidity, which under normal circumstances would have been detrimental to returns and value. However, in the context of the HMC, it was a factor that effectively supported their solvency (Czajkowska et al., 2023).

The COVID-19 pandemic was a catalyst for rapid changes in social behavior and the way modern economies function. Immediately after its announcement, both in Poland and Europe, the demand for cash increased dramatically (Kaźmierczak et al., 2022), as did the supply. For example, in Poland, 283 billion Polish zloty was added to the market. Such values may have influenced not only consumers but also companies and how they operate in terms of indebtedness and financial liquidity.

The purpose of this paper is to present the factors that influence debt in relation to assets and equity and how they changed in light of the COVID-19-related HMC. We hypothesize that the change in market conditions influenced the factors that shape debt levels in Polish non-financial public companies listed on the WSE. To test this, we use statistical methods, including difference tests, correlation analysis, and Ordinary Least Squares (OLS) regression, comparing data from before and during the pandemic. The resulting insights contribute to the ongoing discussion on capital structure management and provide valuable information for both financial managers and the decision-makers who shape credit policy.

Under normal circumstances, access to external funding is generally easier for liquid firms whose financial ratios align with the criteria of financial institutions (Sarlija, Harc, 2012). Such companies often capitalize on this advantage to increase debt levels. Trade-off or substitution theory (Kraus, Litzenberger, 1973), agency theory (Jensen, Meckling, 1976), and pecking order or hierarchy theory (Donaldson, 1961; Myers, 1984; Myers, Majluf, 1984) explain the capital structure of the enterprises and can help understand the motivations for debt levels before and during the HMC.

Czerwonka and Jaworski (2017) analyzed the determinants of capital structure and debt in enterprises through the lens of the theory of optimal capital structure. Pecking order theory suggests that financial liquidity is a variable that influences a company's debt levels. Firms capable of generating significant amounts of cash rely on internal sources of financing to avoid using debt. Thus, the higher the liquidity, the lower the level of debt. According to the theory of substitution, this relationship should be positive. As liquid assets increase, the cost of selling them decreases, resulting in a lower risk of bankruptcy and allowing companies to increase debt and benefit from the tax shield.

The article comprises the following sections. The first section contains the literature review, followed by a description of the data and methods description. The next section presents the results, followed by a discussion and, finally, the conclusions.

2. Literature review

2.1. Overview of the empirical research on indebtedness and the factors that determine it

Companies' capital structure and indebtedness are directly related to their value. Capital structure theory is one of the most important theories in corporate finance. It is linked to the theorems of Miller and Modigliani formulated in four separate statements presented in three articles published in 1958, 1961 and 1963. According to the first proposition, an enterprise's value does not depend on its debt-to-equity ratio or how it is financed. The second proposition is that the company's financial leverage does not affect the weighted average cost of capital, and the cost of equity is a linear function of the debt-to-equity ratio. According to the third statement, a company's value is independent of its dividend policy. Finally, the fourth proposition is that owners of equity capital are indifferent to a company's financial policy.

In subsequent years, several new concepts emerged that highlighted various factors that influence the company's financing sources. Among them, prominent theories include the theory of bankruptcy costs (Baxter, 1967), agency costs (Jensen, Meckling, 1976), signaling theory (Ross, 1977; Leland, Pyle, 1977) and pecking order theory (Myers, Majluf, 1984). Trade-off theory was proposed by Kraus and Litzenberger (1973) and later improved by Myers (1984).

Factors that affect capital structure and, therefore, indebtedness encompass both universal and specific determinants tailored to a particular market. Factors that influence the debt level include market characteristics, such as inflation, the tax system, the capital market situation, government policies, and the characteristics of the industry. Factors that are specific to a particular economic unit include enterprise size and profitability (Fernández et al., 2019), sector type, asset type, taxes, management quality, capital cost, the organizational and legal

form of the enterprise, and capital suppliers, as well as asset structure, profit volatility, development prospects, and atypical production (Chang et al., 2009).

Research into the factors that influence the capital structure and debt in the Polish market has revealed various insights. For example, Czerwonka (2017), Chojnacka (2012), Wilimowska and Wilimowski (2010), Mazur (2007), Hamrol and Sieczko (2006), Skowroski (2002), Gajdka (2002), and Campbell and Jarzemowska (2001) showed a negative impact of profitability and financial liquidity while Chojnacka (2012) and Szudejko (2013) showed that the growth potential had a positive impact on the capital structure ratio. Czerwonka (2017), Chojnacka (2012), Wilimowska and Wilimowski (2010) and Campbell and Jarzemowska (2001) stated that enterprise size positively influenced the capital structure, although Mazur (2007) stated that the influence was negative. Campbell and Jarzemowska (2001) claimed that asset structure has a positive effect on capital structure, while Kościelniak (2008) claims it is negative. Wilimowska and Wilimowski (2010) and Kościelniak (2008) investigated how capital structure influences capital costs, while Hajduk (2018) presented ambiguous results about the effects of these elements on debt levels.

Czerwonka and Jaworski (2017) concluded that higher liquidity tends to lower the level of debt. Meanwhile, Kuhnhausen and Stieber (2014) confirmed that a high level of corporate liquidity can reduce the tendency to finance debt due to a shortage of free cash flows. Kaźmierska-Józwiak and Sekuła (2016) verified that there is a positive relationship between long-term debt and financial liquidity. Common indicators of financial liquidity are static ratios, including the current liquidity ratio (Abeywardana, Banda, 2015), the quick-test liquidity ratio (Imtiaz et al., 2016) and the ratio of liquid assets to sales (Nejad, Wasiuzzaman, 2013).

In the Croatian market, statistically significant correlations were found between static liquidity and leverage ratios, with statistically significant correlations observed between leverage ratios and the structure of current assets. The relationship between liquidity ratios and short-term leverage was stronger than that between liquidity ratios and long-term leverage. Interestingly, the more liquid assets companies owned, the less leveraged they were. The rise in inventory levels led to an increase in leverage, while an increase in cash in current assets was related to a reduction in short-term and long-term leverage (Sarlija, Harc, 2012). Sibilkov (2009) showed that leverage was positively correlated to liquid assets, as did Williamson (1988) and Shleifer and Vishny (1992), who argued that more liquid assets increased leverage. Williamson (1988) stated that because the costs associated with financing these assets are lower, more liquid assets should be financed to a greater extent by debt. As a result, the liquidity of assets increased the amount of capital that companies could borrow. The correlation between liquidity and debt can be positive or negative.

Lipson and Mortal (2009) showed that more liquid firms in the US were financed by internal resources to a greater extent and were, therefore, less leveraged. Chaplinsky and Niehaus (1990) and Nejad and Wasiuzzaman (2013) studied the positive influence of financial liquidity on debt and capital structure. The influence of liquidity on the debt ratio was also analyzed by

Serghiescu and Vaidean (2014), who investigated Romanian listed construction companies. They found a negative influence of liquidity on the total debt ratio, as did Jędrzejczak-Gas (2018) for the TSL (Transport, Forwarding, Logistics) sector in Poland.

2.2. The impact of the COVID-19 pandemic on the capital structure

Research findings (e.g., Altman, 2020; Acharya, Steffen, 2020; Ellul, Erel, Rajan, 2020; Srivastava Sampath, Gopalakrishnan, 2022), as well as reports from international organizations (e.g., the OECD and World Bank) and analyses from top consulting firms, show that the COVID-19 pandemic had a significant impact on debt levels (see Table 1). Despite lower credit quality, favorable financing conditions have enabled companies to issue more debt, resulting in a larger percentage of corporate debt being held by companies with riskier financial profiles than before the global financial (Feyen et al., 2017). The findings suggest that while there was an overall increase in debt, the impact varies by sector and company size. Some companies managed to leverage the situation to invest in growth, while others faced increased financial distress. The pandemic underscored the need for robust financial management and the potential benefits of strategic investments during economic downturns.

Table 1.

The impact of COVID-19 on the company debt

Organization	Key findings
World Bank: Kose et al. (2021)	Known as the “fourth wave” of debt, a sharp increase in debt had already started to occur in developing and emerging market countries prior to the pandemic. The pandemic-induced worldwide recession of 2020 led to a high increase in debt, which is what made the fourth wave of debt turn into a tsunami and become even more hazardous. Second, the amount of global government debt kept rising five years after previous global recessions.
International Monetary Fund: Haque, Varghese (2021)	The leverage (expressed as Net Debt/Asset) of American listed companies dropped by 5.3 percentage points from the pre-shock mean of 19.6%. The effect of deleveraging was more pronounced for companies that faced substantial rollover risk; firms with businesses that were most affected by social distancing did not experience a decrease in leverage. Large, highly leveraged companies and those under stress prior to COVID-19 experienced the greatest decline in default probability. Further stress tests indicate that a 20% decline in cash flows would put these firms’ values less than one standard deviation from default.
Deloitte: Buckley, Barua, Samadar (2021)	The average annual growth rate of non-financial enterprises’ total debt was 5.5% between 2010 and 2019; however, it spiked to 9.1% in 2020. That year saw a spike in debt that was most likely caused by one of three things. First, since a lot of the economy slowed down or stopped altogether, some businesses had to take on greater debt in order to continue operating. Second, some companies had to make technological investments to enable remote work whenever feasible, while others had to reorganize their workspaces to guarantee social separation for jobs that needed to be done in person. Lastly, not every business suffered as a result of COVID-19. Concerns regarding businesses’ reduced capacity to pay back debt, however, can be allayed if they increase their investments in productivity-boosting initiatives.

Cont. table 1.

OECD (2020)	<p>The COVID-19 shock's fall in book value of equity would have an immediate impact on a company's leverage ratio, which rises by 6.7-8% percentage points in comparison to a business-as-usual scenario. The ability of businesses to service their debt is further hampered by the reduction in revenues; between 30% and 36% of businesses would not be lucrative enough to pay for their interest costs.</p> <p>A significant corporate "debt overhang" could be more likely due to the increased levels of indebtedness and default risk. Experience from the past indicates that the investment ratio should drop by about two percentage points when a company's financial leverage ratio increases in line with our accounting model's forecasts.</p>
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Notes: underlined by the authors of this paper.

Source: authors' own elaboration.

The COVID-19 pandemic significantly impacted companies' capital structures. Altman (2020) linked COVID-19 to the corporate credit cycle. He highlighted the vulnerability of "BBB tranches of corporate bond market" to downgrades in response to the downturn in the real economy and its potential impact on expected delinquency rates. Ellul et al. (2020) analyzed the macroeconomic implications of COVID-19-driven total corporate debt. They identified two major risks associated with the nonfinancial companies' heavily leveraged balance sheets. First, declining cash flows during a crisis make it hard to sustain business models. Secondly, debt overhang can significantly hinder investment once the recovery gets underway.

Gopalakrishnan et al. (2023) observed that firms' financial resources were strained as a result of the COVID-19 disruptions and the subsequent government measures, expanding their debt financing. They employed firm-level data from 61 countries to analyze the variation in loan and bond financing that may be attributable to features specific to COVID-19. Companies that were located in countries with severe lockdowns and those that were more exposed to the pandemic were more likely to raise their debt, which could indicate that they were taking extra precautions. Furthermore, companies operating in industries with lower rates of remote labor tended to use debt more than their counterparts, but they also paid higher financing expenses.

Carletti et al. (2020) and Schivardi, Sette and Tabellini (2020) investigated the impact of COVID-19 and the related lockdowns on the liquidity conditions and equity positions of numerous Italian businesses. In the long run, companies faced significant challenges from equity shortages and debt overhang once the immediate COVID-19 storm passed and the question of zombie financing was recognized (Demary, 2021). This underscores the importance of designing effective public policies to support companies.

Acharya and Steffen (2020) highlighted the phenomenon of "dash for cash" triggered by the COVID-19 pandemic. Data on daily credit line drawdowns at the firm-loan level in the US revealed a business "dash for cash" brought on by the COVID-19 outbreak. All of the companies pulled down bank credit lines and increased cash levels during the initial stages of the crisis, which were marked by excessive caution and elevated aggregate risk. However, during the second phase, which came after stabilization policies, only the best-rated companies shifted to the capital markets to obtain cash.

Huang and Ye (2021) examined how the COVID-19 pandemic, capital structure, and corporate social responsibility (CSR) programs impacted company risk. Their findings suggest that businesses may increase sustainability and resilience in a volatile market by implementing recommendations for CSR policies and post-pandemic capital structures. The trade-off theory of capital structure served as the inspiration for the concept mentioned above. They applied a leverage measure adopted from Korteweg's (2010) Bayesian model. Overleveraged enterprises were more likely to be bankrupt, were more financially rigid, and were more susceptible to COVID-19 and higher risk.

Conversely, underleveraged companies were less hazardous than overleveraged ones for two reasons. Firstly, having modest levels of debt shields businesses from bankruptcy after an unexpected drop in revenue. Businesses with low leverage can nevertheless pay off their debt. Secondly, according to Halling et al. (2020) and Li et al. (2020), companies sought bank loans to cover the reduced cash requirements brought on by the start of COVID-19 (Halling et al., 2020; Li et al., 2020). Firms with more excess leverage experienced higher risk during COVID-19, consistent with some COVID-19 studies, which found that firms with high leverage react more negatively to market performance (see Ding et al., 2020; Fahlenbrach et al., 2020). While underleveraged firms may experience a considerable reduction in risk as excess leverage increases, the outcomes for overleveraged firms remain unchanged. This could be explained by the trade-off hypothesis, which states that business value rises with debt level until it reaches the optimal threshold since underleveraged enterprises do not fully utilize their debt capacity to take advantage of interest tax benefits (see Halling et al., 2020; Li et al., 2020). According to Huang and Ye (2021), overleveraged businesses with low social and environmental scores are more likely to experience the negative effects of COVID-19. Enterprises with low leverage were shielded against rising business risk in a volatile market by having low leverage, while those that were underleveraged were protected from market volatility.

Bai and Ho (2022) used a sizable sample of public companies from 31 different countries between 2002 and 2020. They found that Corporate Social Performance had a considerable positive impact on business debt levels during the pre-COVID period. According to Ding et al. (2021), the insurance role of CSP during the COVID-19 crisis might have helped businesses gain the trust and loyalty of investors and customers.

Mond et al. (2022) explored the determinants of capital structure in publicly traded firms in Malaysia before and after the COVID-19 epidemic. The findings indicated that the maximum debt was higher before the COVID-19 period. Over the COVID-19 period, there was a slight decline in both short-term and total debt. Despite this, long-term debt increased. Tangibleness, liquidity, and firm size had an impact on capital structure in both periods, regardless of the capital structure proxy. A significant factor influencing total debt both before and after the COVID-19 crisis was profitability.

The size of the enterprise and the type of economy had an impact on the exogenous factors that influence the capital structure. Demirgüç-Kunt et al. (2020) explored the role of the global financial crisis and found that both in developed and emerging countries—including those without a crisis—firm leverage and debt maturity decreased. Closs (2021) found that American companies and their leverage between the pre- and post-pandemic periods showed statistically insignificant changes. The regression results showed that the epidemic reduced the leverage of aggressive enterprises and increased the leverage of conservative enterprises. Pettenuzzo et al. (2021) identified key characteristics of US companies and stocks that could explain much of the cross-sectional variation in corporate payments and funding decisions. They also demonstrated that the Federal Reserve's broad monetary policy in the early stages of the crisis had a major impact on the timing and sequence of these decisions.

The market situation during the COVID-19 period was examined in relation to the impact of different policies (tax reductions, debt suspension, and wage payment support), the results of which indicated that government assistance to alleviate wage payments was the most effective means of reducing liquidity shortages, followed by debt suspension policies (Demmou et al., 2021). The countries in the sample included Belgium, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Poland, Portugal, Romania, Spain, Sweden and the United Kingdom.

To conclude, the impact of COVID-19 on firm debt can be analyzed from various perspectives, including sector, firm size and location (i.e., developed economies vs. countries in transition/emerging markets). The results of our review may be helpful in identifying new research niches, including the direction and strength of the interdependency between financial liquidity and capital structure (e.g., Acharya, Steffen, 2020; Mond Azhari, Mahmdu, Sharrudin, 2022).

3. Data and Methods

This section presents the results of the analysis. To verify the main hypothesis that the change in market conditions related to the COVID-19 pandemic transformed the factors that shape indebtedness, the following research sub-hypotheses are tested:

- SH1: There was a difference between the average values of ratios representing debt, strategy, and market condition in the periods before and during the pandemic.
- SH2: There was a difference in correlation between ratios representing debt, strategy and market condition in the periods before and during the pandemic.
- SH3: There was a difference in the impact of factors representing debt, strategy and market condition in the periods before and during the pandemic.

Here, strategy is understood as other ratios related to profitability, liquidity, growth potential, bankruptcy, and value.

Statistical analysis was conducted by grouping the data into two independent subperiods. The first subperiod covers the financial quarterly data before the COVID-19 pandemic (Q1 2019 – Q1 2020), while the second sub-period covers the pandemic period (Q2 2020 – Q2 2021).

The research was based on panel data collected for 421 non-financial companies (3368 observations) listed on the WSE (excluding the financial sector). The data were obtained from the Notoria database. The following variables were taken into account:

- DER: debt ratio = total debt/assets.
- DE: capital structure ratio = long-term debt/equity.
- CR : current liquidity ratio = current assets/current liabilities.
- QR : quick liquidity ratio = (current assets - inventories)/current liabilities.
- AT: acid test ratio = (current assets - inventories and receivables)/current liabilities.
- CCC: cash conversion cycle: inventory cycle + receivables cycle – short-term liability cycle.
- gEPS: EPS growth (EPSt- EPSt-1)/Assetst-1; - EPS growth (Danbolt et al., 2011).
- Z-Score: Altman Z-Score (Altman, 1968).
- TQ: Tobin's Q = (total assets + market value of equity – book value of equity)/total assets - (Danbolt et al., 2011).
- lnTA: asset level as a natural algorithm.
- FA/TA: asset structure ratio = fixed assets/total assets.
- GDP Growth: % change in GDP (source: World Bank),
- M3: broad money includes currency, deposits with a fixed maturity of up to two years, deposits redeemable at notice of up to three months, repurchase agreements, money market fund shares/units, and debt securities up to two years (source: World Bank).

Based on the literature and the data analysis, the following models to describe the debt and capital structure ratios are proposed:

$$l_{DER_{i,t}} = const_{i,t} + l_{TA_{i,t}} + ROA_{i,t} + \frac{FA}{TA_{i,t}} + l_{CCC_{i,t}} + l_{CR_{i,t}} + TQ_{i,t} + l_{DER_{i,t-1}} + GDP\ Growth_{i,t} + M3_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$l_{DE_{i,t}} = const_{i,t} + l_{TA_{i,t}} + ROA_{i,t} + \frac{FA}{TA_{i,t}} + l_{CCC_{i,t}} + l_{CR_{i,t}} + TQ_{i,t} + l_{DE_{i,t-1}} + GDP\ Growth_{i,t} + M3_{i,t} + \varepsilon_{i,t} \quad (2)$$

where:

const – constant,

ε – is a random component with basic properties.

4. Results

The basic descriptive statistics of the variables are presented in Table 2, along with the analysis of the differences between average values.

Table 2.

Descriptive statistics with differences in the periods before and during the pandemic

Variable	Measure	Before the pandemic	During the pandemic	t-Student
				Asymptotic significance
DER	Mean	1.517	1.90	0.828
	St. Dev.	18.627	14.006	
DE	Mean	27.565	32.685	0.817
	St. Dev.	617.394	639.941	
CR	Mean	8.878	6.612	0.327
	St. Dev.	88.450	40.710	
QR	Mean	8.325	6.127	0.343
	St. Dev.	88.457	40.719	
AT	Mean	4.185	2.343	0.304
	St. Dev.	67.604	22.323	
CCC	Mean	3,653.090	4,352.175	0.850
	St. Dev.	90,825.267	103,830.652	
gEPS	Mean	0.001	0.000	0.252
	St. Dev.	0.156	0.002	
Z- Score	Mean	4.952	5.153	0.036
	St. Dev.	2.829	2.852	
TQ	Mean	3.789	4.645	0.526
	St. Dev.	29.945	44.311	
ROA	Mean	1.263%	4.010%	0.785
	St. Dev.	26.015%	23.078%	
ROE	Mean	3.141%	5.626%	0.113
	St. Dev.	39.947%	42.709%	
TA	Mean	16,104,611.566	17,620,896.279	0.736
	St. Dev.	261,428,002.102	286,266,114.221	
FA/TA	Mean	0.587	0.578	0.409
	St. Dev.	0.259	0.263	
GDP	Mean	3.976	-3.253	0.000
	St. Dev.	1.182	2.924	
M3	Mean	109.669	116.474	0.000
	St. Dev.	1.274	1.371	

Note: The difference is significant for $p < 0.01$ at the 1% significance level, $p < 0.05$ at the 5% significance level and $p < 0.1$ at the 10% significance level.

The results in Table 2 reveal that in the periods before and during the pandemic, there was significant growth in the Z-Score and M3 variables and a significant decrease in GDP. However, the first hypothesis suggesting a difference between the average values of ratios representing the strategy and condition of companies in the two periods was not fully supported as the differences in most cases were not significant.

The correlation between variables was tested with Pearson's coefficient. The results are presented in Table 3.

Table 3.
Pearson correlation between variables

Variables	DER	DE
Period before the pandemic		
DER	1.000	
DE	-0.002	1.000
CR	-0.008	-0.005
QR	-0.007	-0.004
AT	-0.005	-0.003
CCC	-0.002	0.988**
gEPS	-0.001	-0.001
Z-Score	-0.104**	0.074**
ROA	-0.481**	0.006
ROE	-0.036	0.049
Tobin's Q	0.635**	-0.008
Period during the pandemic		
DER	1.000	
DE	-0.005	1.000
CR	-0.015	-0.008
QR	-0.014	-0.008
AT	-0.010	-0.005
CCC	-0.002	0.999**
gEPS	-0.003	-0.001
Z Score	-0.128**	0.081**
ROA	-0.381**	0.009
ROE	-0.165**	0.045
Tobin's Q	0.353**	-0.011

The significance levels of the parameters are given in the table: ** – $p < 0.01$ * – $p < 0.05$.

Source: Own elaboration using PS Imago.

To present the general relationships between the variables used in the study, correlations were calculated, with a focus on debt ratios. Before the pandemic, the total debt ratio DER was negatively correlated with ROA and positively correlated with TQ. After the pandemic, the signs and dependencies did not change, although the relationship with the Z-score strengthened, and the relationship with ROA and TQ weakened. The relationship between DE and both CCC and the Z-Score was positive before the pandemic, and both relationships strengthened during the pandemic. However, the second sub-hypothesis, suggesting that there was a difference in correlation between the ratios representing debt and factors determining indebtedness in the periods before and during the pandemic, was not confirmed.

The influence of the chosen micro and macroeconomic factors on debt ratio DER was analyzed using an OLS model, and the results are presented in Table 4.

Table 4.
OLS model estimations for DER

specification	<i>Pooled OLS</i>	<i>FE</i>	<i>GMM 2-step</i>	<i>GMM 2-step</i>	<i>GMM 2-step</i>
	<i>l_DER model</i>	<i>l_DER model</i>	<i>l_DER model</i>	<i>l_DER model (before the pandemic)</i>	<i>l_DER model (during the pandemic)</i>
const	0.823*	0.496	0.362	0.129***	0.585
l_TA	0.007**	-0.012	0.022***	0.009	0.023**
ROA	-0.097**	-0.071*	-0.181***	-0.017	-0.117**
FA/TA	-0.302***	-0.452**	-0.647***	-0.308	-0.819***
l_CCC	-0.001	-0.008	-0.018**	-0.006	-0.024
l_CR	-0.105***	-0.351***	-0.230***	-0.117	-0.313***
TQ	-0.002**	-0.001	-0.002**	0.000	0.001
l_DE_1	0.878***	0.215***	0.616***	0.851	0.519***
Growth	-0.005	-0.004**	-0.003*	0.000	0.001
M3	-0.007*	-0.006**	-0.004**	-0.001	-0.006
R square	0.943	0.976			
F stat (p-value)	2,299.590 (0.000)				
Durbin-Watson	1.753	1.597			
Breusch-Pagan test		3.679 (0.055)			
Hausman (p-value)		230.589 (0.000)			
AR(1) p-value			0.000	0.000	0.038
AR(2) p-value			0.4810	n.a.	n.a.
Sargan p-value			0.003	0.093	0.508
Wald p-value			0.000	0.000	0.000

Note: The significance levels of the parameters are given in the table: *** – $p < 0.01$, ** – $p < 0.05$, * – $p < 0.1$.

Source: Own elaboration using GRETL based on data from Notoria.

Panel modeling was carried out using naive analysis. The occurrence of fixed effects was confirmed by the analysis of panel models. Due to the large number of observations in the database, we also studied the impact of the variables on debt using the GMM two-step system. Table 3 reveals no significant influence of any variable on DER before the pandemic. However, during the pandemic, TA and delayed DE had a statistically significant and positive influence, while ROA, CR and FA/TA had a negative effect. The same analysis was performed for the capital structure DE ratio. The results are presented in Table 5.

Table 5.
OLS model estimations for DE

Specification	<i>Pooled OLS</i>	<i>FE</i>	<i>GMM 2-step</i>	<i>GMM 2-step</i>	<i>GMM 2-step</i>
	<i>l_DE model</i>	<i>l_DE model</i>	<i>l_DE model</i>	<i>l_DE model (before the pandemic)</i>	<i>l_DE model (during the pandemic)</i>
const	2.632**	-4.166	-0.125	-2.095	5.787**
l_TA	0.018**	0.392*	0.071***	0.093***	0.033***
ROA	-0.423***	-0.770***	-0.436***	-0.169	-0.542***
FA/TA	0.010	2.152***	-0.008	0.218	-0.135
l_CCC	-0.014	-0.048*	-0.038	-0.067*	-0.025
l_CR	0.027	0.262***	-0.163***	-0.151**	0.027
TQ	0.012	-0.016*	0.001	-0.030	0.000

Cont. table 5.

I_DER_1	0.919***	0.303***	0.543***	0.513***	0.856***
Growth	-0.019*	-0.023***	-0.007	-0.009	-0.040
M3	-0.026**	-0.027***	-0.011**	0.004	-0.055**
R square	0.848	0.913			
F stat (p-value)	570.383 (0.000)				
Durbin-Watson	2.075	1.830			
Breusch-Pagan test		12.190 (0.000)			
Hausman (p-value)		204.604 (0.000)			
AR(1) p-value			0.000	0.007	0.002
AR(2) p-value			0.617	n.a.	n.a.
Sargan p-value			0.258	0.208	0.557
Wald p-value			0.000	0.000	0.000

Note: The significance levels of the parameters are given in the table: *** – $p < 0.01$, ** – $p < 0.05$, * – $p < 0.1$.

Source: Own elaboration using GRETL based on data from Notoria.

Before the pandemic, total assets were positively associated with DE. Conversely, CCC, CR and delayed DER exhibited a negative association. During the pandemic, the situation changed. Only ROA and M3 had a statistically significant negative impact on DE. Notably, the positive influence of size and delayed DER did not change.

In the next step, the temporal differences between the regressions were analyzed. The results are presented in Table 6.

Table 6.

Chow test for the DER and DE models

Specifications	DER model	DE model
Chow test	36.200	11.900
p-value	0.000	0.292

Source: Own study using GRETL based on data from Notoria.

The Chow test revealed no structural changes in the DER model. However, the DE model did exhibit structural changes. It should be inferred that structural changes are taking place in the DE model, suggesting a shift in how various factors influence debt levels during the pandemic.

The level of debt in relation to assets (DER) and equity (DE) did not change significantly in the periods before and during the pandemic. However, in light of the decline in GDP and the increase in money supply, enterprises strengthened their security related to the threat of bankruptcy, leading to a significant increase in the Z-Score during the pandemic. A negative correlation was found between DER and Z-Score, and a positive correlation between DE and Z-Score, both before and during the pandemic.

DER and profitability were characterized by a negative correlation before and during the pandemic, while DE and CCC were characterized by a positive correlation. Additionally, DER was positively correlated with TQ, representing the growth potential, in both periods.

Debt, as measured by DER and DE, was positively influenced by the size of assets held by the enterprise. During the pandemic, DER was negatively influenced by profitability, liquidity, asset structure, and delayed DE. DE was negatively affected by liquidity before the pandemic, while during the pandemic, ROA negatively influenced capital structure. Lagged DER positively influenced debt, regardless of the period.

5. Discussion

The companies listed on the WSE were analyzed to detect their sensitivity to market changes due to the COVID-19-related HMC. A significant change in the Z-Score was detected. The Z-Score increases when working capital, gross profit, retained earnings, equity, and sales revenues increase and when the value of assets and debt decreases. The correlation of the Z-Score with DER and DE is due to changes in corporate debt levels.

The negative correlation between DER and profitability shows that an increase in debt generates higher profits according to the principles of financial leverage. Given that Polish companies did not take on excessive debt, they should consider doing so to a greater extent in the future. This is supported by the positive correlation between DER and Tobin's Q index, representing growth potential (Danbolt et al., 2011).

The effect of enterprise size on debt was positive, regardless of the period, showing that larger enterprises were more willing to leverage themselves. During the pandemic, DER was negatively affected by the asset structure, indicating the level of fixed assets, which had a negative impact on debt. Therefore, during the pandemic, companies with lower levels of fixed assets had higher levels of corporate debt. Additionally, liquidity in this period, measured by the current ratio of current assets to current liabilities, also had a negative impact on debt, showing that enterprises with decreasing levels of current assets took on debt to survive the pandemic.

Regarding capital structure measured by DE, liquidity, as measured by CR and CCC, had a negative impact on debt before the pandemic, suggesting that a more conservative approach to liquidity resulted in lower debt. However, during the pandemic, liquidity became less important for shaping the capital structure, while the profitability of assets began to negatively affect debt, along with changes in the money supply.

The analysis demonstrated that the debt ratios (DE and DER) did not differ significantly between the two periods, which aligns with the findings of Closs (2021). She found that US companies and their leverage differences between the pre-pandemic period and the pandemic period were not statistically significant.

The increase in Z-Score was found to be statistically significant. This finding underscores the importance of solvency-related safety for Polish enterprises, as their economic condition, as measured by the threat of bankruptcy, improved during the pandemic period. The relationship between the debt-to-equity ratio and CCC increased during the pandemic, aligning with the theory of the hierarchy of sources of financing, which indicates that financial liquidity influences a company's debts. The positive influence of financial liquidity on debt and capital structure was identified by Chaplinsky and Niehaus (1990) and Nejad and Wasiuzzaman (2013).

Assets positively influenced both debt ratios, confirming previous findings that loans are less willingly taken out by enterprises with smaller assets (Sawicka, Tymaszko, 2014). Size was found to be an important factor that influences debt (Hajduk, 2018; Czerwonka, 2017; Chojnacka, 2012; Wilimowska, Wilimowski, 2010; Campbell, Jarzemowska, 2001).

Profitability, represented by ROA, negatively influenced both debt ratios during the pandemic period, consistent with previous findings for the Polish market (Czerwonka, 2017; Chojnacka, 2012; Wilimowska, Wilimowski, 2010; Mazur, 2007; Hamrol, Sieczko, 2006; Skowrowski, 2002; Gajdka, 2002; Campbell, Jarzemowska, 2001).

Asset structure negatively influenced DER during the pandemic, which is consistent with the findings of Chang et al. (2009). Asset structure may have either a positive effect on the capital structure (Campbell, Jarzemowska, 2001) or a negative one (Kościelniak, 2008; Wilimowska, Wilimowski, 2010; Kościelniak, 2008).

Previous studies showed that growth potential had a positive impact on the capital structure ratio (Chojnacka, 2012; Szudejko, 2013), which is confirmed in this article.

In conclusion, the change in market conditions related to the COVID-19 pandemic transformed the factors that shape the debt levels in Polish non-financial companies listed on the WSE.

6. Conclusions

This study examined the impact of the COVID-19 pandemic on debt structure and capital structure determinants for companies listed on the WSE. Overall debt levels (DER and DE) did not change significantly despite the pandemic's economic challenges (falling GDP and increasing money supply). Only the way the capital structure was shaped through other key determinants changed. Regardless of the period, larger enterprises incurred more debt. Before the pandemic, liquidity measured by CR and CCC had a negative impact on DE, while during the pandemic, it was asset profitability.

Before the pandemic, general debt was not determined by any factors, but during the pandemic, fixed assets, asset profitability and financial liquidity had a negative impact on DER. The growing money supply had a negative impact on the capital structure, indicating a decreasing level of debt. The correlation between the debt ratios and Z-score, TQ, liquidity, and profitability indicators was stable regardless of the period examined.

Before the pandemic, enterprises were guided by the hierarchy theory. However, during the pandemic, substitution theory shaped the capital and debt structure as companies became more risk-averse.

The study acknowledges limitations related to the research period. The introduction of the vaccine influenced the behavior of the market. Therefore, future research could explore how debt levels evolve in the post-vaccine era and whether they depend on the strategy of maximizing value or on minimizing the risk associated with the lack of financial liquidity. Additionally, during the pandemic, risk reduction may have provided a comparative advantage over profit maximization, which translated into a reduction in capital cost, and although cash flow was decreasing, it did not have such a negative impact on value. This issue will be the subject of further research.

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HUMAN RESOURCE MANAGEMENT – PERSONALITY TRAITS AND PSYCHOLOGICAL PROFILES AND THE CHOICE OF A CAREER PATH

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Purpose: The article aims to investigate the relationship between Gustav Jung's theory of psychological types, the Myers-Briggs Type Indicator (MBTI) tool, and John Holland's model of occupational preferences. It was explored how these theories can be integrated to better understand and support the career selection process. In addition, the aim of the article is also to try to find an answer to the question whether there is a relationship between the personality type of an employee and the choice of their preferred career path.

Design/methodology/approach: The authors described and analyzed 3 psychological theories: Gustav Jung's theory of psychological types, the Myers-Briggs Type Indicator (MBTI) tool, and John Holland's model of occupational preferences. These theories could be supportive in the area of human resources management aiming at achieving workers' job satisfaction. The research was to integrate above-mentioned theories to identify patterns of behavior and career preferences to support human resources management processes.

Findings: The study gives the recommendations for possible actions to use of big data analytics to identify patterns of behavior and career preferences, which can lead to more personalized career guidance. Practical implementation of theory integration could be implemented into career counselling, career planning, recruitment, and human resource management. The integration of the analysed theories allows for a more comprehensive approach to career counseling, allowing for a better match of the career path to individual personality traits. Practical application can lead to greater job satisfaction, better professional results and more informed career planning.

Originality/value: The value of the research is the possible implementation of the integration of Jung's theory, MBTI, and Holland's model with other psychological theories, such as Maslow's theory of motivation or Bowlby's theory of attachment, which can lead to a more holistic approach to career choice. For example, taking into account intrinsic motivations and psychological needs can help to better understand why individuals choose certain career paths and how they can be supported in achieving job satisfaction.

Keywords: human resource management, psychological profiles, career counseling, personality types.

Category of the paper: literature review, general review.

1. Introduction

Choosing a career path is one of the most important and influential choices a person makes in his life. It is a complicated process that is influenced by many factors, including interests, skills, values, and personality. In a psychological context, understanding how personality traits affect career preferences can help individuals make more informed and rewarding career decisions.

This article aims to investigate the relationship between Gustav Jung's theory of psychological types, the Myers-Briggs Type Indicator (MBTI) tool, and John Holland's model of occupational preferences. It was explored how these theories can be integrated to better understand and support the career selection process. In addition, the aim of the article is also to try to find an answer to the question whether there is a relationship between the personality type of an employee and the choice of their preferred career path.

Recently, we have been observing clear transformations of the reality around us, which to a large extent force us to revise the way we perceive and interpret the world, values, goals, and thus also the concept of work and employment, which is not only an important economic resource, but above all also a personal one. Observing people during their professional careers allows to notice that some people have an orderly pattern of their career path, and their adequately targeted education allows them to enter a previously planned profession and gain knowledge and skills in carrying out new tasks, overcoming subsequent levels and achieving success. On the other hand, we can observe on the labor market how people whose professional experience is completely different are increasingly functioning. They pursue several, sometimes very different professional fields at the same time, often change jobs or take up different fields of study, and finally manage to find a job that requires a combination of very different skills and are (or not) successful in this field. Professional work plays an important role in shaping our identity when a person is matched to the profession performer (Paszowska-Rogacz, 2009).

Otherwise, there is a high probability that work would become only a way to satisfy one's living needs and a necessary, unpleasant element of everyday life. The choice of a profession is a manifestation of an individual's personality, expression of his interests, motivation, knowledge, abilities and values. It is not a reaction detached from the personality structure, because consciously or not, the individual follows his needs in accordance with his various temperamental conditions, learned patterns, motives of the I, acquired beliefs or the permanence of the features of personal individualism. J.L. Holland (1992) (Ratajczak, 2006) is a pioneer of the field called genetic algorithms. He is the creator of the theory of professional personality, according to which job satisfaction depends on matching the individuality and uniqueness of a particular person to the specific requirements of a given job. Therefore, it becomes necessary to match the personal characteristics of the individual to the requirements of a given profession (Kilian, 2020).

Personal qualities are something unique for an individual. They form her internal system of self, and as forces they are directed inwards and give a unique framework for the self-image. They maintain relationships with the outside world, are inextricably linked to important needs, perception of reality, its narrative and representation in the mind of the individual. This multifaceted nature makes it difficult to unambiguously define the concept of personality. It is a multidimensional construct of human functioning, an element of cohesion, quality of life, the cause of a sense of happiness, satisfaction, good functioning, but also various disorders. In literature, we can encounter many concepts of personality and a variety of definitions. One of the most popular approaches defines personality as a set of fixed and variable psychophysical traits that are related to all actions, sensations and needs of a person at the level of physiology, character traits, intellect and spirituality. Personality is inextricably linked to emotions, directs the needs. But personality also represents, above all, such characteristics of an individual from which it is possible to draw conclusions about the behavior of a given person in an unambiguous and predictable way. Webster's dictionary defines personality as a distinct aspect of one's character that affects others (Cakrt, 2006). Personality is also individual diversity. Our individual uniqueness, non-copyability and at the same time continuity, resulting from genetic predispositions, temperament, social learning or other environmental characteristics. The psychology of individual differences deals precisely with the study of what makes us feel, think, and behave differently from other people in the same situations. Diversity creates contrasts, gives color to the people of the epoch and ensures the development of civilization. It is also an indispensable component of all creativity, a space for the development of societies, it forces the need for knowledge, continuous growth and, finally, it helps people to look for their own place in the world, social and professional environment, allowing them to look for such works that they can like, fulfill themselves in them and realize themselves professionally. Such a subjective character of the choice of profession by given people was pointed out by the precursor of career theory, F. Parsons, who believed that each person has a set of relatively stable predispositions that allow him or her to be assigned to a specific professional profile, and all the choices that a person makes are nothing more than the resultant of his personality traits. According to these typologizing decisions, it is considered to combine models of choosing a profession with the concepts of individual differences or matching with a profession. According to Parsons, the final career decision should be preceded by building a reliable image of oneself, and matching one's skills to the offer of the world of work should be a source of effective career choice. In turn, the level of development of this ability is to be manifested in the recognition of one's own abilities and the determination of the right path of education, understood as environmental orientation (Zimbardo, Johnson, McCann, 2017; Horzyk, 2017).

2. Gustav Jung's theory of personality

Gustav Jung, a Swiss psychologist and psychoanalyst, introduced the theory of psychological types, which became the foundation for many later studies on personality. Jung identified four basic mental functions: thinking, feeling, perception, and intuition. Each of these functions can be directed outwards (extroversion) or inwards (introversion). This creates different personality types that influence the way people perceive the world and make decisions (Jung, 1921).

Extroversion and introversion

Extroversion and introversion are two basic types of orientation that describe the direction in which an individual directs their psychic energy. Extroverts focus on outdoor venues and events, and are sociable and energetic. Introverts, on the other hand, focus on internal thoughts and feelings, and are more reflective and introspective (Jung, 1921).

Jung distinguished four mental functions that are fundamental to understanding personality types:

1. Thinking (T): Analysis and logic are the basis for decision-making.
2. Feeling (F): Decisions are made based on values and subjective judgments.
3. Perception (S): Focus on reality and facts.
4. Intuition (N): Focus on possibilities and abstract ideas.

3. J.L. Holland's hexagonal model of career preferences

In this theoretical scope of research, the achievements of J.L. Holland also seem to be important, who, emphasizing the importance of the uniqueness of each person, maintained that the source of his professional success lies in the proper matching of features to a specific profession. The result of Holland's research is the so-called hexagonal model of professional preferences "RIASEC", the foundations of which determine that a person's personality is shaped and expressed primarily through professional interests. These types refer to the properties represented by the professional environments assigned to them. J. Holland's hexagonal theory is based on the main assumption that professional preferences are a form of a style of adaptation to the socio-professional environment characteristic of a given individual, and the personality regularities of professional development are anchored on the following four assumptions (cf. Holland, 1992, pp. 2-5; Myszka-Strychalska, 2017).

The first assumption assumes that the preference structure as a model is confronted with the real results of the diagnosis of the assessed person. It is a factor related to personality traits and conditions of socialization in the environment. The structure of most people's preferences can be classified by taking into account a frame of reference in the form of six types of preferences, which Holland includes: realistic, research, artistic, social, entrepreneurial and conventional.

The second assumption draws attention to the types of environment that, like personalities, are characterized by a specific profile of preferences of a more or less pronounced nature. Within these environments, specific personalities, styles of behavior, ways of solving problems and opportunities for development dominate.

The third assumption indicates that individuals are looking for environments that enable them to use resources (abilities, competences, attitudes) and to implement specific values and social roles.

The fourth assumption of Holland's theory is that knowledge about the degree of compatibility between a person's professional preferences and the opportunities offered by the environment can be used as a basis for predicting the behavior of this person in various contexts of social behavior. In the table 1. the structure of personal preferences and their characteristics resulting from the first assumption is given.

The intentional choices made and important decisions that determine further career paths are based on career values that are an end in itself, other career goals, as well as expectations related to the professional career itself.

Table 1.

Scales of occupational preference traits in the J. Holland method

Modal Personnel Preferences by J. Holland	Characteristics of individual attributes
Realistic (manufacturing)	Enjoying physical work and the need to see immediate results from one's work
Research (analyzing)	Feeling the need to understand the surrounding reality in an empirical sense
Artistic (works)	Enjoying the creation of new things and ideas
Social (helping)	Enjoying establishing close relationships with others and choosing learning and counseling activities
Entrepreneurial (influencing others)	Feeling the need to take control of the situation and taking pleasure in participating in public life
Conventional (organizing)	Attention to detail and enjoyment of everyday organizational problems

Source: Savickas, Taber, Spokane, 2002.

These career-oriented orientations constitute specific personal hierarchies of needs, values, competences, motivations, expectations, attitudes, aspirations and professional preferences perceived and expressed by individuals, and their cognition, determination and formulation is necessary to develop an appropriate strategy for the development of one's own professional career. This strategy, in turn, means all those conscious actions of the individual that serve the achievement of the adopted career goals. In the selection of professional competences, in the psychological aspect, it is important to compare them with the potential resources of the

individual. The aspect of correlating basic interests with potential orientation in performing future work is very important, because it is personality traits that allow an individual to fulfill himself and fulfill himself in a given professional activity. (Krause, 2012). Examples of comparison of the scales of professional orientation and correlated basic interests are presented in Table 2.

Table 2.

Assignment of Scales of Basic Interest to Orientation Scales

Career orientation scales	Scales of basic interests
Producing	Machinery Manufacturing, Carpentry, Agriculture/Forestry, Cultivation/Fruit Growing, Animal Care
Analyze	Mathematics, Science
Creativity	Art/Design, Performing Arts, Writing, International Work
Helping	Adult Development, Counseling, Child Development, Religious Activities, Medical Practices
Influencing others	Leadership, Law/Politics, Public Speaking, Sales, Advertising/Marketing

Source: Boggs, 1999; <http://www.pearsonassessments.com/tests/ciss.htm>

For personal preferences constructed in this way in the context of selected professional orientations, four types of psychological professional preferences can be distinguished.

The first type of orientation expresses the social traits of the individual's personality and includes high extroversion, social (interpersonal) potential, entrepreneurship, optimistic attitude.

The second type of personality orientation – research and factual – creates realistic and research preferences, which are also positively correlated with high scores in tests of perceptual abilities and mathematical reasoning. The relationship between realistic and research preferences is therefore solidly empirically grounded.

The third type is a personality oriented by conventional patterns, within which there are preferences related to conventional professions, traditional values, perceptual speed, high control and meticulousness. The preference for conventionality can be linked both to a high level of meticulousness as a personality trait and to the ability to quickly perceive recognition.

The fourth type of orientation is an open and expressive mind, including artistic and research preferences measured by Holland's method and openness to experience as a personality trait. This orientation is most strongly correlated with the ability referred to as the so-called ideational fluidity.

Based on observation, scientific research and the cited literature, it can be concluded that the choice of a profession is dictated by many decisions in the life of every person, and most of them are often revealed in childhood, when in the process of socialization and the acquisition of role models, attitudes, abilities and skills are shaped. Among the factors related to the formation of career decisions among young people in the literature on the subject, the following are most often mentioned: the views of other people, considered by young people as authorities, as well as the opinions expressed by their peers (Keating, 1990; Sobańska, 1965; Tyszkowa,

1977), the ability to set long-distance goals and to subordinate them to an organised and planned activity (Wright, Carr, 1995), gaining first professional experience in performing casual or seasonal work (Bachman, Schulenberg, 1993; Lucas, Lammont, 1998).

These factors are not the only ones that influence adolescents to make plans for their professional careers. When choosing a profession, young people also take into account their own abilities and predispositions (Czerwińska-Jasiewicz, 1997, 2005; Liberska, 2004), and research on the perception of success (Brown, 2002; Lounsbury et al., 2003) show that the group of important determinants indicated by young people includes personality traits, skills, values and abilities. Of course, these decisions are usually subject to modifications during life, and choosing a professional career is not easy and requires an in-depth analysis of oneself: one's own intelligence (including emotional intelligence), various types of abilities, resources, imperfections, interests, but also psychophysical condition, the ability to establish contacts, settle disputes, cope with emotions or be aware of one's own defense mechanisms. All this, in addition to competences and achievements, determines the individual's suitability for work, and thus their satisfaction with a given choice and mutual cooperation with others.

Research shows that individuals who are psychologically suited to their professional role are more engaged, interested in the content of their work and more successful.

The relationship between professional fit and job and life satisfaction is particularly strong in people for whom their professional career is at the top of the hierarchy of values and is a source of self-fulfilment, which is confirmed by the degree of their commitment to work. Career matching also seems to be particularly important in the case of professional roles that require strictly defined personality predispositions and set tasks with a high degree of difficulty due to the number, degree of complexity or level of responsibility. Researchers of the subject emphasize that individual factors in the field of personality dimensions, like those in Holland's model, associate the prosocial type with high extroversion. Some of the studies reveal a personality profile characterized by a high intensity of the prosocial type, focused on coping with difficult situations, with high perseverance and emotional stability, but not associated with agreeableness and submission to others. At the same time, the explanation of the studied type through Holland's model allows it to be shown as focused on interests and activities related to people, not to things, but also to the world of ideas, related to analysis and abstract thinking (Markiewicz, Kaczmarek, Kostka-Szymańska, 2010; Bajcar, Borkowska, Czerw, Gąsiorowska, Nosal, 2006; Ochnik, Stala, Rosmus, 2018).

Therefore, it can be concluded that the personality traits of an individual have a fundamental impact on the direction of his or her professional preferences. These orientations are associated with specific cognitive abilities and personality traits, which is confirmed by numerous studies on human personality, theories related to it, as well as the assumptions of J. Holland's theory mentioned in the article, assuming that revealing professional preferences and career path are not something narrow, fragmentary, but a broadly understood form of self-expression, resulting from the permanent characteristics of a given person. Therefore, a person, deciding on a specific

career path, should absolutely not take up professions that do not match his permanent, individual personality traits and declared values. This is because it has extremely serious psychological consequences, diminishes the individual's resources and reduces their sense of agency. Therefore, the correctness of the choice of a profession that completely matches the complementary characteristics of a given person cannot be questioned by any arguments (Wilsz, Bał, 2015).

John Holland proposed a theory of career choice that is based on six types of professional personality: Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C). These types are often abbreviated as RIASEC. Holland believed that people choose professions that are compatible with their personality, and that matching personality type with the professional environment leads to greater job satisfaction and better professional performance (Holland, 1997):

1. Realistic (R): Preference for working with tools, machines, and practical, specific tasks.
2. Research (I): Interest in working with data, problem analysis, and theoretical issues.
3. Artistic (A): Tendency to creative expression, working with artistic ideas and materials.
4. Social (S): Interest in working with people, helping others and teaching.
5. Enterprising (E): Preference for influencing, managing, and taking risks.
6. Conventional (C): Propensity to work with data, organization, and procedures.

Holland's model is widely used in career counseling and helps individuals understand what professional environments are most compatible with their personality. Tests such as Self-Directed Search (SDS) are used to assess the type of RIASEC of an entity and help identify relevant career paths (Holland, 1997).

4. The Myers-Briggs Type Indicator

The Myers-Briggs Type Indicator (MBTI) was developed by Isabel Briggs Myers and her mother, Katharine Cook Briggs, based on Jung's theory of psychological types. The MBTI is a personality assessment tool that identifies 16 different personality types based on a combination of four dichotomies: extroversion/introversion (E/I), intuition/sensory (N/S), thinking/feeling (Y/F), and judgment/perception (J/P) (Myers, McCaulley, 1985).

MBTI is based on four dichotomies:

1. Extraversion (E) / Introversion (I): Directing energy to the external world of people and things or to the inner world of thoughts and feelings.
2. Intuition (N) / Sensory (S): Focusing on possibilities and patterns or on specific facts and sensory data.

3. Thinking (T) / Feeling (F): Making decisions based on objective criteria and logic or subjective values and feelings.
4. Judging (J) / Perception (P): Preference for structure and orderliness or flexibility and openness to new information.

Based on the combination of these dichotomies, 16 personality types are formed, each characterized by a unique set of traits and preferences. Examples of types are ENFP (Extraversion, Intuition, Feeling, Perception) or ISTJ (Introversion, Sensory, Thinking, Judging). Each type has its own strengths and areas for development, which can affect career preferences and job satisfaction (Myers, McCaulley, 1985).

5. Integration of Jung's theory, MBTI, and Holland's model

Research indicates significant correlations between MBTI personality types and career preferences according to Holland's model. For example, people with an MBTI ENFP (Extraversion, Intuition, Feeling, Perception) type often choose occupations that are consistent with the Artistic (A) or Social (S) type, while the ISTJ (Introversion, Sensory, Thinking, Judgment) type may be more likely to choose Conventional (C) or Realistic (R) occupations (Tieger, Barron-Tieger, 2014).

Examples of MBTI Type Matches to RIASEC:

1. ENFP (Extraversion, Intuition, Feeling, Perception):
 - Compatibility with the Artistic (A) and Social (S) types.
 - Preferred professions: writer, psychologist, teacher, counselor.
2. ISTJ (Introversion, Sensory, Thinking, Judging):
 - Compatible with Conventional (C) and Realistic (R) types.
 - Preferred professions: accountant, engineer, administrator, data analyst.
3. ENTJ (Extroversion, Intuition, Thinking, Judging):
 - Compatibility with the Enterprising type (E).
 - Preferred professions: manager, entrepreneur, lawyer, business consultant.

Research on the use of MBTI in career choices has shown that matching personality type to profession can lead to greater job satisfaction and better career performance. For example, research by Furnham (2001) indicates that people working in occupations that match their MBTI type achieve higher levels of job satisfaction and are more engaged in their work.

Similar results were obtained using Holland's model. Research shows that matching your personality type with your professional environment results in higher job satisfaction, less stress, and better professional performance. For example, a study by Holland (1997) found that people who work in occupational environments that conform to their RIASEC type are more satisfied with their jobs and perform better.

Studies conducted on large population samples indicate significant correlations between MBTI personality types and career preferences according to the Holland model. For example, a study by Macdani et al. (2002) found that people with the ISTJ type are more likely to choose occupations related to organization and data management, which is consistent with the Conventional type according to Holland. On the other hand, people with the ENFP type are more likely to choose professions related to creativity and social interaction, which is in line with the Artistic and Social types.

Longitudinal research allows you to track changes in career preferences and job satisfaction over time. For example, a study by Roberts and Robins (2004) found that matching personality type with the work environment has a long-term impact on job satisfaction and job stability. People who work in jobs that align with their MBTI type and Holland model are more likely to stay in their jobs for longer periods of time and achieve higher levels of job satisfaction.

Job preferences can vary by culture, which affects the interpretation of MBTI scores and Holland's model. For example, research by Wang and colleagues (2010) found that in collectivist cultures such as China, job preferences are more oriented towards social and collective occupations, while in individualistic cultures such as the United States, job preferences are more diverse and individualized.

In order for tools such as the MBTI and Holland's model to be useful in different cultural contexts, they need to be adapted. Examples include translating tests into different languages and adapting questions to specific cultural conditions. Research by Cheung and colleagues (2008) shows that such adaptations can increase the validity and reliability of personality assessment tools in different cultural contexts.

6. Conclusions

With the development of new technologies, such as artificial intelligence and machine learning, it becomes possible to assess personality and career preferences more precisely and comprehensively. An example would be the use of big data analytics to identify patterns of behavior and career preferences, which can lead to more personalized career guidance.

Practical implementation of theory integration:

- career counselling,
- career planning,
- recruitment and human resource management,
- applications.

Career counseling

The integration of Jung's theory, the MBTI tool and Holland's model can be particularly useful in career guidance. Career counselors can use these tools to better understand their clients' personality traits and help them choose a career path that aligns with their preferences and skills. For example, a career counselor might use an MBTI to determine a client's personality type, and then use Holland's model to identify potential occupations that would be most rewarding for that personality type.

Career planning

Individual career planning can also benefit from the integration of these theories. People who are aware of their personality type and career preferences can plan their career path more consciously. For example, a person with an INTJ (Introversion, Intuition, Thinking, Judging) type may choose to pursue a career in engineering, science, or technology, where their analytical and strategic skills would be highly valued.

Recruitment and Human Resource Management

Companies can also use these tools in their recruitment and human resource management processes. Understanding what personality types are most suitable for different roles in an organization can help you recruit employees who would be a good fit for their tasks and work environment. For example, an organization may use the MBTI and Holland's model to identify candidates who have personality traits suitable for teamwork, project management, or research.

Applications

Both Gustav Jung's theory of personality, the MBTI tool, and John Holland's model of career preferences offer valuable frameworks for analyzing and understanding career choices. The integration of these theories allows for a more comprehensive approach to career counseling, allowing for a better match of the career path to individual personality traits. Practical application of these tools can lead to greater job satisfaction, better professional results and more informed career planning.

Integrating Jung's theory, MBTI, and Holland's model with other psychological theories, such as Maslow's theory of motivation or Bowlby's theory of attachment, can lead to a more holistic approach to career choice. For example, taking into account intrinsic motivations and psychological needs can help to better understand why individuals choose certain career paths and how they can be supported in achieving job satisfaction.

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SHAPING SAFE AND HYGIENIC WORKING CONDITIONS FROM THE PERSPECTIVE OF IMPLEMENTING THE ASSUMPTIONS OF THE LEAN MANUFACTURING CONCEPT

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Purpose: The aim of the article is to show the importance given to working conditions in the hierarchy of employees' interests and to attempt to verify the question whether, when implementing LM solutions in enterprises, working conditions are consciously shaped in terms of employees' health, in the physical and mental sense.

Design/methodology/approach: In order to determine the rank of safety of working conditions among employees, a survey was conducted on a representative sample of employees from Lower Silesia. (Poland). The study was conducted in several companies from the Lower Silesia region. As a result, practices used in manufacturing companies when implementing 5S principles were identified.

Findings: The deployments analyzed did not consider the context of working conditions as a conscious goal of the measures taken. The potential impact of the implementations on the mental comfort, physical and mental health of employees was also not considered. The implementations did not measure the pre- and post-implementation status of working conditions, physical and mental health of employees. Companies focus on waste reduction (MUDA) excluding MURA and MURI.

Research limitations/implications: An important issue in conducting further research is the distinction between physical and non-physical factors shaping working conditions in the light of their impact on physical and mental health. The research was conducted regionally, which may limit the results and conclusions from the research to a defined cultural area.

Practical implications: The increased awareness of the importance of the MURA and MURI principles for the proper functioning of the Lean Management philosophy.

Social implications: To improve the quality of life, the implementation of LM tools should include appropriate training, personalization of workstations and the application of the MURI and MURA principles.

Originality/value: In the cognitive layer, the research allows for a better understanding of the phenomena accompanying the implementation of 5S practices and their impact on working conditions related to physical and mental health, both in the implementation phase of this practice and its further consistent use.

Keywords: 5S, Working Conditions, mental health, physical health.

Category of the paper: Research paper.

1. Introduction

The modern realities of business operation are referred to as the world of VUCA (volatility, uncertainty, complexity, ambiguity), or the world of BANI (brittle, anxious, non-linearity, incomprehensibility). This is accompanied by changes in the sphere of technical and organizational conditions for the implementation of tasks. The development of technology and technology cause us to deal with certain changes concerning workplaces, including their equipment. Aiming at the elimination of unnecessary waste, more and more often the importance is pointed out in this regard of standing the assumptions of the Lean Manufacturing concept and related management methods and techniques, also referred to as tools of this concept (e.g. 5S, kanban, Poka-Yoke, etc.). Their implementation in certain ways (positive, but also negative) can affect both the physical and psychological comfort of the people performing the work. In a broader sense, it can affect employees' perception of the issue of providing them with safe and hygienic working conditions (occupational safety and health - OSH).

Providing employees with safe and healthy working conditions should be considered as an important interest of employees. In the literature - for a long time now - it has been stated that employees are the primary stakeholder group (Stuart, 2002). In doing so, it is pointed out that it is extremely important to be aware of the expectations (interests) of employees (Maxwell, Knox, 2009). Thus, the self-awareness of employees and the organizations representing them regarding the need for basic solutions to ensure occupational health and safety as well as personnel policies to ensure the fairness of working conditions developed often at the philosophical-ethical or economic level deserves attention. Thus, the issue of the working conditions of employees is not only a matter of the enterprise itself, which employs the employee, but an element of the socio-economic order that ensures its sustainability. The literature states that the provision of safe and hygienic working conditions is considered a key area of socially responsible activities within the CSR concept (cf. Ruiz-Frutos et al., 2019; Macassa et al., 2021). These few sentences are meant to indicate the magnitude of the scope and gravity of the importance of the issue of working conditions and their formation in the enterprise.

With the above in mind, the aim in this article has become, on the one hand, to address the issue of determining the rank given by employees - among their interests - to safe and hygienic working conditions and, at the same time, to their elements. On the other hand, the article tries to present the problem lying at the interface between the implementation of lean production methods (lean manufacturing) and working conditions. These issues, in addition to those indicated above, this one is all the more relevant in light of the set of radical changes referred to in the literature as Industry 4.0 or the fourth industrial revolution. As a direct result of Industry 4.0, the need for employees to perform work in harmful conditions (physical health) has been reduced.

On the back of the enthusiasm for Lean methodology present in the Polish literature on the subject, and even more so in business practice, the question arises as to whether such a one-sided picture is appropriate, and whether perhaps there is something we should know about that somewhat demolishes this ideal picture. Such an attitude may be the result of an axiological context, often the evaluation of the Lean concept is derived from the results to which its application leads in the perspective of the employer/owner. Other perspectives for evaluating this philosophy are extremely rare omitting the perspective of other stakeholders such as employees. Sometimes evaluation from a perspective other than the owner's is simplistic and residual, and often discredited. It is this attitude that became the source and inspiration for this article and further conducting adequate research in this light. The evaluation of the research conducted was developed from the perspective of an employee for whom physical and mental health is one of the most important values. The article attempts to answer the question: do the working conditions co-created by Lean Manufacturing tools affect the physical and mental health of employees?

From here, further questions arise:

- What place in the hierarchy of employees' interests is occupied by ensuring safe and hygienic working conditions (OSH) for employees?
- In the surveyed manufacturing companies in Lower Silesia, were working conditions taken into account when introducing lean production solutions?
- Have the effects on the physical and mental health of employees been studied before and after the introduction of lean methods?
- Are the principles of LM application carried out correctly methodologically?

The idea of the research carried out is to juxtapose with each other, the key philosophies, principles and, practices of LM with the theory of working conditions and factors affecting employee health. The paper draws on the findings of other researchers (desk research) to define the meaning and scope of the issue. Further, the collected empirical material related to the identification of the interests of employees, including those related to ensuring safe and hygienic working conditions for them and those related to the implementation of Lean Management in manufacturing companies in Lower Silesia was used. As a result of the analysis, conclusions were drawn regarding the consideration of conscious shaping of working conditions when designing and implementing LM solutions in terms of employees' health, in the physical and mental sense. In these enterprises, the LM concept was most often not functioning and methods such as SMED, 5S, layouts or even work standardisation were not used in the management process. The implementation of LM in these enterprises consisted of implementing the 5S method. Due to the social sensitivity of the issue raised, the objects of the research were kept confidential.

The paper focused primarily on the link between the safety of working conditions and the implementation of 5S practices, which is one of the tools of the Lean Management concept. In particular, it was concerned with considering the awareness of employers and employees of

the benefits and limitations in the area of shaping this safety in relation to the implementation of 5S practices.

2. Theoretical background

2.1. Safe and healthy working conditions

The term safety is difficult to define unambiguously, as it is interdisciplinary in nature. According to one definition, safety should be linked to the ability to avoid harm resulting from a risk, hazard or threat (Cambridge Dictionary, 2021). Management literature - under the heading of occupational safety and health (OSH) - addresses the issue of keeping workers free from exposure to hazardous and damaging factors associated with working conditions. These factors may be of both a physical and psychological nature and may endanger the health and life of the person performing the work. The elimination or minimisation of the risks in question is, in turn, linked to a specific - and also changing - approach, preferred by the employer and the workers, to the shaping of the working conditions, i.e. their individual components. It becomes important to anticipate, recognise, control workplace hazards that may affect workers' health and safety, taking into account the impact on the surrounding communities and the environment (Alli, 2008; Cierniak-Emerych, 2023).

When defining the concept of working conditions, it is most common to point to definitions proposed by organisations concerned with conditions. For example, the European Foundation for the Improvement of Living and Working Conditions (EUROFOUND) defines working conditions as a set of factors relating to the working environment and aspects of a worker's employment. This includes issues such as:

- work organisation and worker activity (type of work),
- training, skills and competence development, employability (neologism employability),
- health, safety and well-being,
- working time and work-life balance.

More broadly, the organisation's understanding of the concept of working conditions can be gleaned from the range of questions posed in its five-yearly surveys since 1991. The surveys were conducted in 2015 (EUROFOUND (2019) 'Working conditions', <https://www.eurofound.europa.eu/pl/topic/working-conditions> (Date accessed the site 4.03.2019) and the European Working Conditions Telephone Survey (EWCTS) 2021 was also conducted in 2021. In each edition, the scope of the survey has been clarified and expanded.

Referring to the Polish literature on working conditions, it is stated that working conditions form a very diverse category. Conditions are most often considered by dividing their elements into two basic groups. These are tangible and intangible elements, within which specific

components are distinguished (Cierniak-Emerych, 2005; Cierniak-Emerych, Gableta, 2022). Among the former, physical, tangible, chemical, biological elements are listed, including, for example, equipment of workstations and rooms, lighting, microclimate, noise, etc. Intangible elements usually include working time, interpersonal relations, social and living activities. It can be assumed that safeguarding the health and life of employees is to a large extent linked to special attention to the proper formation of the material elements of working conditions.

Against this background, it is noteworthy that these material conditions have to be considered nowadays from a slightly different perspective than just a few years ago. This applies both to the specifics of the material elements of these conditions and to their impact on the mental health of workers. In both office and production work, there is widespread use of ICT equipment. This situation is conducive to an increase in the negative impact of these devices on the health of workers. The result of their use, as evidenced by the results of scientific studies, can be serious health problems, not only physical, but also mental. At this point, it is also worth noting the so-called technological addiction (Lin, Y.H. 2017) related to the human-technical object relationship. The issues indicated cannot therefore be ignored. They should, it seems, be highlighted within the material working conditions.

Additionally, with regard to the impact of working conditions on both physical and mental health, a special case is occupations that are characterised by high risk work. Research in this case indicates that - difficult physical conditions - cause employees to feel often or very often severe or very severe stress. It relates not only to discomfort in the performance of professional duties, but mainly to the sense of risk to life and health of those working underground. At the same time, however, it is known that this source of stress cannot be eliminated (Molek-Winiarska, 2015).

Many researchers have listed the characteristics of work that can increase mental tension, which Sperandio (1980) defined as "a term associated with the affective rather than the cognitive area and carrying with it all the negative effects and all the pollution associated with professional activity". Karasek and Theorell (1991, 1996) considered a combination of three dimensions to be special for generating stress: demands, control over work (autonomy) and psychosocial support. They developed a mental stress index that assesses psychological demands, control over work (autonomy) and social support (psychosocial). The basic idea of this indicator is that the complexity of work and social support offset the negative effects of excessive psychological demands. Karasek also showed that psychological tension resulting from the demands of work can be reduced by increasing the freedom to decide about work (autonomy). The combination of a small range of work decisions (control over working conditions) and high psychological professional requirements has been shown to be very stressful. Which, subsequently, resulted in, m.in cardiovascular diseases (Schnall, Landsbergis, Baker). This has been demonstrated in many empirical studies m.in. Stock et al. (2006), Lucifora and Cottini (2013).

Long-term exposure of an employee to stressors affects the mental health of employees, and subsequently the physical health. There are three ways of defining it in the literature (Cox et al., 2000). In the first stage, stress is understood as a set of stimuli describing the work environment, causing disorders in health and functioning. In the second approach, stress is defined as a reaction to the excessive demands of the work environment. These reactions are described in physiological, psychological, and behavioral terms. The third approach captures stress as a relationship or interaction between the environment and the employee. The OSI (Occupational Stress Indicator) questionnaire developed by Cooper, Sloan and Williams (1998) is one of the most frequently used tools in global research on occupational stress. This tool is mainly designed to measure the stress of managers. The OSI test examines the following stress factors:

- requirements overload,
- social relations,
- work-home balance,
- requirements of a managerial role,
- personal responsibility,
- everyday nuisances,
- appreciation,
- organizational climate.

Therefore, research can be carried out in the field of identifying factors shaping working conditions or, more anthropologically, their changes, to the strength of their impact on physical and mental health, well-being, productivity, creativity, etc.

Analyzing the literature, it can also be noted that the definition of working conditions has not changed drastically over the last dozen or even several dozen years. However, the authors of this article believe that security should be looked at more broadly. In their opinion, it is worth using the concept of safety of working conditions, which should be understood as the lack of an acceptable risk of a threat to health and life by the employee in certain circumstances of performing work. At the same time, it is assumed that the sources of these damages should be sought in the impact of material and non-material elements of working conditions.

Against this background, it is worth noting that a query of the literature on the issue of working conditions, from the perspective of implementing the Lean concept complexes that we are interested in in this article, gave the basis for the conclusion that there is still a lack of studies directly devoted to the issues we are interested in here. In the last few years, most publications concerned the working conditions of individual professional groups, such as: hospitality industry workers (Lugosi, Ndiuini, 2022) and women from deprived areas of South Africa (Stumbitz, Jaga, 2020), academics (Yildirim, Eslen-Ziya, 2021). Working conditions were also studied in relation to: migrants (Giordano, 2021), working mothers (Guy, Arthur, 2020), women employed in agriculture and the productive sector (Sarker, 2021).

2.2. Lean Manufacturing

In Poland, this system is called "lean production", "lean manufacturing", "lean management" or "lean organization" (Walentyńowicz, 2013). The origins of LM date back to the 1950s, this method was born after the end of World War II in the Toyota factory in Japan, and was improved over the next 20 years until it became the proper system (Walentyńowicz, 2013). The term "Lean Management" was first used by IMVP scientist John Krafcik. It comes down to the assumption that by producing the same or similar amounts of goods, factories using the above-mentioned system use half as much materials, raw materials, human resources, production space and need significantly smaller amounts of inventory compared to enterprises using mass production (Womack, 2008).

Operating according to the Lean concept involves the most effective use of available materials and company resources in order to obtain the best results. Mostly, it is a series of activities aimed at eliminating waste in a broad sense. Not only that occurring during the production process, but from the entire area located around it, including the network of logistic connections" (Walentyńowicz, 2013).

In Japan, three causes of waste have been distinguished (Kornicki, Kubik, 2008):

MUDA (waste) – when production exceeds demand, this method identifies seven basic types of waste, they are:

- overproduction,
- unnecessary supplies,
- improper transport,
- shortcomings,
- unnecessary processing,
- unnecessary downtime,
- excessive movement, multitasking (switching between tasks), walking between rooms/departments, switching between applications, bending, reaching, twisting/rotating the torso, crouching, jumping, walking.

MURA (variability) - sometimes production exceeds demand, and sometimes it does not exceed demand, unevenness in the broad sense of the word, causing sudden loading and underloading of our resources, e.g.

- no standards, no rules,
- incomprehensible rules and standards, complicated procedures and instructions,
- freedom of action,
- individual approach,
- work 4 days, 10 hours a day,
- four-brigade system,
- shift work,
- unequal use of machines and people,

- changes to work schedule,
- lack of standards regarding the work methods and tools used,
- undefined, non-standardized industry vocabulary,
- seasonality,
- variable workflow,
- unequal division of responsibilities,
- uneven pace of work,
- information scattered in various places or systems.

MURI (irrationality) – when demand exceeds production. Overload, strain, difficulties - everything that requires extraordinary effort and work. This component mainly refers to the overload of a person at work in a given organization, increasing his comfort and work ergonomics, and thus increasing the employee's efficiency. Typical manifestations of muri include:

- overloaded shelves, containers, carts, vehicles, people,
- operation of machines and devices, as well as people with higher than average loads,
- unergonomic workstation,
- overtime,
- accumulation of tasks,
- increased work pace,
- responsibilities beyond current competences,
- urgent reports and summaries "on demand",
- monotonous work (repetitive activities, constant body position),
- failure to delegate tasks (overload of managers and leaders),

This is one of several waste classifications, called 3M or 3MU. It strives to optimize the consumption of human resources, machines, equipment and materials necessary for the production of products, as well as to deliver them on time. Improving production efficiency therefore requires their waste identification and elimination of their causes. As Kornicki (2008) writes, if the management adheres to the principles consistent with the Lean philosophy, it can be expected that waste will be significantly minimized. Walentynowicz (2013) points out that the purpose of implementing Lean Management is to continuously improve the company through the use of appropriate tools that will allow you to completely get rid of waste. However, this is not the only goal, it also strives to improve quality, reduce costs and improve logistics liquidity.

The literature on the subject indicates a whole range of LM tools from basic TPM, through SMED, JiT, 5S and a number of methods to shorten the time of work on an element at the workstation, e.g. timings, layouts. The last group of methods is to focus on improving productivity at the workplace.

2.3. Lean manufacturing as a method shaping working conditions

In Polish literature, enthusiasm and an uncritical view of the LM are revealed. By taking a critical look at the goals and objectives of LM as they are widely used in the literature, we can see without much insight that the dominant goal of LM is to improve, solely production efficiency. Humans are reduced to the role of a "bio-robot" whose goal is to bring the highest efficiency, self-limiting unnecessary downtime or excessive movement. Reducing downtime can mean increasing time pressure, increasing the speed of performed activities, reducing micro-rests. Timings and layouts are often built in the light of radicalization of efficiency, forcing an increase in the intensity of work and improper, painful and burdensome postures or an increase in the risk of injuries and accidents caused by physical fatigue or mental fatigue. Fatigue causes a lack of concentration. It would seem that the theory of inverted U is overlooked, which clearly explains that no extrema of the explanatory variable gives the optimal long-term effect of the explanatory variable. Therefore, the high efficiency obtained by excessive workload (overload) is unsustainable in the long term.

It cannot and must not be denied that many LM solutions such as 5S allow for the improvement of material conditions and safety at work. Working conditions are not only material conditions, but also non-material ones, which strongly affect the mental sphere of the employee. The impact of working conditions on mental and further psychosomatic health is now becoming an increasingly frequent subject of research. In this context, we often talk about stress or burnout. Science has not yet developed certainties and paradigms in this area.

Globalization and the Industrial Revolution 4.0 changed the labor market, leading to the growth of the service sector, while production was moved to countries with lower wages. The process of globalization has also changed the organization of work in various sectors through the implementation of the concept of lean management. Lean management is widely considered to be one of the ways of organizing work (Valeyre, 2007) that has a negative impact on the health of employees. This is an extremely important statement in the context of the considerations conducted in the article. In the United States, the deterioration of workers' health occurred earlier than in the European Union, and lasted from the mid-1980s to the mid-1990s, as the first forms of LM-based production organization were first implemented in this country (Askenazy, 2001; Brenner et al., 2001, Fairris, Brenner, 2001). Research conducted at the beginning of the 21st century reveals that this phenomenon reached Europe in the 90s of the twentieth century (Daubas-Letourneux, Thébaud-Mony, 2001, 2003; Datta Gupta, Kristensen, 2008; Bertrand et al., 2011).

The study identified a relationship between several main factors of working conditions that contributed to the deterioration of employees' health. These factors included:

- repetitive work, its intensity,
- teamwork, the pace of work depending on the work of colleagues, machines,

- rotating schedules,
- adherence to quality standards, sitting position (Askenazy, Caroli, 2003, Stock et al., 2006; Gollac, 2005).

Figures for work-related accidents and occupational diseases in the United States began to decline in the mid-1990s. This seems to be because the role of the Occupational Safety and Health Administration (OSHA) has been strengthened (Askenazy, 2006). At the same time, the concept of corporate social responsibility began to be introduced in the USA as a way of indirect protection of employees and the environment. It should be noted here that historically in the US, health care is an organizational responsibility, and in Europe, it is a role of the state (Matten, Moon, 2008). Analysing working conditions is not just a matter of physical working conditions. Most of the labour resources are currently outside the sphere of production. In the sphere of production, physical health risks are relatively well recognized and studied. However, the situation is quite different in the case of services, especially in the field of mental health. Stock et al. (2006) identified workplace bullying and excessive psychological demands as factors contributing to the deterioration of health among workers in Canada. According to data provided by the International Labour Organization (ILO, 2022), there are 2.9 million deaths from work-related accidents each year, and 2.32 million people die annually as a result of work-related diseases.

To sum up the theoretical considerations and the achievements of researchers in the discussed area, it should be stated that the LM concept in its basic version, which was derived from the war economy, was basically oriented towards production efficiency, and in particular the efficiency of machines; humans were not the central point of this concept. It should be emphasized that working conditions may affect both the level of stress (mental tension) and the level of concentration, fatigue and tiredness, which may lead to incidents and accidents. Let's take as an example the work of a driver who, in order to maintain concentration and reaction time, is forced by law to rest. However, many professions do not notice this problem, leading to employee overload. However, the problem of overload is a phenomenon whose assessment is difficult and subjective, especially in the case of work that does not require physical strength and does not cause strong social consequences (road accident). Another phenomenon is the developing network of services in which contact with customers is an extremely important aspect. This applies to both public services (offices, etc.) and private services (business). Contact with the client is often very difficult and is associated with psychological tension. Basińska (2005) says that mental health deficits are the first signal of insufficient coping with the demands received. Chronic fatigue syndrome and burnout develop next, especially in people who are constantly exposed to contact with other people (Basińska, 2005). In this context, the question arises how to understand the intensity of work of people providing customer service; working in a call center; working with sick, disabled and elderly people, etc. So wherever contact with a large number of people is the main content of the work.

2.4. Method 5S

Preliminary discussions with representatives of the surveyed entities showed that these companies are implementing the LM approach in the first place by introducing the 5S method. So they start with cleaning. The content of the article therefore requires a brief explanation of what this method is. A tool supporting the solution of problems related to the organization of work is the 5S system (practice), the term of which is an abbreviation of the first five letters of the Japanese words: *seiri* – *seiton* – *seiso* – *seiketsu* – *shitsuk* (Gapp et al., 2008), which is most often translated as: selection – systematics – cleaning – standardization – self-discipline. The 5S system allows, as it is emphasized, not only to improve the organization of work, but also to improve working conditions and safety (Karaszewski, 2009).

Therefore, attempts are being made to "expand" this system with another S, i.e. safety, i.e. safety understood as safe and hygienic working conditions. As a result, the concept of 5S+1 or even 6S appears (Gajdzik, 2014; Junewick, 2002; Becker, 2001).

5S practices, as Zimon states, have a positive impact on the state of material working conditions, creating opportunities to minimize the costs of reorganization (Zimon, 2012) carried out at workplaces. Reference to 5S requires consideration (Gapp et al., 2008; Szatkowski, 2014):

- *seiri* as the selection and elimination of what is superfluous,
- *seiton*, which is an expression of systematics, segregation and sorting,
- *seiso* corresponding to the cleaning category,
- *seiketsu* who prefers standardization, and thus order,
- *shitsukae* referring to self-discipline.

They are related to the introduction of order, elimination of unnecessary equipment and objects of work, discipline, including self-discipline, also in the use of personal and collective protective equipment, etc. This results not only in a clean and pleasant working environment, but also – in relation to the interests of employees – in the improvement of the level of work safety (Imai, 2006; Karaszewski, 2009; Krasieński, 2014), which is conducive to the involvement of employees in work and organization (Juchnowicz, 2010), and as a result, an improvement in the image of the company as an employer.

Safe working conditions as a consequence of the application of 5S practices result directly from the essence of the system in question. This is because this system somehow enforces respect for legal regulations in the field of occupational health and safety, but also the definition of internal guidelines regarding the desired behaviors and activities at workplaces, important from the point of view of occupational safety of interest here. Thus, the preferred "enrichment" of the system in question with another S seems unnecessary in this context. "Good management in one's own workplace and in its vicinity" (Aluchna, Płoszajski, 2008) – as the 5S system is referred to – also means management that is safe for people, taking into account the implementation of their interests in this area.

3. Research methodology

In search of answers to the first of the research questions formulated in the Introduction to this article, reference was made to the results of empirical research conducted:

- in 2018-2020¹ among employees. The information was collected using a survey. The PAPI (Paper and Pencil Interview) technique was used. Additionally, the research also used in-depth interviews in the form of informal interviews²,
- in the years 2020-2023 using a loose interview.

The research conducted in 2018-2020 used a survey questionnaire³ addressed to a randomly selected sample of people providing work (based on an employment relationship or, for example, a mandate contract) employed in enterprises registered in the Lower Silesian Voivodeship. Based on data from EURES (European Job Mobility Portal), it was determined that the population of employees (in the Lower Silesian Voivodeship, in the enterprise sector) in 2018 was 484,100. For the purposes of the study, a random sample of $n = 274$ was taken from a finite population employees employed in enterprises registered in the Lower Silesian Voivodeship. Assuming a 6% maximum estimation error, a significance level of $\alpha = 0.05$ and an estimated size of the fraction of 0.5 for a finite population of $N = 484,100$, the minimum sample size is $n = 267$. To obtain the randomness of the sample, a sampling frame was used in the form of a database of employed employees in enterprises registered in the Lower Silesian Voivodeship coming from the employee population defined for the purposes of the study (Cierniak-Emerych, Gableta, 2022; Cierniak-Emerych, Pietroń-Pyszczek, Zareba, 2023).

Women constituted 50.4% and men - 49.6% of the survey respondents. 24.5% of respondents were under 30 years of age, and every fourth respondent was aged 31-40. The largest group covered by the study were people aged 41-50 (28.8% of respondents).

In the years 2020-2023, taking into account changes in economic realities, including the Covid-19 pandemic and the war in Ukraine, loose interviews were conducted and addressed to respondents previously covered by the study. Those who agreed to it were selected (approx. 40% of those surveyed).

In turn, looking for answers to the three remaining research questions included in the introduction, due to the qualitative nature of the discussed issue, the case study method was chosen to present it, focusing more on its in-depth understanding. The point is to discover what the results of quantitative research can only suggest (Wójcik, 2013, pp. 17-22). The analysis of

¹ The research results presented here are part of broader research into employee interests and how far they are respected by one of the co-authors of this article, and presented in a broader context in a monograph (Cierniak-Emerych, Gableta, 2022).

² Cooperation with the IPC Sp. z o.o. Research Institute was used at this stage of the research.

³ The questionnaire covered a range of interests. For more information on the questionnaire, see (Cierniak-Emerych, Gableta, 2022).

available documents was used, as well as participant observation and informal interviews conducted with management representatives and employees of selected 5 enterprises from Lower Silesia involved in the implementation of the Lean concept, which was associated in particular with the use of 5S⁴. In other words, an in-depth individual interview (IDI) was used, i.e. a direct method of primary survey measurement, in which the respondent is the active object of measurement and there is direct communication between the people subjected to the measurement and those carrying (conversation) (Kaczmarczyk, 1999, p. 252). The analysis was carried out using the descriptive method. The main aim of the study is to determine whether the consequences of its implementation for the physical and mental health of employees were taken into account during the implementation of the LM concept.

4. Research results

Looking for answers to the first of the indicated research questions (what is the place of ensuring safe and healthy working conditions for employees in the hierarchy of employees' interests) during the research conducted in 2018-2020, it was revealed that occupational health and safety takes first place among the category of their interests considered by employees (96.3% of respondents' indications). The above indications for safe and healthy working conditions were also confirmed by the parametric results from the sample. The mean for the answer to the question about the degree of importance of health and safety is 4.54 with a standard deviation of 0.593. The median value is 5.0 and the dominant value is 5.0. The value of the asymmetry coefficient is -1.095. It is worth adding here that the next places in the hierarchy of employees' interests were taken by interests related to ensuring pay adequate to the duties performed (96% of responses), followed by 92% of responses, good atmosphere at work. Also in the 2020-23 survey, occupational health and safety was considered by respondents to be their most important interest. In this context, it should be added that occupational health and safety has somewhat become more important among the interests of employees, as stated by respondents, especially due to the Covid-19 pandemic and its consequences.

Subsequently, the research sought answers to the next three questions included in the Introduction, i.e. Were the broadly understood working conditions taken into account when implementing Lean Manufacturing solutions in the surveyed companies in Lower Silesia that implemented at least elements of LM? Was the impact on physical and mental health of employees studied before and after the implementation of lean methods? Are the rules for the use of LM carried out methodically correctly?

⁴ Attention was focused on companies where the management declared that they had implemented the Lean concept and, at the same time, agreed to participate in the study.

The results of the research indicate that during the implementations, the concentration of implementation teams was focused in particular on the search for and elimination of waste, i.e. MUDA, while omitting the application of the MURI and MURA principles. During the research on the part of enterprises, words such as uniformity or overload were not used to describe the objectives of the implementation. The main emphasis was placed on increasing efficiency, e.g. by reducing the time needed to search for tools, and thus increasing the time for performing production tasks, an additional expected result of the implementation was the improvement of work safety, understood as material working conditions. There is no denying that the principles of 3MU are often internally contradictory and the use of one causes the violation of the other. For example, improving layouts and timings can lead to overloads and uneven workload, but it will improve efficiency at the workplace (reduce waste).

Referring to the specific tools of the Lean concept, it is worth noting that the implementation of the 5S practice did not differ significantly in the surveyed entities. The market in which they operate is stable and competitive. The organization of work in enterprises is based on the division of responsibilities, in which specific tasks are assigned to specific areas and employees.

In the light of the results of the research, answering the question: Were the broadly understood working conditions taken into account when implementing Lean Manufacturing solutions in the surveyed companies in Lower Silesia, which implemented at least elements of LM? It was found that most of the measures were aimed at improving efficiency by reducing the loss of time. On the other hand, in response to the question whether working conditions were taken into account during the implementation of Lean tools, the results of interviews and document analysis indicate that working conditions were not indicated as the purpose of implementing this method. It was also not checked whether work does not cause negative changes in the employee's mental health. At the same time, the implementation work was not supervised by an OHS expert. However, it can be said that the physical working conditions have been unintentionally improved by removing unnecessary objects and creating space for individual materials, tools and equipment. It should be noted, however, that in two cases some actions were identified to improve health and safety of working conditions. In the first case, it concerns the change, use and control of protective clothing and the use of other personal protective equipment. In the second case, it was pointed out that it was necessary to include the OHS instructions contained in the 5S rules.

The interviews show that the places for individual items were not always correctly indicated. By achieving the effect of standardization and systematization, ergonomics and optimization of processes are achieved. The implementations did not verify the effects of the implementation in terms of the impact of the changes on the health of employees, their well-being at work or the level of stress they experienced.

The survey shows that in connection with the implementation of e.g. 5S principles, employees felt: fear that they would not be able to cope with the new requirements; fear that they would not adapt to the new order, that they would have to look for something longer,

with the current state considered good; fear that the cleaning process will take more time and they will not perform basic tasks; fear that cleaning will have to be carried out after the working time agreed with the employer (without appropriate overtime); fear that the work environment will start to resemble a sterile laboratory.

The interviews show that the feeling of anxiety did not disappear, but was replaced by a habit that weakened its effects. The 5S method, considered an important element of the Lean Management approach, has been implemented in a way that raises many concerns among employees. The implementation of 5S did not take into account the mental health and well-being of employees.

To answer the question: Has the impact on the physical and mental health of employees been studied before and after the implementation of lean methods? It was found that no such studies were conducted. We can identify a certain picture by analyzing the number and place of accidents at work.

The last question concerned the correctness of using LM methods. Are the rules for the use of LM carried out methodically correctly? The observation showed that the implementation of 5S itself was carried out quite correctly. Particular attention is paid to conducting introductory training to alleviate the feeling of stress. The methodology of LM or LO itself does not take into account the specificity of individual departments. In the interviews, the fight against waste (MUDA) was emphasized, while no one even mentioned MURI and MURA. This means that the understanding of LM is limited only to improving efficiency by eliminating waste.

5. Discussion

The analysis presented in the article allowed to draw conclusions on the importance given among the interests of employees to the issue of ensuring safe and hygienic working conditions and taking into account and consciously shaping these conditions when designing and implementing LM solutions in the light of ensuring employees' physical and mental health.

As demonstrated, the issue of providing them with safe and healthy working conditions is a key interest in the opinion of the respondents surveyed in 2018-2023. This should not be surprising, in particular, that the results of research presented in the literature on the subject prove that, for example, excessive workload and extended working hours prevent the employee from regenerating adequately (Sánchez, 2017). In turn, improving working conditions has a positive effect on the health and well-being of employees (Belloni, Carrino, Meschi, 2022) (Bratberg, Holmås, Monstad, 2020). All this also affects work efficiency.

Another question that arises is the limits of improvement so that they do not lead to overload. Here another question arises, when to talk about overloading the employee. From a practical perspective, this is a challenge for building labour standards.

Comparing the main causes of deterioration of health, repetitive work, its intensity, teamwork, work pace dependent on the work of colleagues, machines, rotational schedules, compliance with quality standards, sedentary posture (Askenazy, Caroli, 2003; Stock et al., 2006; Gollac, 2005) with factors lying in the area of MURA and MURI, it can be said that the application of these two principles should mitigate the impact of MUDA reduction at the workplace. However, the research shows that the practice is different. When implementing LM, companies focus on reducing waste in its simplest form. At the same time, apart from the application of the MURA and MURI principles.

This is confirmed by the results of research conducted in the USA and Europe, where it was only the activity of trade unions that forced the actions of relevant state institutions, forcing changes in the approach of enterprises to shaping safe material conditions of work.

Another effect of standardization and systematization is the depersonalization of the workplace, which means for the employee and the employer:

- easier preparation of a new employee for the position, shortening the training time to the level of expected efficiency,
- mismatch of the workplace to the physical characteristics of individual people, in the case of people with physical parameters not adapted to the norm, it is possible to work only in a strenuous position, which may lead to deterioration of the health of the musculoskeletal system, which should also be understood as a kind of exclusion,
- exclusion of people with reduced mobility from work,
- instilling a sense of substitutability among employees, which leads to a decrease in their motivation and self-esteem,
- fear of losing your job.

The results of the study encourage the development of solutions within the implementation of Lean assumptions, especially in the 5S system, which will also ensure:

- improving production efficiency,
- occupational health and safety (physical and mental health),
- the level of workplace organization that guarantees a certain level of personalization,
- standardization of work guaranteeing minimization of overloads,
- changes in work position, the use of position variation, e.g. changing every other day or during a shift, so as to achieve the effect of changing position,
- alleviating negative emotions in the process of implementing new management methods.

This solution can be offered by tailoring the 5S principles to individual employees. It can be said that this would mean the development of the 5S+P concept. In addition, many negative emotions and behaviors can be avoided by showing all employees a broader vision of the production system and the place of individual employees. In the case of planned redundancies, indicate ways to support employees in getting a new job or improving their

competences. Detailed LM methods should be introduced only after ensuring an appropriate level of knowledge and a sense of security of employees.

6. Conclusion

An important problem in conducting further research is to distinguish between physical and non-physical factors that shape working conditions in the light of their impact on physical and mental health. There can be physical conditions that affect mental health, but there can also be non-physical conditions that affect physical health. The question is also whether health should be considered psychosomatic so that conditions can have a greater impact on physical and mental health. Today, the labour market is changing and more and more work is being done in the service sector, where working conditions and health problems are shifting the focus from physical to non-physical working conditions and from physical health to mental or at least psychosomatic health. There is also a practical problem of standardizing work based on the principle of limiting overload while maintaining adequate efficiency.

The practical usefulness of the research can be considered to increase awareness of the importance of the MURA and MURI principles for the proper functioning of the Lean Management philosophy.

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AFFORDABILITY OF RENTAL APARTMENTS IN POLAND IN COMPARISON TO SELECTED EUROPEAN UNION COUNTRIES

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Purpose: The aim of the article is to present the affordability of rental prices in relation to property sales prices and to assess the situation in Poland compared to selected European Union countries.

Design/methodology/approach: To examine rental affordability in Poland, the ratio of average rents to incomes was determined in the 7 largest cities, and compared. Rental prices for a standardized apartment size (50 m²) were calculated for selected EU capitals based on average rent per m² rates, and their ratio to average monthly earnings of a full-time worker was assessed.

Findings: Based on the conducted analyses, it can be concluded that despite the increase in average rents in the surveyed Polish cities, rental affordability is improving. This is due to the fact that incomes are rising faster than rental prices. Simultaneously, while rental costs in Poland burden budgets significantly, Warsaw's situation is not the worst among the selected European capitals. There are cities where high incomes do not guarantee ease of renting. Affordability is very limited, and housing expenses consume a significant portion of earnings (more than in Poland).

Research limitations/implications: The analysis of rental affordability in Poland was conducted for the 7 largest cities. Further analysis for smaller cities would be valuable to assess affordability in smaller, local rental markets. In the context of the European market analysis, calculations were based on selected EU capitals due to data availability regarding rental rates, making it difficult to generalize the situation across entire countries. These limitations suggest potential directions for further research focusing on both local markets within Poland and considering the situation across entire EU countries. Future research should also focus on developing new indicators and evaluation methods for housing affordability, as well as assessing the effectiveness of various housing policies.

Practical implications: Determining rental affordability can provide crucial information for governments developing support programs for individuals struggling to afford rent, as well as for property owners and developers making decisions regarding new investments and property purchases for rental purposes based on investment returns. Knowledge of rental affordability can assist in adjusting market offerings and pricing strategies to meet market needs.

Social implications: Studying rental affordability reveals the scale of issues related to mismatching rental prices with societal income levels. Affordable housing could increase societal mobility, enhancing income by providing access to better-paying jobs, education,

and services. Affordable housing provides residents with a greater sense of stability, influencing quality of life and reducing stress.

Originality/value: Rental affordability is a growing concern in the EU. While numerous indicators address this issue, most focus on the property sales market. The authors identified a gap in studying rental affordability, particularly in a European context. This research targets investors in the rental market, developers, and governments influencing rental rates.

Keywords: rental market, rental affordability.

Category of the paper: research paper.

1. Introduction

Rental housing affordability is a crucial element of housing markets across Europe, and housing accessibility issues have broad social and economic implications. In recent years, the issue of rental affordability has gained prominence, especially in the context of urbanization, demographic changes, and the concept of sustainable housing market development.

In many European countries, including Poland, the rental market plays a pivotal role in providing housing solutions for diverse social groups, from young individuals seeking flexibility to families in need of stability and security. However, varying economic conditions, regulatory frameworks, and housing policies significantly influence the dynamics of rental housing affordability. Understanding these factors is crucial for policymakers, investors, developers, and tenants navigating the complex landscape of housing provision and rental pricing strategies.

This article aims to explore and compare the affordability of rental housing in Poland with selected European Union countries, focusing on key factors influencing rental affordability. The study centers on assessing rental housing affordability by analyzing the ratio of average rents to incomes in major Polish cities and comparing them with selected capitals in the EU. Through this analysis, the article seeks to provide insights into the challenges and opportunities of the rental housing sector, aiming to support evidence-based policy decisions and strategic investments.

2. The concept of rental housing affordability

Housing costs are among the largest expenditures for households in Europe (Eurostat, 2024). High rental costs, mortgage payments, and other housing-related expenses significantly impact finances, quality of life, and social mobility. Analyzing and understanding these costs are crucial for developing effective housing policies, increasing housing affordability broadly defined, and thereby improving citizens' living conditions (Molloy, 2020). High housing costs

can exacerbate social inequalities, especially in cities where incomes do not rise proportionally to the cost of living.

Housing affordability, understood as the extent to which residents of a particular area can meet their housing needs considering their incomes, property prices, and rents, is a key element of social and economic policy in many countries. It influences citizens' quality of life and economic stability. This concept refers to the ability of different social groups to acquire or rent housing based on their incomes and housing needs. In the literature, housing affordability is examined from multiple perspectives, encompassing economic factors (Bryx, Rudzka, 2021), social factors (Rolfe, Granham, Godwin, 2020; Hick, Pomati, Stephens, 2020), and spatial considerations (Haffner, Hulse, 2012; Szumilo, 2018; Cavicchia, Peverini, 2022).

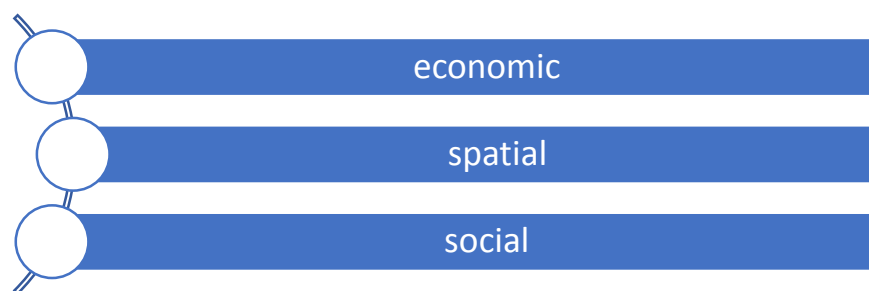


Figure 1. Dimensions of housing affordability.

Source: Own study.

The term "affordable housing," although often used synonymously with "social housing", has its own definition and policy instruments in specific cities and countries. However, the boundaries between these concepts remain relatively unclear, and affordable housing is increasingly becoming a distinct field parallel to the development of social housing (Czischke, van Bortel, 2018).

Many factors influence housing affordability. The most important ones include:

- Household incomes: Higher incomes increase the ability to purchase or rent housing.
- Property prices and rental levels: Increases in property prices and rents can reduce housing affordability.
- Housing policy: Government support programs such as rent subsidies, construction of communal housing, and real estate market regulations significantly impact housing affordability.
- Credit conditions: Ease of obtaining mortgage loans and interest rates affect the purchasing power of potential buyers.
- Demographic factors: Demographic changes such as population aging or migration also affect housing demand.

The term "affordable housing" is typically used in countries where both the rental market and housing acquisition system are highly developed, with rental affordability becoming a significant issue (Bryx, 2021). Since the global financial crisis, housing affordability has gained greater political importance in many countries worldwide. Nationally, housing policy

development increasingly follows global political trends, and the emergence of new policies addressing housing affordability relies on networks involving global political entities, housing experts, and consultants (Murphy, 2014).

Bryx (2021) emphasizes that the definition of affordable housing in Poland should focus on two directions. Firstly, the purchase of housing to meet personal needs, and secondly, efforts to increase the number of rental apartments available, which is crucial for meeting societal housing needs. As indicated above, Poland is characterized by a relatively low percentage of rental apartments in the housing stock. Simultaneously, in order to pursue these directions, state-offered rental housing should be financially accessible (cheaper than those on the free market), and the increase in investment purchases should not limit the ability to purchase housing for personal residential purposes.

Housing affordability is a significant focus in real estate market research. It is analyzed in the context of housing policy formulation (Strączkowski, 2022; Marona, Tomasik, 2023; Machalica, Nowak, Potocki, 2023), housing market financing (Bryx, Rudzka, 2021), as well as the sustainable development of the market (Bryx, 2021; Lis, 2021).

Income-based rental affordability is a concept within housing affordability, focusing solely on the ability to rent housing in relation to household incomes. International comparisons of rental affordability may be challenging due to:

- Rental costs: Analyzing rental prices across different cities and countries in Europe, where costs can vary significantly by location, impacting income-based affordability.
- Household incomes: Analyzing household incomes, a key element in assessing income-based affordability, which may be evaluated in terms of median or average incomes in a given location.
- Housing policies: Regulations influencing the rental market, such as rent control, tenant support programs, or social housing construction (Yang, Zan, Chen, Jie, 2014).

Discussions on housing affordability and income inequality are increasingly linked to the concept of income quintiles, a statistical tool used to analyze income distribution within a population. Quintiles divide the population into five equal parts, each representing 20% of the whole. Researchers, policymakers, and organizations dealing with housing and social policy use income quintiles to better understand and assess how different income groups are affected by housing issues and income inequalities (OECD, 2016; World Bank, 2018). Using income quintiles in the analysis of housing affordability allows for: identifying the most affected groups, evaluating housing policies, and understanding regional differences (Dewilde, Bram, 2013).

Discussions on the affordability of housing and income inequality are closely intertwined due to several reasons:

1. **Impact of Incomes on Housing Affordability:** Income inequalities directly affect the ability of different income groups to purchase or rent housing. Households with lower incomes face greater difficulties in accessing affordable housing, thus exacerbating their economic situation.
2. **Social and Economic Issues:** Income inequalities can lead to social problems such as housing segregation, lack of housing stability, and social exclusion.
3. **Public Policy:** Understanding the linkages between housing affordability and income inequalities is crucial for shaping effective public policies. These policies may include housing support programs, tax reforms, rental market regulations, and initiatives to increase the affordability of affordable housing.

The scale of housing affordability issues varies across European countries, with differences less related to wealth levels and more influenced by classifications within the social welfare system. In many countries, housing problems are often more prevalent among market renters than homeowners burdened with mortgages, although this is not always the case. The rental market position in relation to homeownership affordability deteriorated between 2010 and 2018 in most European countries (Hick, Pomati, Stephens, 2022).

There have been discussions in the literature for several years about the global crisis of urban housing affordability and accessibility. This crisis stems from the fact that household housing expenditures are rising faster than wages and salary increases in many urban centers worldwide. This situation has been driven by at least three global megatrends emerging after the global financial crisis: accelerated urbanization of capital and people, provision of cheap credit, and increased inequality within societies (Wetzstein, 2017).

Confirming the global pursuit of affordable housing are three supra-national programs formulated within the United Nations framework: Sustainable Development Goals (SDG 11), New Urban Agenda Habitat III (UN, 2017), and the European Union's Urban Agenda (European Commission, 2016). In various formulations, these programs promote sustainable access and living in affordable and adequate housing conditions.

The issue of accessibility also pertains to the rental housing market across different regions worldwide, which has been the subject of numerous studies and analyses. For instance, over the past few decades, American metropolitan areas have witnessed increasing income inequality and deteriorating rental affordability. Income inequality has been the focus of research revealing its direct impact on rental affordability for low-income households. This research also indicated that incidental factors play a significant role in determining housing affordability for many individuals seeking housing. This suggests that housing policies and demand-side programs cannot be overlooked (Dong, Hongwei, 2017).

Financially, studies examining the relationship between changes in mortgage interest rates and housing affordability have shown a strong seasonal and bidirectional link between rental housing affordability and homeownership affordability. An increase in homeownership affordability affects rental affordability, but this relationship appears stronger in the reverse direction, where rental affordability influences homeownership affordability. Furthermore, rental affordability affects homeownership affordability with a one-year lag, and the reverse causality diminishes. Therefore, policies aimed at controlling housing price inflation should focus on influencing rental market prices rather than mortgage interest rates (Squires, Webber, 2019).

3. Measures of housing affordability

Housing affordability refers to the costs of housing services and shelter – both for renters and homeowners – relative to the disposable income of an individual or household. Despite the lack of a universal definition for this term, the concept of housing affordability is generally understood. However, practically determining affordability is complex, especially in defining appropriate geographic market scopes, representative units or households, and accounting for changing circumstances over time. At its most basic form, housing affordability relates to the ratio of rent to income or the ratio of house price to income. More advanced measures of affordability consider additional aspects such as:

- The extent to which non-housing expenditures are constrained by the amount remaining after housing costs are paid,
- Beyond "income affordability," distinguishing "purchase affordability" (the ability to secure a mortgage for home purchase) and "repayment affordability" (the ability to service mortgage repayments for a home).

There are numerous indicators used to assess housing affordability, each differing in their definitions and calculation methods.

The National Bank of Poland (NBP) utilizes two indices in its analyses: the housing accessibility index and the credit accessibility index. According to NBP (2024), the housing accessibility index is an income-based measure indicating the square meters of housing that can be purchased at the transaction price equivalent to the average monthly wage in the corporate sector in a given city. It reflects the number of square meters of housing that can be acquired based on the average transaction price in the market (40% from the primary market and 60% from the secondary market, according to NBP's database).

The credit accessibility index, on the other hand, determines the number of square meters of housing that can be purchased using a housing loan, considering the average monthly wage in the corporate sector in a given market (as per the Central Statistical Office, GUS), along with

bank credit requirements and loan parameters (interest rate, amortization period, minimum subsistence as residual income after mortgage payments) based on the average transaction price of housing in the market (calculated similarly to the housing accessibility index). The informational significance lies in the index's rate of change and the spread across markets.

In Europe, housing affordability is often defined using the Housing Cost Overburden Rate published by Eurostat, which measures the percentage of the population living in households where total housing costs (net after deducting housing allowances) exceed 40% of disposable income (net after deducting housing allowances). This approach is also employed by the OECD in studies related to affordable housing. In the EU in 2022, 10.6% of the urban population lived in such households, while the corresponding rate in rural areas was 6.6%. The highest rates of housing cost overburden in urban areas were observed in Greece (27.3%) and Denmark (22.5%), and the lowest in Slovakia (2.3%) and Croatia (2.6%). In rural areas, the highest rates were in Greece (24.2%) and Bulgaria (18.1%), and the lowest in Malta (0.2%) and Cyprus (0.5%). Housing cost overburden was higher in urban areas compared to rural areas in 20 EU member states (Eurostat, 2023).

In the United States and Australia, a threshold of 30% is commonly used. The Global Housing Watch takes a slightly different approach, defining housing as affordable if the ratio of house price to household annual income does not exceed 3.05 (Housing Affordability and Sustainability in the EU, Analytical Report, 2019).

In the United States, the "rent burden" indicator is used, which identifies the financial burdens households face from rental costs. Households spending more than 30% of their income on rent are often categorized as "rent burdened", and those spending more than 50% of their income as "severely rent burdened". According to the Joint Center for Housing Studies of Harvard (2024), a record 22.4 million renting households in 2022 spent more than 30% of their incomes on rent and utilities. This marks an increase of 2 million households over three years, completely offsetting the modest improvements in cost burden rates seen from 2014 to 2019. Among cost-burdened households, 12.1 million had housing costs that consumed more than half of their incomes, the highest value recorded to date.

4. Rental housing affordability in Poland

The aim of the article is to present and assess the rental market situation regarding housing affordability in Poland. The rental market situation will be presented analogously to the sales market. The empirical material of the article concerns the situation across Poland and its 7 largest cities and will be compared to the situation in the European Union. Numerical data is sourced from Eurostat, the Central Statistical Office of Poland, and materials from the National Bank of Poland and AMRON, covering the period from 2019 to 2024. The collected and

subsequently organized empirical material has been processed using a comparative method and presented in graphical and tabular form.

One of the best indicators determining the degree of housing satisfaction in a given country is the number of dwellings per 1000 inhabitants. As Figure 2 shows, the average indicator for the European Union was 475 dwellings in 2023. Among the analyzed countries, Poland ranked third from the bottom with an indicator of 413 dwellings per 1000 inhabitants. The best situations were observed in Portugal (585 dwellings), France (552 dwellings), and Lithuania (549 dwellings). Despite Poland's less favorable position compared to other countries, it is important to emphasize that this indicator has been steadily improving (mainly influenced by the number of dwellings put into use, as well as a decreasing population). In 2018, this indicator was as low as 380 dwellings for Poland¹.

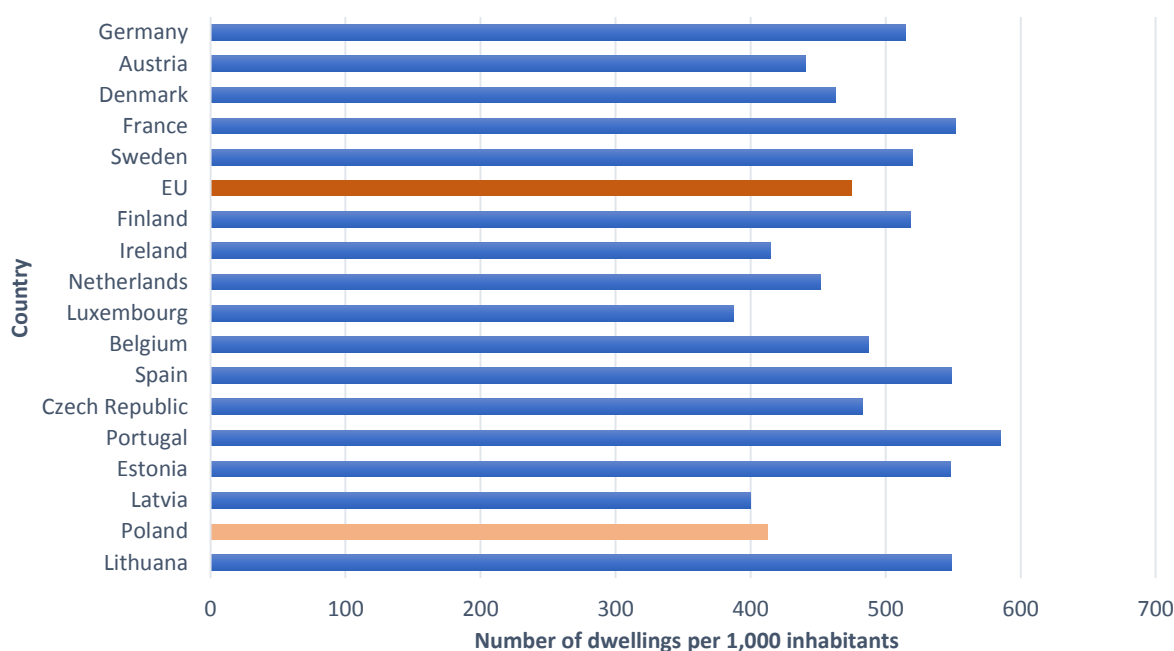


Figure 2. Number of dwellings per 1000 citizens in selected European Union countries.

Source: Own study based on Eurostat (2023).

In Poland and Eastern European countries (Lithuania, Latvia, Estonia), the majority of the population owns their homes. These are countries where rental housing does not exceed 20% of the ownership structure. It can be observed that Poles consider renting an apartment as something inferior, whereas in Western European countries, it is completely the opposite. The average level of homeownership is 69%, with countries like Germany (46.50%) and Austria (51.50%) where homeownership is beginning to give way to rental housing (Figure 3).

¹ Data from the Central Statistical Office (GUS) regarding basic indicators of housing resources in 2018. <https://bdl.stat.gov.pl/bdl/dane/podgrup/tablica>, 25.06.2024.

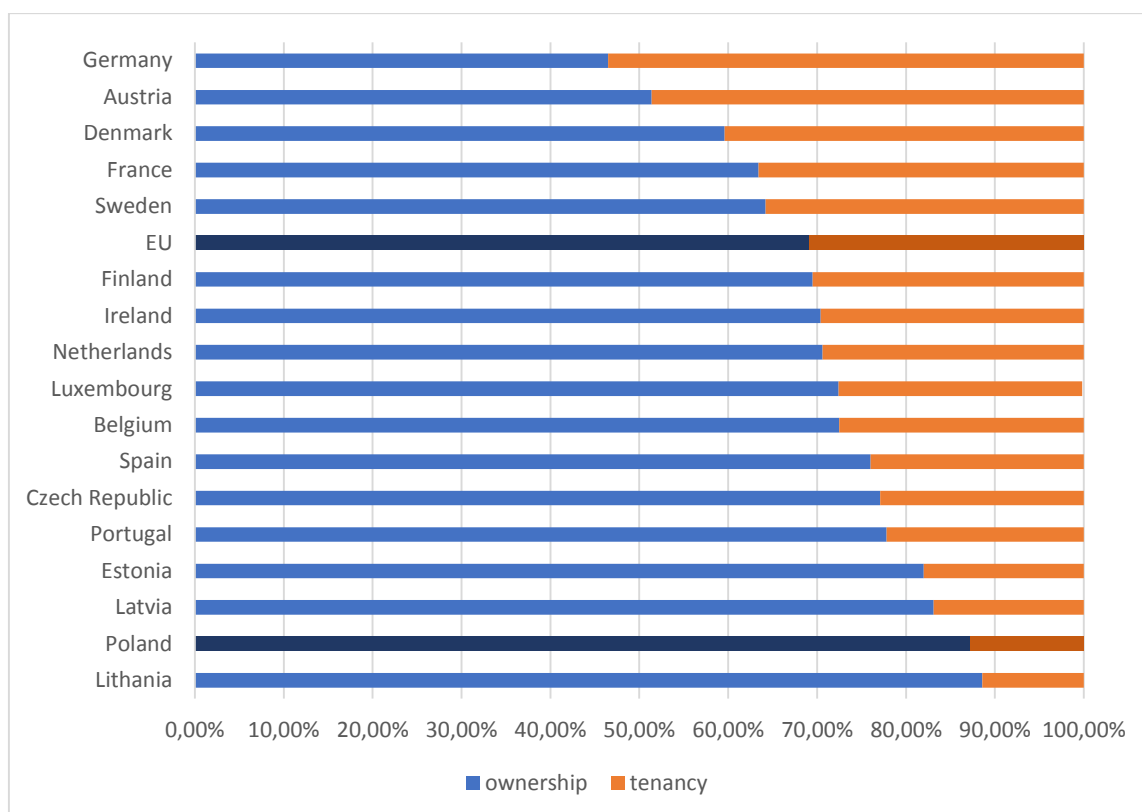


Figure 3. Ownership structure of dwellings in selected European Union countries.

Source: Own study based on Eurostat (2023).

The affordability indicators of housing mainly concern the market of residential properties intended for sale, yet for the purposes of this article, they are also presented in the context of the rental market, referring to the rental affordability ratio. The housing affordability ratio, defined in foreign literature² as the ability of households to meet the costs of purchasing or renting a property, has been included in the article with regard to the rental market. For many individuals, purchasing a home represents the largest expenditure in their lifetime, and the costs associated with maintaining a residence (mortgage, rent, operating expenses) constitute one of the largest categories of household expenses. To assess it, the average level of home prices/rental rates is compared to the average household income. Additionally, housing cost burden indicators can be calculated, which represent the percentage of the population for whom housing costs exceed 40% of disposable income (including utility costs).

In Poland, the measure of housing affordability is the indicator used by the National Bank of Poland (NBP), where housing affordability is defined as the ability to purchase a certain area of housing expressed in square meters based on the average monthly wage in the corporate sector in a given city. The average transaction price is considered to be the price derived from

² Report „The State of Housing in Europe 2023”, 2023, https://www.stateofhousing.eu/The_State_of_Housing_in_Europe_2023.pdf, 10.06.2024.

the NBP database concerning prices in the primary market (40%) and the secondary market (60%)³ (Figure 4).

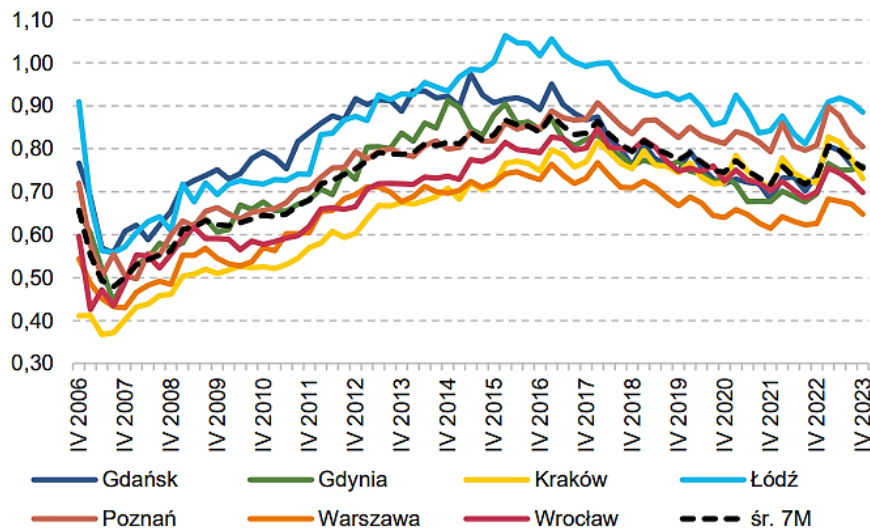


Figure 4. Estimated housing affordability in the 7 largest cities in Poland based on the average monthly wage in the corporate sector (m²).

Source: NBP (2024).

According to data from the National Bank of Poland, at the end of 2023, the average salary in Poland could buy just under 0.8 square meters of housing. Residents of Łódź could afford a little more (around 0.9 square meters), while residents of Warsaw could purchase the smallest area (slightly over 0.6 square meters). As shown in the presented graph, the most favorable situation for buyers was in 2015-2016, when housing affordability was highest, nearly 0.9 square meters per average salary in Poland. Since then, housing affordability has declined, with a slight increase in 2022 bringing it to the current level of 0.75 square meters.

Another way to determine housing affordability in Poland is through a synthetic measure published by the Amron Research Center – the Housing Affordability Index (IDM) M3. This index assesses housing affordability for a typical family in terms of prices (two working adults and an older child), taking into account changes in transaction prices, interest rates on new housing loans, average gross family income, and changes in living costs (Figure 5).

³ Information on apartment prices and the situation in the residential and commercial real estate market in Poland in the fourth quarter of 2023. Financial Stability Department, 2024 <https://nbp.pl/wp-content/uploads/2024/03/Informacja-o-cenach-mieszkan-w-IV-2023-.pdf>, June 10, 2024.

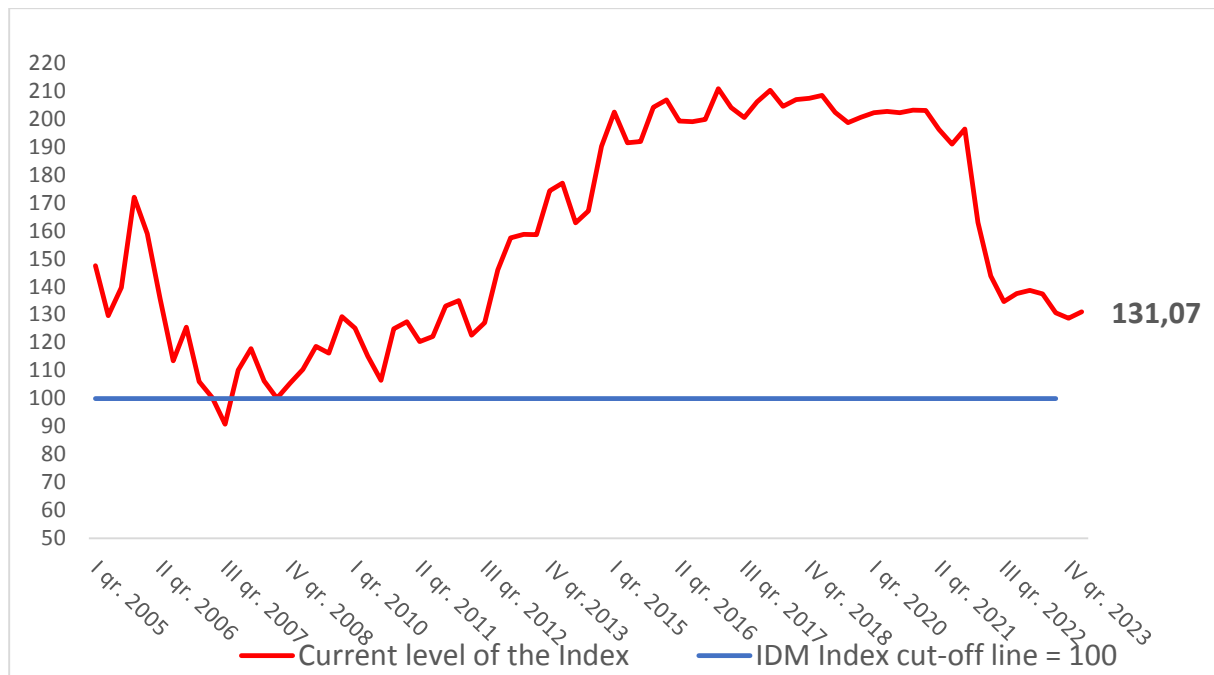


Figure 5. Housing affordability index M3 in Poland in the years 2005-2023.

Source: Amron, 2024.

Since 2021, there has been a noticeable decline in housing affordability in Poland due to rising transaction prices (the average transaction price for the 7 largest cities in Poland in the primary market increased from 9,142 PLN/m² in Q1 2021 to 12,730 PLN/m² in Q4 2023)⁴. During the same period, the interest rates on new housing loans also increased from 2.86% in Q1 2021 to 7.7% in Q4 2023⁵. Additionally, maintenance costs have risen, leading to the Housing Affordability Index M3 reaching 128.68 points in Q4 2023, matching the level of the index in 2010.

Both indices (NBP and Amron) focus on purchasing apartments. However, what does housing affordability look like in the rental market? It's important to note that the affordability of rental housing depends on the specific rental market, whether it's the open market or rentals supported by the government or municipalities. Assessing "ease" should be considered separately for non-market rent resources and for apartments rented on the open market (Bryx, 2021).

When it comes to renting with support, we mean social housing, communal housing, and housing provided by Social Housing Associations (TBS), where household eligibility depends on an upper income threshold. Criteria for allocating social housing are determined annually by municipalities and are conditional on income levels. Consequently, these accommodations are typically earmarked for the poorest individuals with very low

⁴ Data from NBP regarding the Housing Property Price Database (III Q 2006-I Q 2004): <https://nbp.pl/publikacje/cykliczne-materialy-analityczne-nbp/rynek-nieruchomosci/informacja-kwartalna/>, 10.06.2024.

⁵ Data from "AMRON-SARFiN Report. Nationwide report on mortgage loans and transaction prices of real estate" 2024, No. 4(58), p. 23.

incomes. Rent rates for social housing are set individually by municipalities; for instance, in Poznań in 2024, it was 2.45 PLN per square meter (ZKZL, 2024A).

Meanwhile, renting communal housing depends on housing circumstances and the absence of entitlement to another property with low family income. Rent rates for communal housing are determined by the mayor or city president and in Poznań in 2024 ranged from 4.90 PLN to 12.90 PLN per square meter based on a scoring card set individually for each apartment (ZKZL, 2024B). On the other hand, TBS apartments are available to individuals residing in the respective municipality without rights to another property, provided their income does not exceed 1/3 of the average monthly salary in the given voivodeship. Rent rates for TBS apartments vary based on the type of lease (rent with the option to purchase, rental for graduates, rental for seniors, etc.) and are determined by the assembly of partners, general meeting of shareholders, or general meeting. In Poznań, under the "Rent with the option to purchase" program, this rate was set at up to 31 PLN per square meter (PTBS, 2023).

The affordability in the subsidized rental market, or rather its lack, stems from a significant imbalance where the number of applicants far exceeds the number of available apartments. According to GUS data, the number of people awaiting social housing in Poland exceeded 70,000 in 2022, while demand for rental units from municipal housing stock—including residential units that do not meet technical standards for habitation, with signed social lease agreements—reached over 143,000 individuals (Bank Danych Lokalnych, 2024B).

The situation is quite different in the free market, where rents are determined by apartment owners, among whom two distinct groups of landlords can be identified:

- Private individuals, mostly owners of single apartments for rent, who derive additional income from renting and do not rely on it as their primary source of income;
- Institutional rental, involving individuals engaged in business activities related to leasing properties.

As emphasized by Bryx (2021), the rent in the free market should be set at a level that, on the one hand, is affordable for tenants while maintaining their current standard of living, and on the other hand, ensures that the landlord recoups costs associated with the construction/purchase of the apartment.

For the purposes of this article, an analysis was conducted on the average rent rates in selected 7 largest cities in Poland (Figure 6).

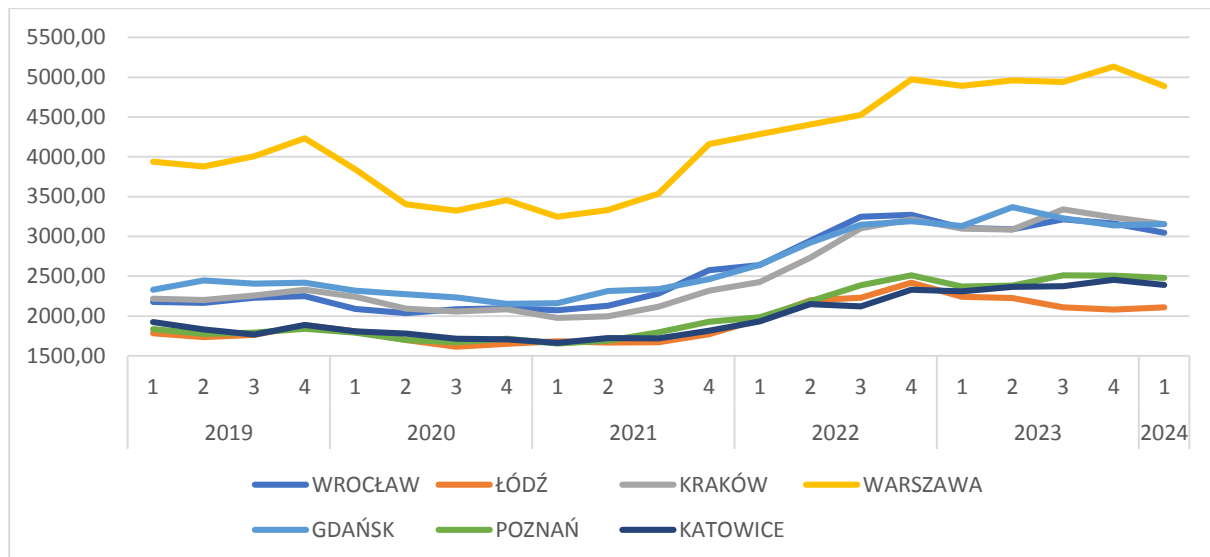


Figure 6. Rental prices in the 7 largest cities in Poland at the end of each quarter from 2019 to 2024.

Source: Own study based on (Otodom Analytcs).

As indicated by the above chart, rental prices in the first quarter of 2024 increased on average by about 30% compared to rental prices from the first quarter of 2019. The highest increase was observed in Krakow (by over 40%), followed by Wrocław and Gdańsk. The lowest increase was in Łódź, around 18%. Regarding rental prices outside the capital, where rental prices are significantly higher and averaged over 4800 PLN in the first quarter of 2024, some of the higher prices were observed in Wrocław, Krakow, and Gdańsk, at approximately 3000 PLN in the first quarter of 2024, while about 500 PLN less was paid in Poznań, Katowice, and Łódź. Rental prices have been consistently increasing with a slight decline in the second and third quarters of 2020 due to the pandemic⁶ and government restrictions, which led to remote learning at universities and reduced mobility and tourist traffic.

Based on the conducted analysis and considering that the average rental rates per square meter were 68 PLN/m² ⁷ in January 2024, it is evident that supported housing units are significantly cheaper for tenants than housing units on the open market and cannot compete in terms of rental affordability.

The affordability of rental apartments on the open market involves determining the income level required to rent an apartment. Marek Bryx defined the rent affordability index as the ratio of the average offered rent price for a two-bedroom apartment to the average gross per capita wages in a given city. For the purposes of this article, data from Otodom Analytics regarding average rental prices in the 7 largest cities in Poland were used, along with data on average monthly gross wages in the business sector in these cities at the end of each quarter from 2019 to 2024 (Figure 7).

⁶ The Covid-19 pandemic – epidemic cases throughout Poland caused by the Sars-CoV-2 virus.

⁷ "Rental Market Report" Otodom, January 2024, https://www.otodom.pl/wiadomosci/wp-content/uploads/2024/02/OTOD_raportzryнку_STY2024-3.pdf, 13.06.2024.

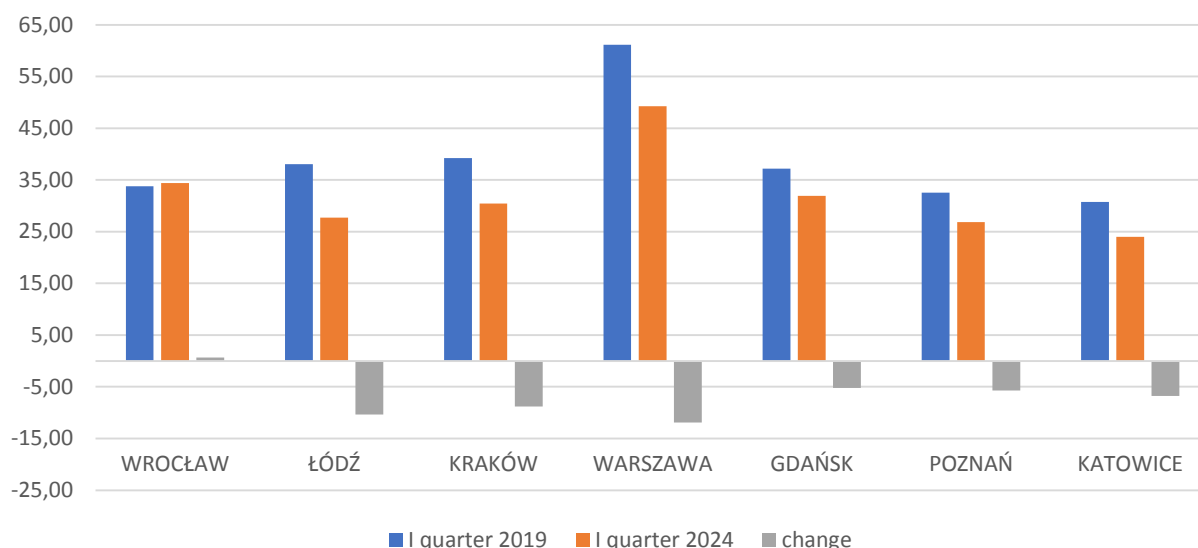


Figure 7. Rental affordability index for the 7 largest cities in Poland.

Source: Own study based on (OtodomAnalytics, 2024) i (Bank Danych Lokalnych, 2024).

As shown in Figure 7, the highest rent affordability index in the first quarter of 2019 was in Warsaw, reaching 61.13. This means that on average, more than 60% of gross earnings were needed for rent, indicating that during this period, rental costs were a significant burden on household budgets. The situation was somewhat better in the other largest cities in Poland, but rent affordability still exceeded 30%. Over the next 5 years, despite increases in average rents, rent affordability improved. By the first half of 2024, the index in Lodz, Poznan, and Katowice was below 30%, while in Krakow, Gdansk, and Wroclaw, it did not exceed 35%. Only in Warsaw, despite a decrease, it remained high at 49.23%. In almost all cities (except Wroclaw), the rent affordability index decreased, which is favorable for tenants.

Comparing the data on rent affordability with housing purchase affordability, it is evident that while housing purchase affordability is decreasing, rent affordability is improving. This indicates that with the rise in average earnings, property prices for sale are increasing faster than earnings, whereas average rental prices are also rising but not as rapidly as earnings, making rental housing more accessible. It's important to note that several factors influence average rental prices, including the standard of accommodation, the number of newly constructed apartments in the area, the affordability of rental properties and location.

When presenting the housing affordability situation in Poland, it is valuable to compare it with selected European Union countries to provide context. To determine the affordability of homes for sale, similar to the index calculated by NBP in Poland, the housing affordability index was calculated using data on the average price per square meter of housing in the third quarter of 2022 in euros in selected EU capitals (Catella, 2022), and Eurostat data on average monthly earnings of full-time employees in selected EU countries (Figure 8).

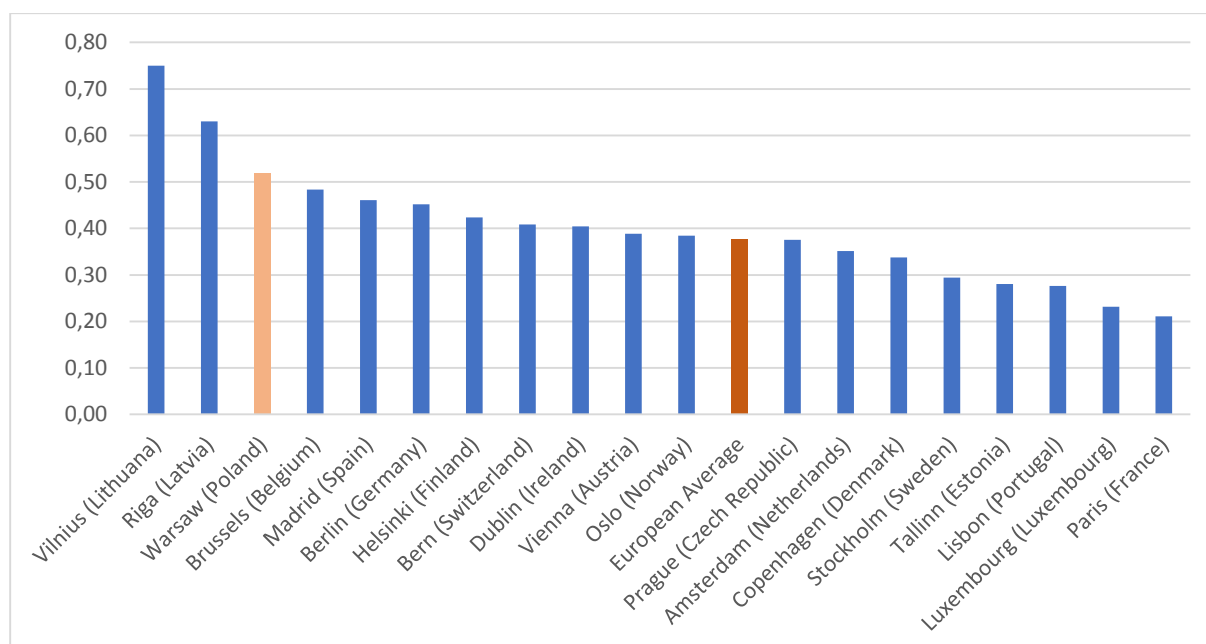


Figure 8. Estimated affordability of purchasing an apartment in selected European Union capitals based on average monthly net earnings of a full-time employee.

Source: Own study based on (Catella, 2002), (Eurostat, 2024).

Despite the fact that the average monthly earnings of an employee in Poland, according to Eurostat data, are around 1558 euros per month and are among the lowest among the presented countries, the price of apartments at approximately 3010 euros per square meter in Warsaw results in an affordability index of 0.52 square meters. This means that for the average salary, Poles can purchase just over half a square meter of apartment in the capital city. As shown in the chart, Warsaw ranks third after Vilnius and Riga in terms of the highest level of affordability. In comparison, an average resident of Paris (France) can afford to buy 0.2 square meters of apartment. Similarly, in Luxembourg, despite earnings exceeding 2700 euros per month, residents can afford only 0.23 square meters of apartment. The average affordability for purchasing an apartment in the European Union is 0.38 square meters. Referring to the data presented in Figure 9, despite the decreasing affordability for purchasing apartments in Poland, the situation in Warsaw compared to other countries is very favorable.

Another indicator calculated to present the situation in Poland compared to the European Union was the rental affordability index. Since such an index does not exist for other countries, the authors independently calculated the rental affordability using data on average monthly rent per square meter in selected EU capitals in the third quarter of 2022 in euros (Catella, 2022), along with Eurostat data on average monthly earnings of full-time employees in selected EU countries. The authors assumed that the average rented apartment size in all countries is 50 square meters and calculated the rent for such a size. Based on this, they determined the ratio of rent to average monthly earnings, as presented in Figure 9.

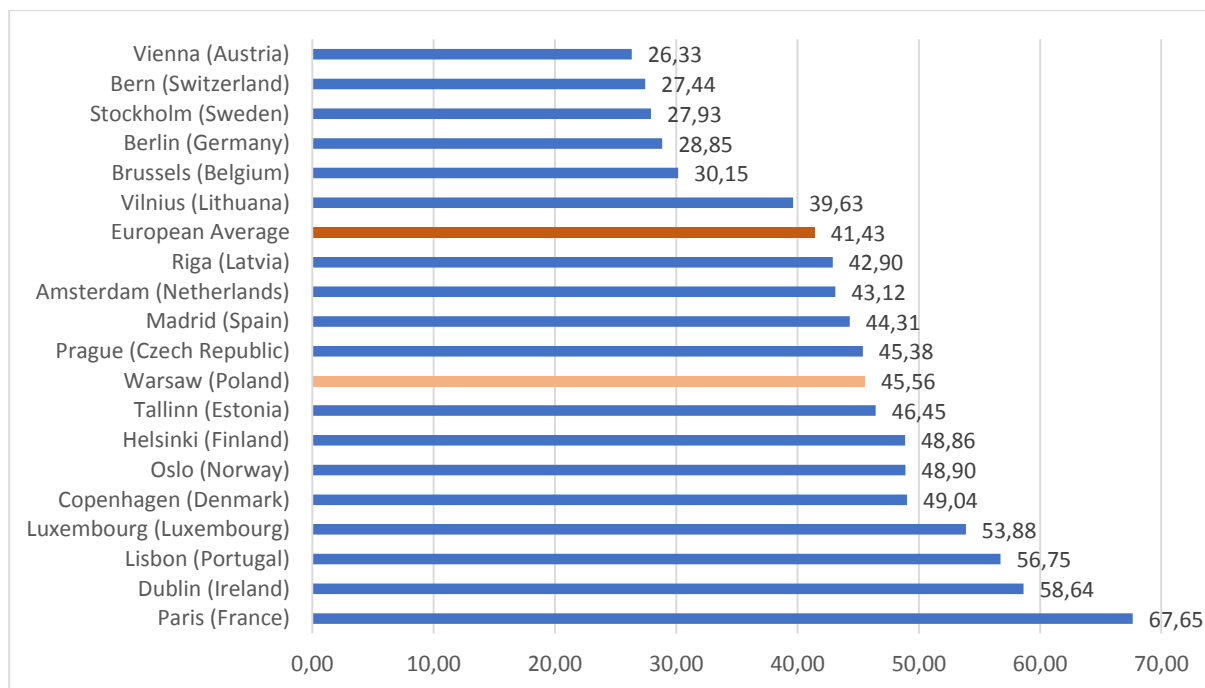


Figure 9. The rental affordability index for selected European Union countries.

Source: Own study based on (Catella, 2002), (Eurostat, 2024)

The average rental affordability index in the European Union was 41.43%, indicating that rental expenses consume more than 40% of earnings. In Warsaw, according to the adopted data, the index was 45.56%⁸, ranking among the higher ones, with the highest rental burden observed in Paris (67.65%), Dublin (58.64%), and Portugal (56.75%). Conversely, the lowest rental affordability index was in Vienna (26.33%), Bern (27.44%), Stockholm (27.93%), and Berlin (28.85%), which is favorable for tenants and partially explains the high proportion of rental properties in Austria, Sweden, and Germany.

5. Conclusions

Housing affordability is becoming an increasing problem in the EU. Housing and inequalities are intertwined, with homes constituting a significant portion of wealth in developed economies. Simultaneously, housing cost burdens and quality of living conditions are becoming more critical issues. Understanding these indicators requires looking beyond sums and averages, as divisions by area and income present a different picture.

Rental affordability depends on two variables – rental prices and wage levels. Research indicates that rents in the 7 largest cities in Poland have been steadily increasing. Over the past 5 years, they have risen by approximately 30%. However, simultaneous wage growth has

⁸ The magnitude of the index corresponds to the value calculated in Figure 7, where the figure for Warsaw in the first quarter of 2024 was 49%.

improved rental affordability despite the rise in average rents. Housing affordability is becoming an increasing challenge in the face of rising property prices and income inequalities. Many cities worldwide are witnessing housing exclusion, where a significant portion of the population cannot meet their basic housing needs. Meanwhile, the situation in Warsaw, compared to other selected European capitals, is not the worst. In cities where high incomes do not guarantee easy access to rental housing, affordability is severely limited, and housing expenses consume a significant portion of incomes.

Future research should focus on developing new indicators and methods for assessing housing affordability, as well as analyzing the effectiveness of various housing policies. Understanding how economic, social, and political changes impact housing affordability in the long term is particularly crucial. Future studies should identify best practices and innovative solutions that can improve housing accessibility in different property markets.

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FROM THEORY TO PRACTICE: POLISH PAY AND LABOUR LAW PROFESSIONALS' VIEWS ON THE PAY TRANSPARENCY AND THE EU DIRECTIVE

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Purpose: The study presents the impacts of the recently introduced EU pay transparency Directive as viewed by Polish pay and labour law specialists.

Design/methodology/approach: the research findings are based on the analysis of 248 LinkedIn posts authored by these specialists and 24 in-depth interviews (IDI) conducted with some of them.

Findings: The study resulted in the identification and thick description of pay transparency aspects surrounding the Directive. Most participants expected its impacts to be positive but also pointed out organisational and mental challenges to be faced by employers and employees alike. They also shared their attitudes and expectations regarding pay transparency regulations.

Research limitations/implications: The limitations of the study are mainly related to the non-representative sampling of posts and IDI participants.

Practical implications: The study's findings contribute to remuneration practices by providing insights into the benefits and challenges surrounding the Pay Transparency Directive as viewed by people with hands-on experience. Their mostly favourable comments concerning its implementation may encourage employers to commit to reforming their pay systems toward greater pay transparency and the elimination of discriminatory remuneration practices. The findings could also serve as a foundation for future research.

Originality/value: The study's findings contribute to both the theory and practice of remuneration practices.

Keywords: pay transparency, EU Directive, LinkedIn Analysis, individual depth interview (IDI), Poland.

Category of the paper: Research paper.

1. Introduction

Although remuneration is a critical aspect of HRM in all types of organizations due to its influence on employees' performance, motivation, attraction, and retention (Schnauffer et al., 2022), it appears to be neglected by human resource management (HRM) research.

Remuneration systems are generally expected to be designed on the principles of equality and fairness, but in the real world, pay discrimination and pay gaps are frequently observed (Kirby, 2023; McMullen, Dahle, 2023). As one way to combat pay disparities, including the male-female pay gap, is transparency in remuneration, the EU enacted a pay transparency directive that became effective on June 6, 2023. The Directive, which the Member States are required to be implemented by June 7, 2026, imposes a number of new responsibilities on employers (Nieżgódka, 2023).

Recent years witnessed renewed interest in pay transparency from theoreticians and practitioners, who have long discussed its various facets (Kulikowski, 2023; Stofberg et al., 2022; Král, Kubišová, 2021). One reason for this is the influence of transparent pay on employees and employers. Employees will gain improved access to information about remuneration and its structures what may potentially enhance their sense of fairness. Employers, in turn, will be compelled to conduct a review of their compensation practices. Another reason for taking this topic is controversies around pay transparency (Stofberg et al., 2022), which have been revived by the EU pay transparency directive.

While the legislative background of the Directive and its solutions have been well recognised, little research has been done on how it is viewed by those who will implement it. This study was prompted by the existing research gap and the belief that practitioners' opinions about the Directive can help organisations through necessary adjustment to the Directive's provisions.

The mentioned Directive introduces solutions that are new in the context of current regulations concerning pay transparency. What we know so far relates to the provisions and issues regulated by the Directive, along with the legislative assumptions. However, what we do not know are the opinions of those responsible for implementing this Directive. Understanding their views can provide valuable insights for organizations preparing to implement the Directive's provisions. Therefore, it is important to focus on what is not yet known. The motivation for this paper directly arises from this gap in the literature.

The research problem pertains to the opinions of Polish pay and labour law specialists on the Directive. It has been specified in the form of two research questions:

RQ1: How can the Pay Transparency Directive benefit employees and employers?

RQ2. What problems and challenges may its implementation entail?

The Directive sparked a vigorous debate among HRM and labour law specialists, many of whom exchanged their opinions via LinkedIn. Their posts suggested that they could be a valuable source of information on how specialists responsible for implementing the Directive view its potential impacts and challenges. Thus, the author designed a two-step study on pay transparency in the context of the Directive, consisting of an analysis of the posts and in-depth interviews (IDI) with some of their authors.

The article consists of a theoretical section containing a discussion of selected publications on pay transparency and an outline of the Directive. The second, empirical part presents the implications of the Directive based on a qualitative analysis of the pay and labour law specialists' posts and interviews.

The term 'pay and labour law specialists' as used in the study denotes individuals who are knowledgeable, trained and experienced in handling remuneration and/or labour law issues, and are likely to implement the Directive. In the study, they are also be described as "experts" and "professionals" synonymously.

2. Literature review

Although the Treaty on the Functioning of the European Union (Article 157, Item 1) establishes that "each Member State shall ensure that the principle of equal pay for male and female workers for equal work or work of equal value is applied" and the gender equality is the 5th Sustainable Development Goal by United Nations, gender pay inequalities are not uncommon – discriminatory pay practices are ubiquitous in organizations worldwide, but proving their existence and assessing their actual scale is difficult due to opaque remuneration policies (cf. Kurzynoga, 2023). In many cases, female employees are not aware that they are discriminated against in pay. According to Eurostat data, women's earnings in 2020 were lower, on average, by 13% compared with men's. Almost 37% of women believed that they earned less than their male co-workers. However, nearly 71% of men claimed otherwise, with more than 8% believing that their remuneration was lower. There is a multitude of reasons why women are paid less than men, including gender-based discrimination, cultural factors, and potential unavailability to employers related to maternity and childcare (Stowarzyszenie Women in Technology Poland, 2020).

It is believed that one way to alleviate gender pay gap problems is pay transparency that Stofberg et al. (2022) understands "as the degree to which employers disclose information about how they determine pay (process transparency), how much they pay (outcome transparency) and how much they permit employees to discuss pay (communication transparency)". Scott et al. (2023) have defined a transparent pay as "employer practices of sharing information with employees about salaries, incentives and benefits". It is a product of pay communication strategy, i.e., the organizational practice regarding if, when, how, and which pay information (its ranges, structure, individual pay levels) is disclosed to employees and whether (or not) they should be allowed to discuss it amongst themselves and with outsiders (Braje, Kuvač, 2022; Bussin, Christos 2023). A prerequisite of pay transparency is the adoption by organisations of an open pay communication policy providing employees with access to information about their pay and its calculation (Bussin, Christos, 2023).

In organisations with transparent remuneration, employees can monitor pay disparities and promptly react to them (Kim, 2015). Pay transparency policies range from very secretive to very open, the latter being usually observed in the public sector (Braje, Kuvač, 2022). In the survey by Sury (2023), 36% of the respondents reported that pay transparency was part of their current or past employers' remuneration policy. Currently, 39% of respondents have a salary confidentiality provision in their job agreements. A similar percentage reported that they have discussed remuneration with their co-workers. According to the survey, 78% of respondents want remuneration to be publicly disclosed in every company, and 89% believe that salary ranges should be included in each job posting. According to 68% of respondents, they do not apply for jobs that do not provide salary ranges, and 87% of respondents believe that the obligation to provide ranges will positively influence the job market as a whole (Sury, 2023).

The Directive may change the workplace and influence on remuneration practices because it imposes a number of new responsibilities on employers regarding pay practices, including (The Directive Eu 2023/970 of the European Parliament...):

- Stating the minimum-maximum pay range for the job opening during the recruitment process. The composition and level of pay must be determined using gender-neutral criteria. The amount offered by the employer should be stated in the job advertisement or communicated no later than a job interview.
- Ensuring transparent pay practices and pay rise policies; the Directive requires employers to make sure that employees have easy access to pay information (included but not limited to career and remuneration criteria, information about their pay and average pay in the organization by gender and position).
- More detailed payroll reporting and analysis.

As well as introducing new obligations for employers, the Directive also prohibits employers from using practices such as (The Directive Eu 2023/970 of the European Parliament...):

- Making job applicants state their current or past pay.
- Using pay non-disclosure clauses in employment contracts.

Overall, the Directive establishes employees' right to information about average levels of pay in their organisations by gender and position. Information about the pay of individual employees will continue to be confidential. Consequently, the Directive puts an end to the tacit ban on pay discussions in organisations.

3. Research Methods

The purpose of the study was to determine the implications of the Directive based on posts and statements of pay and labour law specialists. A qualitative research methodology was selected, because it helps gain a deeper understanding of phenomena, data, contexts, and different meanings of the problem under consideration (cf. Jemielniak, 2012). Additionally, an interpretative paradigm was applied, with which the meanings that people ascribe to their actions, relationships, experiences and social phenomena can be identified and interpreted (cf. Silverman, 2008; Sławecki, 2012).

The study was planned as a two-stage activity. The first stage was carried out between February and March 2024. Its purpose was to find LinkedIn posts published after 6 June 2023 (the day when the Directive entered into force). The LinkedIn platform is a valuable source of research information because it is used by business people and professionals to exchange their views, experiences, and opinions and discuss the latest developments, reports, and other 'hot topics' in their industries. Thus, necessary information can be accessed promptly, easily and inexpensively.

LinkedIn posts were selected for analysis with the following hashtags: (1) #paygap (2) #paytransparency (3) #genderpaygap (4) #gendergap (5) #wagegap (6) #equalpay (7) #directive. The hashtags were in English and Polish (typed with and without diacritics). The hashtags were adopted after a review of the pertinent legislation and literature. The preliminary sample of posts consisted of 282 items. Thirty-four were disqualified after a screening procedure aimed at removing: (1) trivial posts, (2) posts referring to outdated or inaccurate information, (3) posts outside of the scope of the study, (4) posts that only contained links to events, articles, or pay transparency discussions. Thus, the final sample included 248 posts.

The qualified posts were coded and then analysed qualitatively (cf. Nowell et al., 2017). A "sentence-by-sentence" coding approach was used, in which each sentence is assigned a code related to its analytical category (Table 1).

Table 1.

An example of information coding

ANALYTICAL CATEGORY	Analytical sub-category	Illustrative statement	Frequency (the number of mentions in sentences)
benefits of pay transparency	for employees	<i>"stronger sense of remuneration fairness among employees – this is my number 1 regarding benefits"</i>	19
	for employers	<i>"better organisational culture. Everything is about it"</i>	14

Source: created by the author

Table 2.*An example of information coding (2)*

No.	SUB-CATEGORY	
	for employees	for employers
1	Increased work motivation	More trust among employees
2	Increased work satisfaction	Reduced employee turnover
3	Better planning of career paths	Improvement of employer brand

Source: created by the author.

The examination of the posts identified key analytical categories related to themes raised by the authors of the posts. Based on this, a research tool was refined to be used during the second stage of research.

The second stage of the study involved 24 individual, in-depth online interviews (IDI) with pay and labour law specialists, across industries and business sectors, were conducted via Microsoft Teams and Skype in April and May 2024. The interview guidelines were used as the research tool. It included references to the following topics.

1. the background of the Directive,
2. contemporary aspects of remuneration,
3. the assessment of the Directive,
4. publicization/advancement of the Directive
5. benefits, challenges and issues related to Directive,
6. miscellaneous as trends in employee remuneration, knowledge about remuneration, women in the labour market, and competencies for successful implementation of the Directive).

IDIs were selected due to their specific characteristics. They allow for obtaining detailed and in-depth information from respondents, enabling researchers to understand their perspectives, motivations, and experiences. Additionally, IDIs provide flexibility in asking questions, allowing the exploration of new topics and adapting the conversation to the respondents' answers.

Eleven interviewees consented to being taped while the other thirteen refused their consent, so notes of their statements were taken. The purpose of the IDIs was to deepen the understanding of the implications of the Directive based on the opinions of pay and labour law specialists. Although invitations to participate in the study were sent to all authors of the analysed posts, there were 24 respondents: 15 women and 9 men. The criteria for selecting respondents for the sample were their willingness to participate, availability, and being the author of an analysed post. To analyse information gathered during the IDIs the same approach as for posts analysis was applied.

The results of the research were compiled into a thick description (Geertz, 2005) and were organised according to analytical categories. They are illustrated with citations from posts and interviewees' opinions. The letters "P" and "I" in the brackets indicate the source of information, i.e., a post or an interview, and the numbers show the successive number of a post or an interview.

4. Research Results

The changes expected to be introduced by the Directive were viewed positively and even referred to as “revolutionary” (P.145) and as “a new opening in remuneration” (P.59). The benefits anticipated by the respondents applied to both employees and employers.

Some professionals discussed the current pay practices, pay inequalities, and their negative impact on employees. “The problem that organizations keep struggling with, to varying degrees of success, is pay discrimination and the fairness and equality of pay” (I.23). “We deviate from the rest of Europe regarding pay, with its level being only one of the problems” (I.4). One interviewee stated that “pay inequalities stir negative emotions among employees, including a sense of unfairness and frustration” (I.8). This happens because “remuneration systems lacking transparency can demotivate employees and reduce their commitment. Pay inequalities can sour workplace atmosphere, impacting employees’ effectiveness and loyalty” (I.4). One post author observed that “the Directive puts a ban on [employment] contracts or internal regulations containing clauses that pay information is proprietary information of the organization, which is a frequent practice today” (P.34). According to another author of the post, “the Directive basically confirms what is already permitted today” (P.4). One interview participant stated that “many employers have not yet created internal rules increasing pay transparency and equality. The Directive will certainly expedite the process” (I.21).

Among benefits associated with the Directive was also the fact that: “equality of pay (...) is a key factor in attracting and retaining high-quality employees” (P.148). The respondents indicated that the Directive would force employers to present pay criteria and rules in a clear and comprehensible manner which would positively affect employees’ motivation. The Directive was also predicted to prevent pay discrimination in organisations and provide equal access to information about pay levels and pay-setting rules. As one respondent noted, “employees are likely to feel more appreciated and respected knowing remuneration rules” (P.58).

One of the IDI respondents concluded that “firms that promote pay transparency and eliminate pay discrimination are perceived as more trustworthy by job candidates and help to build a positive image of the employer” (I.5). The Directive was also believed to influence workplace relations: “The introduction of transparent pay systems can change the dynamics and interactions between employees and employers. Employees may gain greater trust in their employers when pay is transparent and fair. On the other hand, revealing pay differences can also lead to tensions and conflicts if employees feel they are being treated unfairly. Pay transparency can therefore both strengthen and complicate workplace relationships (...). Because of its social and relational importance, it is necessary to make efforts to ensure fair and transparent remuneration systems in the workplace” (I.17). Another respondent added:

“The revelation of salaries will not put an end to arguments among employees; it may even fuel them” (I. 20).

Some of the study participants expected that the Directive would place a heavy organisational burden on organisations: “employers must prepare themselves for the regulations [and] changes to collective labour agreements, remuneration policies, remuneration rules, etc.” (P.6). According to one of the interviewees, “generally, all firms will have to review their pay schedules. They must prepare themselves for disclosing and revising their entire pay systems” (I.18). Other interviewees worried that “information from the HR department about an average pay for the group of jobs you do will be insufficient to verify whether or not one’s pay is fair” (I.1). One of the interviewees expressed doubts that “although I’m looking forward to introducing the Directive, I know firms that already scheme to find ways around it” (I.15).

Several post authors and interviewees expressed concerns about the Directive’s impacts on organisations. According to them, the new regulations could fuel wage competition in the labour market, increasing pressure on employers to raise wages. One posts suggested that the pressure may cause that “businesses’ operating costs, which are already substantial, to grow even higher” (P.127). The author of another post anticipated that although “the Directive can prevent the emergence of pay gaps within an organisation, [it] will not solve the problem of low pay in particular industries” (P.72). The Directive was also associated with the risk of “employees being forced into self-employment to avoid the application of these regulations” (I.14). Interview participants expressed doubts about whether the Directive would achieve its purpose “The Directive offers new tools. You can ask your employer about how your pay compares to other employees doing the same job or work of the same value. However, will information about average pay earned by a given category of employees alone be enough to verify whether one’s pay is fair?” (I.8). Although the Directive offers various tools, the reality may differ, as pointed out by one of the respondents: “In practice, if an employer is unwilling to disclose information about pay brackets, they will not do it, especially that the Directive does not regulate some matters, so job advertisements may still fail to provide pay brackets. Firms will still determine whether or not to present them. Such a requirement does not, in fact, exist” (I.4).

Negative opinions about the Directive were relatively few. Their authors referred to it as “more unnecessary red tape” (P.4), “making employers’ life harder” (P.5) and “another dispensable solution” (I.15). Some of them provided arguments in support of their position “Equality of pay can also [be perceived] as a restriction on the employer’s and employee’s freedom to negotiate pay” (P.57); “Theoretically, at the end of the day, the implementation of the Directive may have negative consequences for some people: it will make more difficult for employees to negotiate a pay outside of the established range, even if they are extremely productive at work” (I.16).

Some interviewees adopted a 'wait-and-see' approach in assessing the role the Directive for organisations and employees: "I can see a surge in hooray-optimism over [its] provisions" (I.6); "every law can be interpreted in such a way as to keep things the old way. Or a change may turn against those who pushed for the law and did not foresee that it will run them into trouble" (I.8).

Among the themes raised by the authors of posts and interviews, the gender pay gap was discussed most often. Most comments concentrated on its negative consequences, precautionary measures, and factors contributing to its size (gender stereotyping, 'glass ceiling' and 'sticky floor', overrepresentation of women in low-paying jobs, etc.). According to one post: "The most difficult thing about identifying the causes of a gender pay gap is finding its root cause, which may be related to objective circumstances, such as a person's qualifications (...) industry, or a region, and not necessarily to one's gender" (P.24).

Many interviewees addressed the issue of lower salaries or limited career opportunities offered to women returning to work from a maternity leave. According to them, fair remuneration for young mothers and their equal treatment require intervention from organisation and the parliament. "The Directive may not produce the expected results unless measures supporting equal/fair pay are taken on behalf of mothers returning after a child-raising-break" (I.2). "After they return to work, their salary should include all rises that other employees received while they were off work" (I.4).

The next group of posts addressed the problem of employees' lack of basic knowledge of remuneration. According to some IDI participants, employees were unaware of how remuneration is determined, what it consists of, how it relates to performance or of employers' costs of their net wages. A lack of basic knowledge about remuneration can lead to many negative consequences, both on an individual and organizational level. Increasing employee awareness about remuneration is crucial for promoting fairness, transparency, and efficiency in organizations, as well as for improving employees' personal financial management. "Many employees lack basic knowledge about pay structures and the factors that influence their salaries. Without this knowledge, they cannot effectively advocate for fair compensation or understand the full value of their benefits. Increasing employee awareness about remuneration has long been a need that is essential for both individual financial well-being and overall organizational transparency (...). Thus, increasing employee awareness regarding pay regulations is already a longstanding demand" (I.20).

Opinions were expressed that the successful implementation of the Directive would hinge upon a thorough understanding of its provisions, communication skills, openness, and mental skills in those responsible for this process. They were indicated as essential for alleviating employers' and employees' concerns and preparing organisations for potential conflicts between employees and as well as increasing administrative burdens and costs. A need for communicating pay practices and policies to employees was emphasised. "Today, what people in organisations know about remuneration rarely comes from official sources.

Will the Directive really change anything? Time will tell. I don't think that talking about money will stop to be a taboo though" (I.14). According to one respondent, "the key will be a dialogue with social partners. Firms will have to prepare themselves for open and transparent communication. Economic education for employees is also important; [they] will have to understand how pay is set so that they could effectively participate in this dialogue" (I.2). It was presumed that organisations with well-developed HR departments would have less problem adjusting to the Directive's requirements and that their workforce would be mentally better prepared to embrace the upcoming changes.

5. Discussion

The posts and interviews were examined with a view to answering the following questions:

RQ1: How can the Pay Transparency Directive benefit employees and employers?

RQ2: What problems and challenges may its implementation entail?

In the literature, pay transparency is similarly described as involving both benefits and challenges (cf. Bamberger, Belogolovsky, 2017; Colella et al., 2007; Smit, Montag-Smit, 2019). A similar conclusion emerges from these studies.

The Directive was found to offer many benefits such as pay transparency underlying equal pay for equal work between genders across the EU. Achieving it will, however, come at a cost for employers, who will have to review their pay practices, systems, rules, and criteria to find and remove dysfunctions and pathologies contributing to unequal and unfair pay, and widening the pay gap.

It is widely agreed that advantages of pay transparency outweigh its disadvantages. It is argued that pay transparency provides employees with access to information that they can use to negotiate their remuneration, which helps reduce pay gaps. This aspect of pay transparency seems to particularly benefit women, who are less proactive in negotiating their salaries and promoting themselves, accept lower pay more often, and negotiate their remuneration less effectively when information is scarce (Baggio, Marrandola, 2023, pp. 164-165). It is noteworthy that in a survey by Pracuj.pl (2023), 8 out of 10 job candidates preferred an employer willing to discuss their future salaries.

According to the study's findings, the implementation of the Directive can be a rough process for many companies. Its effectiveness will depend on careful planning and open communication with all stakeholders. A "psychological challenge" related to pay transparency was also indicated as a factor of effectiveness, along with the need for employers' mental changes as a prerequisite to creating equitable and fair pay practices.

While the authors of posts and the respondents were hopeful that pay transparency would entail positive changes, they were also concerned about organisations' attitudes, concerns, emotions surrounding the transparency of remuneration and equal pay. Their opinions reflect the complexities surrounding pay transparency and the challenges organisations will face when adjusting to the Directive.

In both posts and during the IDIs, the importance of stepping up efforts to increase employees' pay awareness was emphasised. Respondents indicated that knowledge about salaries and how they are determined gives employees a better position in salary negotiations. They can more effectively support their expectations regarding raises or additional benefits. Furthermore, employees who understand the structure of their compensation can better plan their expenses, savings, and investments, allowing them to manage their household budget more consciously. This emphasis on pay awareness is underscored by a Pracuj.pl survey of Poles, which showed that 81% of them had not heard about the Pay Transparency Directive (Pracuj.pl, 2023). However, 7 out of 10 respondents expressed a desire to know the remuneration of people doing jobs similar to theirs and highlighted the lack of widespread education on salary-related topics in Poland.

Comments on employers' feelings about the Directive primarily pointed to fear and frustration, which in the study participants' opinion, could slow down the process of adjusting to the pay transparency rules. Additionally, employers were predicted to demonstrate dissatisfaction with pay, resentment toward other employees' earnings, and reluctance to compare wages with colleagues. The transparency of pay was also anticipated to cause conflicts over pay inequalities in organizations, proportional in scale to the magnitude of disparities.

Employers' and employees' negative emotions were identified as major obstacles to the implementation of the Directive. Král and Kubišová (2021) found that pay transparency is an emotional matter for employees and that the intensity of their attitudes is related to their personal traits. Personal emotions and attitudes may, therefore, significantly influence the introduction of pay transparency and should not be overlooked (Král, Kubišová, 2021).

Some participants expressed doubts about whether the Directive was a panacea for problems concerning remuneration. They wondered whether it could effectively address the wide range of issues related to pay structures, inequalities, and transparency. They believed that while the Directive might introduce some improvements, it is unlikely to resolve all complexities and challenges associated with remuneration systems.

This finding is supported by other studies, according to which the low-learning employees lend to envy, dissatisfaction, and counterproductive interpersonal demeanour associated with pay transparency (Martucci et al., 2022).

Designing guidelines regarding which pay information needs to be disclosed and how to accomplish this is a challenging task. Its execution may have unexpected consequences (Scott et al., 2023), such as higher direct costs of providing the required information, and indirect costs, including reduced productivity and litigious attitudes of resentful employees, and higher

turnover (Baggio, Marrandola, 2023) of under-performing employees who are more likely to leave transparent organizations compared with high performers (Belogolovsky, Bamberger, 2014; Shaw, 2015). Pay transparency may also cause managers to make pay less dependent on performance in order to avoid explaining to employees how their performance translates into their pay (Belogolovsky, Bamberger, 2014).

Women's pay was frequently addressed in the analysed content of posts and interviews. In the Pracuj.pl survey (2023), 82% of women were satisfied with the Directive aimed at reducing gender pay, while 66% of men disapproving of it. About half of the survey respondents believed that the male-female pay gap affecting employees doing similar jobs was greater in Poland than in other EU countries (Pracuj.pl, 2023).

The limitations of this study have three main sources. First, they are related to the use of LinkedIn as a source of data and the non-representative selection of posts based on hashtags. There is a risk that relevant content was either not tagged at all or tagged with different hashtags than those selected for analysis. LinkedIn users frequently present their opinions in the best light possible, which can lead to selective presentation of information on this social media platform.

Secondly, the IDI participants were only selected from among active LinkedIn users, which may have excluded the perspectives of individuals not part of the LinkedIn community. Because of the time that elapsed between making LinkedIn posts and conducting interviews, it is also difficult to determine how consistent they were in content.

Thirdly, the fact that all participants were Polish nationals presented also a limitation, as their opinions on pay transparency were influenced by the Polish context. It is quite likely that respondents from other countries might have different views due to cultural and social differences.

The decision to use LinkedIn posts and interviews with some of their authors as the source of data was based on the assumption that, notwithstanding its non-representativeness, information thus obtained could still provide a valuable insight into the opinions, reactions, and emotions of the community of pay and labour law specialists. Notwithstanding its limitations, the study seems to provide an interesting overview of pay and labour law specialists' opinions on the benefits and challenges in implementing pay transparency, which can serve as a foothold for further research into areas contributing to pay disparities between employees with comparable skills and performance with a view to eliminating them. Some of the aspects of pay transparency indicated by this study as worth more thorough investigation include:

- women's pay, including pay discrimination against women resuming work after maternity leave,
- a relationship between pay communication and the acceptance of remuneration policy,
- Polish employees' views on pay transparency, as little is known about what they think about their remuneration being known to their co-workers,

- employers' perspectives on pay transparency, as gaining insights into their views could help in identifying and mitigating potential challenges in implementing transparent pay practice.

By providing a review of specialists' opinions on the implications of the Directive, the study can help business organisations and institutions to prepare themselves for the implementation of the Pay Transparency Directive and contribute to better relations between employers and employees.

6. Conclusions

Recent years have witnessed a rising interest in pay transparency, leading to debates among employers, employees, and researchers. This study contributes to these debates by presenting findings on the challenges and benefits related to the implementation of the Directive in Poland.

The theoretical part briefly explains the EU Pay Transparency Directive and provides an outline of pertinent pay transparency studies. The empirical section presents the results of an exploratory qualitative analysis, which was chosen as superior to quantitative analysis for exploring and revealing the contexts and circumstances of the problem research under study (cf. Jemielniak). The data were gathered through IDIs and posts published on LinkedIn, a social media platform for specialists to exchange opinions and experiences. The IDI respondents and posts' authors were specialists responsible for remuneration and labour law in their organisations and potentially implementing the Directive. The results of the analysis of posts and interviews were compiled into a thick description structured around analytical categories established according to the procedure for analysing the collected research data.

The study presented in the article sought to answer the following questions:

RQ1: How can the Pay Transparency Directive benefit employees and employers?

RQ2: What problems and challenges may its implementation entail?

The analysis of experts' opinions about the Pay Transparency Directive can be broadly grouped into following categories: the background of the Directive, benefits related to the Directive; challenges and the assessment of the Directive; contemporary aspects of remuneration, including trends in employee remuneration, and employees' knowledge about remuneration, and publicization/advancement of the Directive.

According to the findings related to first research question, the Directive was perceived by the study participants as a step into a new era in managing remuneration. Beliefs were expressed that it would put an end to unethical or unfair pay practices in organisations and contribute to the establishment of transparent remuneration systems. Positive, neutral, and negative opinions on the Directive were found. The benefits and expectations relating to it mainly expressed hopes for better pay transparency in the organisations. Most authors of posts and IDI participants in

this study believed that the Pay Transparency Directive would significantly contribute to more equitable and fair pay in organisations.

Regarding the second question, the introduction of the Directive was expected to entail numerous problems and challenges. Concerns were also expressed that the requirement to ensure pay transparency practices may paradoxically add to employees' dissatisfaction. This is because revealing pay differences can lead to comparisons and feelings of unfairness among employees. Additionally, the respondents believed that employers might become more cautious in granting raises and bonuses. Some opinions and posts concerned about whether Polish employers were prepared for the changes required by the Directive. These doubts primarily pertained to their preparedness for implementing the changes, including their mental readiness.

Although the study has limitations, mainly related to the use of LinkedIn posts and online interviews as sources of research data, it raises some new questions that may become the focus of future research. This paper contributes to the literature by providing insights into pay and labour law's specialists' opinions of the Directive.

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LEVEL UP SUSTAINABILITY – GAME-BASED LEARNING IN MODERN HIGHER EDUCATION

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Purpose: To explore how *Game-based Learning* (GBL) can improve *Sustainable Development* (SD) competencies in higher education students. The paper aims to address the challenge of gradual transformation of educational processes in *Higher Education Institutions* (HEIs) to align *Sustainable Development Goals* (SDGs) with learning outcomes of curricula and learning preferences of new generations of students (Z and Alfa generations).

Design/methodology/approach: The paper focuses on *UNESCO Education for Sustainable Development*, using a case study approach to discuss the SEED simulation game from the EU-funded SEED project. It analyzes the game's design and effectiveness in developing students' SD competencies and attitudes.

Findings: The SEED simulation game presented in the paper may successfully enhance students' understanding and internalization of key SD concepts as well as their applications in real-world businesses, through collaboration and decision-making with regard to sustainability challenges.

Research limitations/implications: The analysis conducted is limited to controlled educational environment and design context of SEED simulation game. Further research is needed to explore long-term impact of an approach used, on students' professional behavior in real business environments.

Practical implications: The SEED simulation game demonstrates the potential of the GBL approach for integrating SD competencies into higher education curricula. This method aligns with new generations' learning preferences, improving teaching practices and better preparing graduates to enhance future enterprise sustainability.

Social implications: The paper emphasizes the role of HEIs in preparing sustainability oriented and focused professionals. It also suggests that using GBL approach to increase students' SD awareness may positively impact public attitudes toward corporate and social responsibility.

Originality/value: The paper provides valuable insights for educators on integrating SD learning outcomes into higher education curricula. It uniquely analyzes the role of the GBL approach in aligning learning outcomes with SDGs, serving as a key resource for stakeholders aiming to develop SD competencies in future generations.

Keywords: Education for Sustainable Development, Sustainable Development, Game-based Learning, SEED project, SEED simulation game.

Category of the paper: Conceptual paper.

1. Introduction

Achieving Sustainable Development requires a profound transformation of our thinking and actions on the economy, society and individual levels. To create a more sustainable world, individuals must become change-makers with the knowledge, skills, values, and attitudes driven by SDGs. Education plays a key role in achieving these goals, but not every form of education promotes sustainable development. Education that only promotes economic growth can lead to unsustainable consumption patterns.

UNESCO *Education for Sustainable Development* (ESD) model provides guidelines on how to enable students to make better informed decisions and act for the environment, economy, and society (UNESCO, 2024). UNESCO emphasizes that ESD aims to equip people with the skills and knowledge to solve economic, social, and environmental problems. It encourages reflection on consumption, poverty, solidarity, and cooperation (Rieckmann, 2017).

Digitization of higher education and educational processes helps to meet the labor market requirements and the learning preferences of the new generations – Z and Alpha. The Sustainable Development Goals (SDGs) describe the main challenges for humanity, aiming to ensure a sustainable, peaceful, and just life on Earth. Higher Education Institutions (HEIs), according to their mission, should contribute to the SDGs. As the United Nations Declaration states *Since HEIs educate and train decision makers, they play a key role in building more sustainable societies and creating new paradigms. As educational institutions, they have the mission to promote development through both research and teaching, disseminating new knowledge and insights to their students and building their capabilities. Given the objectives of Rio+20, HEIs have a special responsibility to provide leadership on education for sustainable development* (UN, 2011).

Therefore, important research question is *How to properly transform HEIs educational processes to fulfill these new responsibilities?* Without a doubt, in the first place, changing the learning preferences of new generations should be taken into account. These young learners, surrounded from birth, by social media, digital devices and interactive content, have developed new learning habits. They expect interactive, dynamic and engaging learning experiences. The new digital world has severely limited their attention spans and accustomed them to frequent dopamine ejections. All this means that traditional, passive learning methods are no longer effective and efficient. New methods are needed, that take into account the cognitive peculiarities and learning preferences of the new generations.

This paper describes *SEED simulation game*, one of the outcomes of *Sustainable Entrepreneurship in EDucation* project (SEED project), funded by the European Union (2022-1-PL01-KA220-HED-000088765). The project aimed to implement a set of innovative learning methods and tools that takes into account learning preferences of new generations and, at the same time, develops SD awareness, related skills as well as deepen the knowledge on SDGs. These have been done through Game-based Learning (GBL) approach, what enables young people to make decisions in digital interactive environment, receive constant and immediate feedback, engage in collaborative learning and act in a way that contributes positively to SDGs. This approach is innovative in combining interactive learning methods with the global agenda for sustainability, offering a practical framework for educators. The paper is focused on two main areas – SD skills, their importance in contemporary enterprises and GBL, as an innovative teaching method that can be used to meet learning requirements of new generations and shape SD competencies in more efficient and effective way. The paper offers valuable insights for higher education institutions (HEIs) on the integration of GBL into their curricula, with the objective of better preparing students for sustainability challenges. The practical implications for improving teaching practices and aligning them with SDGs are clearly articulated.

2. The Critical Role of SD Awareness of the Contemporary Workforce

Employees of sustainable companies should have specific competences that enable them to work effectively in the context of corporate social responsibility (CSR) and sustainability. Sustainability is a transdisciplinary field that deals with complex issues and challenges. Several frameworks emerged in the literature, that describe the key competencies that universities should equip their graduates with. Such future employees and entrepreneurs will contribute to the transformation towards sustainability. Currently, in many cases, students are taught traditionally with the assumption, that creating value for a company is about maximizing profits and sustainability can be a leverage to increase company profits (Foucrier, Wiek, 2019). The most widely accepted framework (Wiek, Withycombe, Redman, 2011), which has also been operationalized (Wiek et al., 2015) includes the following competencies:

- *Systems thinking competency* – the ability to understand and analyze complex systems and the interrelationships between their components.
- *Anticipatory competency* (aka Future Thinking competence) – the ability to anticipate future trends and scenarios and assess their impact on sustainability.
- *Values thinking competency* (aka Normative competence) – ability to recognize, reflect upon, and integrate different values and ethical considerations into decision-making processes related to sustainability.

- *Strategic competency* – the ability to develop and implement strategies and action plans for sustainable development.
- *Interpersonal competency* – the ability to effectively communicate, collaborate, and manage conflicts within diverse groups.
- *Integrated problem-solving competency* – the ability to utilize diverse problem-solving methodologies to address intricate sustainability challenges and formulate feasible solution strategies.

This framework was later subjected to an expert evaluation (Brundiens et al., 2021) and compared with the literature to find convergence (Redman, Wiek, 2021). During evaluation two additional key competences for sustainable development have been identified:

- *Implementation competency* – the ability to effectively execute and manage sustainability initiatives and,
- *Intra-personal competency* – the ability to understand and manage one's own emotions, motivations, and behaviors in the context of sustainability.

Of course, this is not exhaustive list of the competences a graduate should be equipped with. There are several additional competences that should be acquired during higher education such as 21st Century Skills (e.g. critical thinking, problem solving, creativity, communication, learning to learn etc.), topical knowledge (specific to the field of study) and other professional skills (e.g. project management). All the frameworks mentioned do not include a description of a detailed set of major-related competences (topical knowledge) (Bianchi, 2020).

An empirical study conducted in Belgium, with professionals working in sustainability-related management positions for at least 5 years, provided a slightly different breakdown of competences and identified competences not presented in the framework for higher education (Venn, Perez, Vandenbussche, 2022). Practitioners emphasized the role of competences called interventions. These competences enable to develop solutions to sustainability challenges in cooperation with stakeholders and help to support change towards sustainability. The following competencies have been added:

- *Capacity-building competence* – the ability to develop and strengthen stakeholder resources and capacities so that they can contribute to sustainable development.
- *Intrapreneurial competence* – the ability to taking initiative, passion for sustainability, courage to take risk, exploration of opportunities and creativity.
- *Political competence* – the ability to engage in political thought and action.

According to practitioners, *living experience*, defined as knowledge that evolves over time through daily practice, is also important in sustainable development.

3. Aligning teaching methods with new generations learning preferences

3.1. Digital natives and learning likes and dislikes

One of the main challenges nowadays, facing higher education, is to increase the learning engagement and motivation of young people born in the 21st century. Representatives of *Generation Z* (born in the years 1997-2010) and *Alpha* (born after year 2010) use technology for learning. Generation Z may prefer traditional teaching methods, while generation Alpha representatives learn mainly through interactive educational games and apps. Given the usually long lead times for changes at universities, in such areas as teaching methods, modifications to curricula or training of academic teachers, universities should start preparing now to welcome representatives of the Alpha generation into the university walls. As Digital Natives, the Alpha generation is the first generation that coexists with advanced technologies since birth (dos Reis, 2018). Representatives are very proficient in the use of ICT solutions, and heavily rely on mobile devices. For universities, an equally important characteristic is the propensity for entrepreneurship, creativity, and leadership, which will point to leadership and technology-related professions (Asni, Tsuraya, 2023). It is also expected that one in two representatives of Generation Alpha will want to pursue a university degree, which is a decline from Generation Z (Bennett, Maton, Kervin, 2008).

Research results show that new teaching strategies, that resonate with the technological prowess of Alpha generation will need to take into account:

- *Increasingly interactive teaching methods* using technology based on games, simulations, and experiential learning; and shorter class times due to difficulty in maintaining attention (McCrindle, Fell, 2020).
- *Individualizing teaching and adapting to the needs of individual students* considering preferred learning styles and expectations of the education system (Miller, 2023).
- *Alpha generation's propensity to innovate*, that may contribute to progress and the development of society (Ziatdinov, Cilliers, 2022).
- *The constant development of Artificial Intelligence tools* and the proficiency of the Alpha generation in using them (Ahmed, Ahmad, 2023).
- *Collaboration and social interaction* in the teaching methods used (Ziatdinov, Cilliers, 2022).

3.2. Game-based Learning and Gamification

Annual reports on the gaming market indicate continuous dynamic growth in the rate of 8-10%, driven by successive technological innovations, subscription models for game consumption or the growing popularity of mobile games. According to Newzoo's estimates, the value of the global games market in 2023 accounted for \$184 billion, 0.6% higher than in

2022. Last year has shown a growth in both the PC games segment (which increased its value by 5.3% y-o-y to \$38.4 billion), and the console segment (which grew by 1.7% y-o-y to \$53.1 billion). In contrast, the value of the mobile games segment declined in 2023 contracting by 1.4%, to \$ 90.5 billion (Newzoo, 2024). The long-term growth outlook for the global games market remains optimistic.

According to Newzoo, the global video game market will reach \$205.4 billion by 2026 (Newzoo, 2024). Power of Play report prepared by 12 national trade associations (NTAs), serving the video game industry around the world, issued a survey to look at the behaviors and interests of 13,000 players (ages 16 and older). One conclusion is that games are not just for entertainment. Engaging gaming experience provides valuable opportunities for enhancement of different skills and cognitive stimulation. Video games are seen as a tool for building problem-solving, teamwork, collaboration, communication, conflict resolution and leadership skills (Power of Play, 2024). According to the DFC Intelligence Global Game Consumer Market Overview report (Games Industry, 2024), there are currently 3.7 billion gamers in the world, meaning that almost half of the Earth's population engages in computer games in one form or another. These figures show what a huge and diverse social phenomenon computer games have become worldwide. Therefore, it is not surprising, that games, or elements of games, have been used extensively in education for many years. Learning patterns are evolving and students' intrinsic motivation is driven by several factors related to social and economic change, as well as new developments in ICT domain.

3.3. Benefits of games in education

The scientific literature provides numerous examples of the utilization of gamification in a variety of fields, including business, biology, marketing, management, and psychology (Boyle et al., 2014). In the field of higher education, GBL is a well-established teaching method that is employed across a range of disciplines. GBL is increasingly being used in contexts, where the subject-matter content is challenging and requires a sophisticated comprehension process, includes advanced 'what-if' analyses, is difficult to grade, or when strategic thinking and communication skills of learners are required (Al-Azawi, Al-Faliti, Al-Blushi, 2016). The literature on the benefits of GBL and gamification in education is extensive (Vlachopoulo, Agoritsa, 2017). Table 1 outlines the key publications on this topic.

Table 1.

Benefits of using games in the learning process

Publication	Benefits
(Beed, Hawkins, Roller, 1991)	Facilitates teaching based on the individual needs and aptitudes of each student.
(Perini et al., 2018)	Helps students acquire practical skills relevant to their future careers.
(Lapek, 2018)	Encourages students to think critically and solve complex problems in a simulated environment.

Cont. table 1.

(Johnson et al., 2014)	Provides opportunities for formative assessment. In-game feedback helps students to understand their performance and areas for improvement, identifying needs or difficulties among students.
(McGonigal, 2011)	Evokes reactions of an emotional nature, such as happiness, curiosity, self-improvement, as well as others, such as frustration and disappointment
(Boyle et al., 2014) (Muntean, 2011) (Buckley, Doyle, 2016) (Rabah, Cassidy, Beauchemin, 2018)	Increases students' motivation, attention, and involvement in the teaching and learning process what makes education more stimulating and fun.
(Camilleri, Busuttill, Montebello, 2011)	Elements such as rankings, encourage engagement through competition, badges provide a visual display of progress and provides feedback on learning progress.
(Gee, 2003)	Allows "immersion in experience", as a result of which learners are more effective in remembering information and strengthening their lasting understanding of concepts.
(Glover, 2013)	Is an attractive and motivating formula for new generations of learners, growing up in the age of video games and widespread Internet technology.
(Hanus, Fox, 2015)	Fosters a trial-and-error learning process that enables mistakes made to be corrected.
(Kalinauskas, 2014)	Fosters creativity, develops imagination.
(Kazmierczak, 2016)	Takes you out of the routine, breaks up routine duties, triggers curiosity, creates and maintains commitment, convinces students to act more effectively, increases efficiency, improves productivity.
(Lee, Hammer, 2011)	Gives students the freedom to experience failure in the learning process without fear of consequences.
(Oblinger, 2004)	Encourages an active role in the learning process by supporting experiential and problem-based learning.
(Yang, 2012) (Deci, Koestner, Ryan, 2001)	Supports the good atmosphere in classes.
(Zimmerman, 1990)	Allows self-monitoring and progress tracking through feedback to support self-regulation of the learning process.
(Liu, Shaikh, Gazizova, 2020)	Make the learning process more effective, which is reflected in better results.
(Hartt, Hosseini, 2019)	Enable the integration of both intrinsic and extrinsic motivational elements.

Source: (Świątoniowska, 2021).

Properly applied GBL, that considers the learning outcomes, characteristics of the target group, and the quality of game content can be an effective educational tool (Fernández-Raga et al., 2023). It can facilitate and enhance the learning process, by promoting interaction, collaboration, and communication, generate interest in the educational content, and increase students' learning motivation and engagement, by encouraging participants to actively participate in the activities (Anastasiadis, Lampropoulos, Siakas, 2018). Additionally, several studies summarized in a meta-analysis (Karakoç et al., 2022) show that GBL can have a positive impact on student achievements and learning outcomes.

4. SEED Project – shaping tomorrow's workforce SD skills with GBL

4.1. SD skills development with the SEED simulation game

Sustainable Entrepreneurship in EDucation project (SEED project) funded by the European Union (2022-1-PL01-KA220-HED-000088765), aimed to develop a set of innovative didactic tools, that enable young people to take decisions and act in a way that is likely to contribute positively to SD. One of the project's outputs is the SEED simulation game, where students act as executive teams, making realistic business decisions in the context of a whole enterprise – The Café. By making decisions in the game, students develop the skills necessary to manage their own business, with a focus on sustainability. They can make decisions on specific matters, such as determining a convenient location, related to the type of potential customers, planning the offer, equipping The Café with the all necessary equipment and finally hire employees. Students must also take care of advertising and promotion. They are supposed to interpret market feedback, analyze competitors' moves, and adjust properly their business strategy in a real time. The students' business operates in the market ecosystem, with other businesses established by other teams in a group.

Throughout the SEED simulation game, students can:

- *Develop and apply essential business skills*, such as decision making and strategic planning (goals setting, resource planning and allocation, market analysis etc.), financial management (forecasting expenses and revenues, monitoring operational costs, pricing strategies etc.), human resource management (hiring the right staff, providing necessary training etc.), marketing (creating a brand identity, implementing marketing campaigns to attract and retain customers, etc.).
- *Improve teamwork skills*, as in the game all decisions are made by them as a team, according to the division of responsibilities assigned to team members at the beginning of the game. Students must analyze data, discuss and finally implement the selected strategies. They develop communication, negotiation, working under pressure and critical thinking skills. Analyzing successes and failures after each round helps students learn from their mistakes and allows them to plan their next moves. The game teaches responsibility and helps to understand how individual decisions affect the success of the entire team.
- *Face various real-life sustainable dilemmas*. The game engages students in implementing a sustainable strategy for The Café. Students are forced to make decisions that are critical to maintaining the right balance between the profitability of their café and sustainability. They must consider the consequences of every decision they make as an entrepreneur.

According to United Nations, by 2030 all learners should acquire knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship, appreciation of cultural diversity and of culture's contribution to sustainable development.

The authors believe that the best way to educate young people about sustainability is to help them discover how the decisions they make affect their lives, the environment and the economy. This will allow them to better understand the consequences of these decisions and promote responsible attitudes. The SEED simulation game helps to develop students' attitudes toward sustainability and to make young people aware how they can play a role in creating a more sustainable future. Game helps them to understand the impact that entrepreneurs are having on the environment and the steps they can take to reduce their environmental footprint. When making decisions in the game, students are encouraged to consider aspects related to corporate social responsibility (CSR) and SD. Making efforts in sustainable development is promoted in the game.

SEED simulation game develops cross-cutting key competencies that are relevant to all SDGs and are seen as crucial to advance sustainable development. All these key competencies are transversal, multifunctional and context-independent and, as UNESCO underlined, cannot be taught, but have to be developed by the learners themselves. They are acquired during action, on the basis of experience and reflection. Thus, the GBL can be an effective tool to develop these cross-cutting key competencies. The SEED simulation game develops not only business competences but also the following key competencies (UNESCO, 2018), which are seen as crucial to advance sustainable development:

- *Systems thinking competency* – students must recognize and understand the relationships between different elements such as finance, procurement, marketing and human resource management to make efficient decisions in the game. Teams analyze the consequences of their decisions and their impact on other areas of the business. Students' decisions are set in different contexts, including business or environmental, which allows them to develop systems thinking competency.
- *Anticipatory competency* – students must analyze and evaluate the consequences of the decisions made by the team and their impact on the development of the company. By implementing investments in human resources development, sustainability and CSR practices, they develop the ability to anticipate the consequences of their own decisions.
- *Normative competency* – students must take into account the norms and values of both themselves and society when making decisions. Such activities promote the development of the ability to critically evaluate norms and values.

- *Strategic competency* – the game requires taking into account innovative actions that promote sustainability, both at the level of the company itself and at the level of society. Collaborative strategy planning for the company helps transform complex challenges into concrete practical actions.
- *Collaboration competency* – as all decisions in a game are made in teams, it teaches cooperation, understanding and respecting the opinions of others and develops the ability to negotiate and reach consensus. The game also develops conflict resolution, leadership and decision-making skills.
- *Critical thinking competency* - the game encourages students to question norms, practices and opinions as well as to reflect on their own values, perceptions and actions.
- *Self-awareness competency* – applying in game the elements of sustainability and CSR strategy allows students to reflect on their own role in building a sustainable business and their role in the local community and society. The game develops the attitudes of a self-aware student.
- *Integrated problem-solving competency* – students need to apply different approaches related to dealing with market challenges. This requires implementing activities that integrate all the above competencies.

4.2. Game design and learning objectives for SDG

The SEED simulation game takes into consideration the following sustainable development aspects:

- *Location and its impact on sustainability* - including sustainability practices in the selection of location for the café and the consequences of choosing a particular location (e.g., venue in a shopping mall means that customers more likely use take-out products, which will require these elements to be included into a sustainable strategy and then into the price of the products; the venue in a historical center may limit the possibility of making sustainable investments in such buildings, etc.). This aspect is closely linked with Goal 11 (*Sustainable Cities and Communities*), which makes cities and human settlements inclusive, safe, resilient and sustainable.

Example learning objectives for SDG 11 implemented through the SEED simulation game include:

- The learner is able to plan, implement and evaluate community-based sustainability projects.
- The learner is able to participate in and influence decision processes about his/her community.
- The learner is able to co-create an inclusive, safe, resilient and sustainable community.

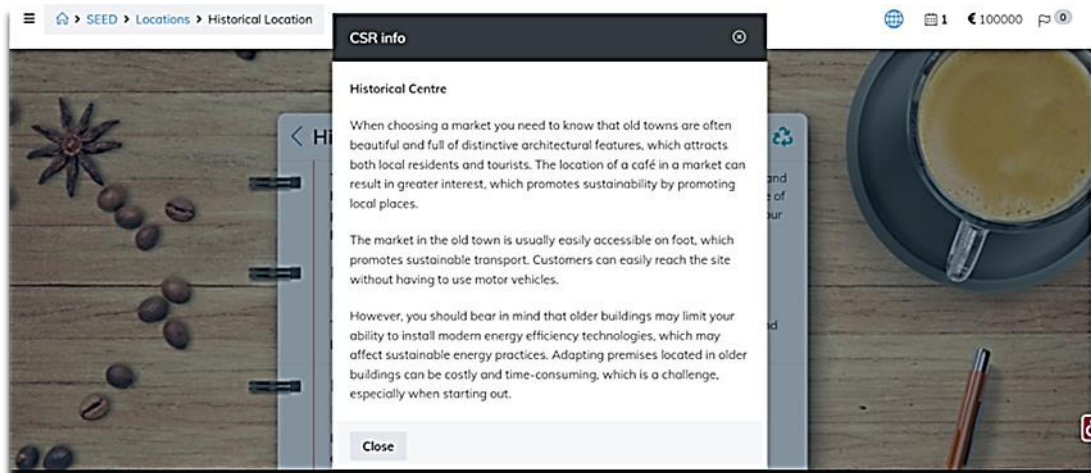


Figure 1. Decision-making interface for sustainable practices in *Location* area.

Source: SEED Simulation Game.

- *Accessible interior design* – as part of the process of opening a café, students must also choose the interior design style. They can select from two predefined styles. In the decision-making process, they can consider the aspect of adapting the interior to the needs of people with disabilities. Such a decision will have consequences in financial aspects as well as in the revenue. This aspect is closely linked with Goal 10 (*Reduced Inequalities*) which empowers and promotes social and economic inclusion.

Example learning objectives for SDG 10 implemented through the SEED simulation game include:

- The learner is able to plan, implement and evaluate strategies to reduce inequalities.
- The learner becomes aware of inequalities in their surroundings and is able to recognize the problematic consequences.

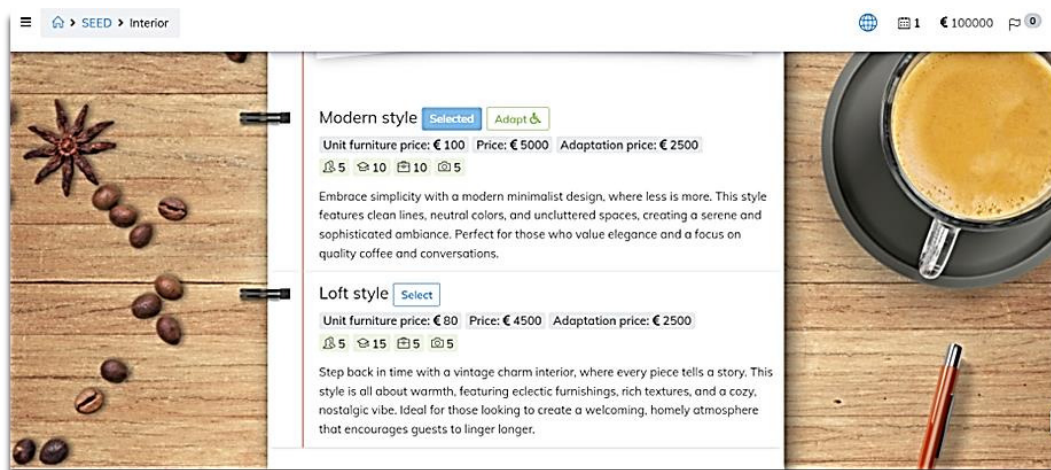


Figure 2. Decision-making interface for sustainable practices in *Interior* area.

Source: SEED Simulation Game.

- *Sustainable equipment* - once the students have decided on the type of products they offer and understood the expectations of their customers, they need to equip their café with the necessary facilities. They should consider various parameters such as energy consumption, reliability as well as eco-friendliness of the equipment. At any stage in the game, teams can revise their sustainability strategy by replacing their equipment with greener ones. This aspect is closely linked with Goal 9 (*Industry, innovation and infrastructure*) which is all about promoting innovative and sustainable technologies, sustainable industrial development and technological progress.

Example learning objectives for SDG 9 implemented through the SEED simulation game include:

- The learner is able to identify opportunities for greener and more resilient approaches to infrastructure, understanding their overall benefits for societies.
- The learner is able to innovate and develop sustainable enterprises.

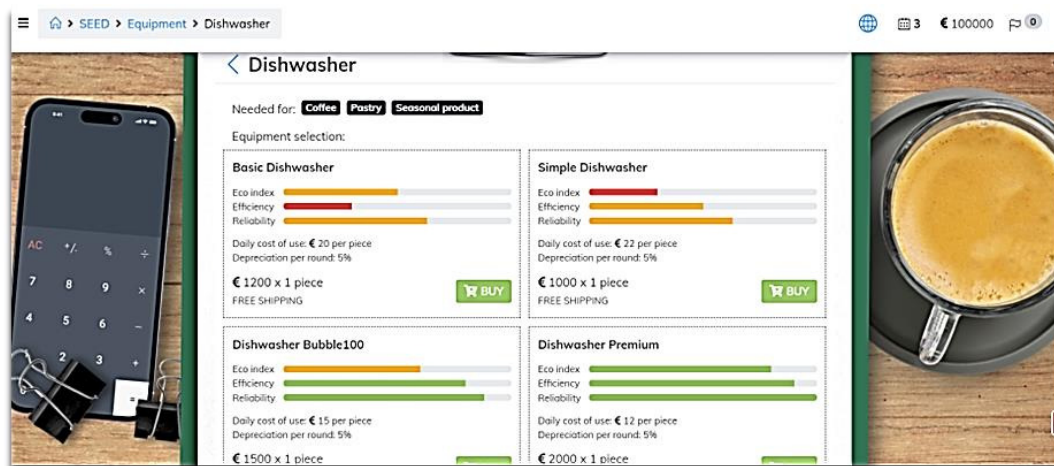


Figure 3. Decision-making interface for sustainable practices in *Equipment* area.

Source: SEED Simulation Game.

- *Sustainable deliveries* – the part of a company's sustainability strategy is to be sensitive to the selection of business partners. There is an “eco-index” in the game, to assess how sustainable and green the supplier's practices are. Students can make their deliveries more sustainable, which would be a step their businesses can take to be more eco-friendly. This aspect is also closely linked with Goal 9 (*Industry, innovation and infrastructure*) as it promotes sustainable industrial development.

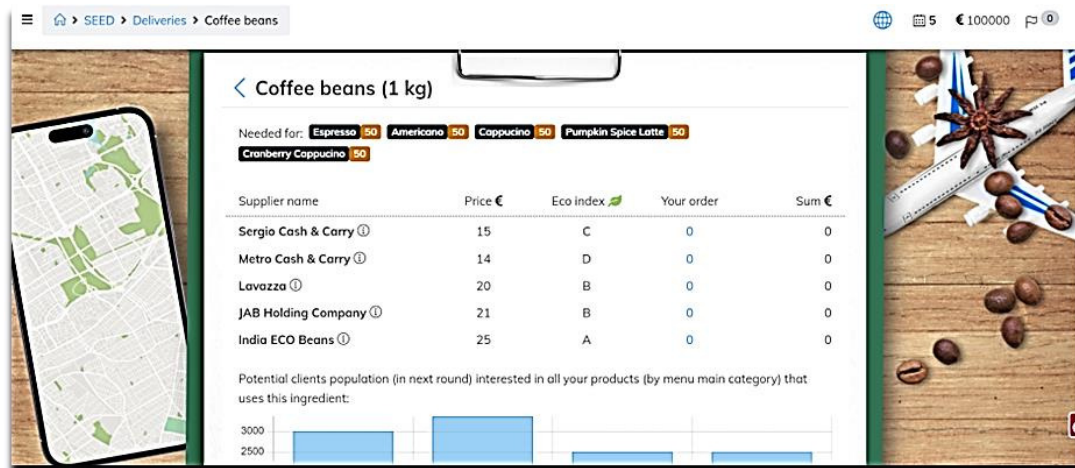


Figure 4. Decision-making interface for sustainable practices in *Deliveries* area.

Source: SEED Simulation Game.

- *Reduced inequalities* – an element related to building students' awareness of equal access for people with disabilities to jobs has also been included in the game. Students have to decide about hiring employees in their company, so they can operate effectively in the market. Among the candidates, from which the teams can choose, are also people with disabilities. However, students must remember that the space in their café must be adapted to the needs of people with disabilities. This therefore requires an appropriate strategy and connects game design with Goal 8 (*Decent work and economic growth*).

Example learning objective for SDG 8 implemented through the SEED simulation game include:

- The learner understands how innovation, entrepreneurship and new job creation can contribute to decent work and a sustainability-driven economy and to the decoupling of economic growth from the impacts of natural hazards and environmental degradation.

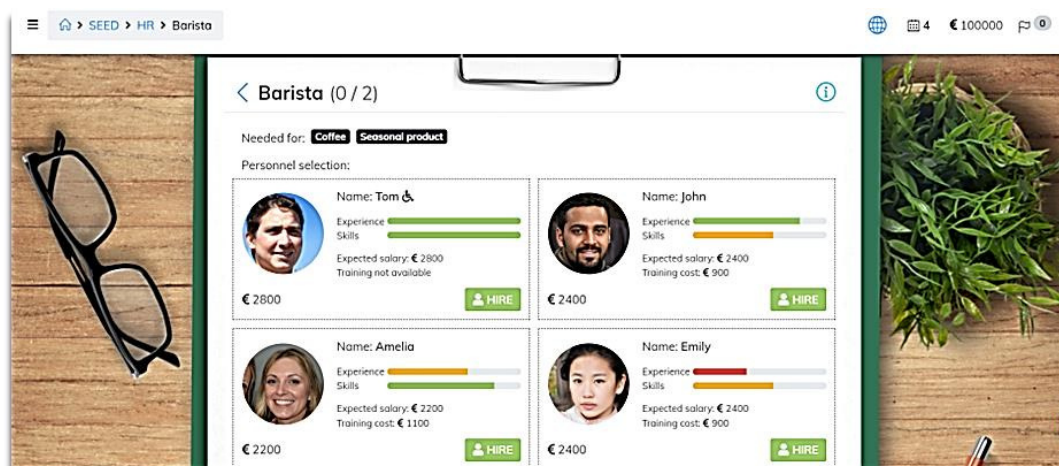


Figure 5. Decision-making interface for sustainable practices in *Human Resources* area.

Source: SEED Simulation Game.

- *ECO-ranking*. The following ranking systems were implemented to evaluate the effectiveness of the students' decisions:
 - *Overall ranking*, which is based on the revenue generated by companies. It reflects the effectiveness of teams in the area of company and finances management and its ability to compete with other companies operating in the market (other teams involved in the game).
 - *Ecological ranking*, which assesses the effectiveness of the implementation of sustainability practices in the game (e.g. the selection of suppliers with a high eco-index or the environmental performance of the equipment used). Ecological ranking is created based on four components: the average eco-index of the equipment, the average eco-index of suppliers, the average eco-index of all marketing actions carried out as well as the leftovers from orders that are disposed of after each round.
 - *CSR ranking*, which measures the teams' commitment to implementing responsible business practices, such as hiring people with disabilities or adapting café space to accommodate them. CSR ranking takes into account the following aspects: eco ranking, accessible interior design, employment of people with disabilities, and the average CSR index of all marketing actions carried out.

Ecological ranking		
PLACE	GROUP	RESULT
1	MC	🌿 5405
2	Bean Brew	🌿 5327
3	wirtualis	🌿 5128
4	Delish	🌿 5100
5	LuCafé	🌿 5012

CSR ranking		
PLACE	GROUP	RESULT
1	Delish	❤️ 5411
2	LuCafé	❤️ 5386
3	SEED CAfe	❤️ 5219
4	Bean Brew	❤️ 5193
5	MC	❤️ 5101

Figure 6. Overview of *Ranking Categories* in SEED simulation game.

Source: SEED Simulation Game.

The use of ecological ranking as well as CSR ranking helps to develop students' awareness, that running a business should not be based only on financial aspects, but each enterprise should take special case of environmental and social responsibility to society. Eco-ranking motivates students to take actions that minimize the negative impact on the environment, while CSR ranking teaches that it is important to implement inclusive practices and build relationships with

the external environment. The SEED simulation game includes the most important components that are pointed out by researchers as characteristic of GBL and that make learning effective and efficient.

Conclusions

As it's stated in *UNESCO Education for Sustainable Development. Learning Objectives* (UNESCO, 2023), HEIs should orient educational processes towards principles of sustainability. Such transformation involves not only rethinking the curriculum, but also methods of teaching and making them as efficient and effective as possible. Integration of GBL with learning objectives related to SD offers a transformative approach to cultivating sustainability competencies in students and engage them into the interactive and immersive experiences that resonate with the learning preferences of Generation Z and Alpha.

The paper presented the SEED simulation game, one of the outcomes of SEED Project. The insights collected during the implementation of the game demonstrate that students can acquire not only essential business management skills, but also develop critical competencies presented in such frameworks as UNESCO and other research initiatives.

During the learning process in the frame of GBL, done with SEED simulation game, which is based on realistic business simulations, students are supposed to make decisions and find a balance between profitability and sustainability. The game provides students with the context of modern business environments where sustainability should be a key factor in decision making processes. The design of SEED simulation game has been aligned with the goals included in the UNESCO framework, that emphasizes the importance of equipping learners with competencies, values and attitudes supporting SD across all aspects of life. In particular, Goal 4 (*Quality Education*), Goal 8 (*Decent Work and Economic Growth*), Goal 9 (*Industry, Innovation, and Infrastructure*), Goal 10 (*Reduced Inequalities*), and Goal 11 (*Sustainable Cities and Communities*) have been taken into consideration in the SEED simulation game design process.

Students are engaged with these goals in practical context and the decisions made require them to consider such aspects as social, economic and environmental. Moreover, controlled game environment enables students to experiment with and internalize SD principles much better than with traditional educational methods. This is because GBL approach fits learning preferences of new generations (Z and Alfa).

The present investigation is not without limitations and weaknesses. Firstly, the analysis is based on a single case study, which may not be representative of all higher education contexts. Secondly, the research primarily examines short-term outcomes, lacking longitudinal data to assess long-term impacts on students' SD competencies. The study paves the way for further

research into the long-term effects of GBL on SD competencies and its applicability across diverse educational settings.

The insights collected during implementation of SEED project have shown that GBL initiatives can be powerful tools for advancing education for SD in HEIs. Such tools can transform educational processes in HEIs and extend their capacity to prepare students to challenges of sustainable future. This wider social impact highlights the potential of GBL to influence not only educational outcomes but also societal values. The SEED simulation game serves as a practical example of how theoretical concepts can be translated into engaging learning experiences.

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MACROECONOMIC SHOCKS AND THE EFFECTIVENESS OF CENTRAL BANKS' INTEREST RATE POLICIES

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Purpose: The aim of the article is to analyze the responses of selected central banks to macroeconomic shocks occurring between 2019 and 2023. The analysis focuses on the use of benchmark interest rates by the central banks of seven countries/groups of countries: Poland, the Eurozone, the USA, Japan, China, Brazil, and India in response to rising inflation triggered by the COVID-19 pandemic and the energy crisis caused by the war in Ukraine.

Design/methodology/approach: The article uses desk research, referencing data published by the central banks of selected countries regarding monetary policy conducted between 2019 and 2023. To analyze the impact of inflation rates and other economic indicators, such as unemployment rates, Lombard rates, deposit rates on benchmark interest rates levels during the study period, a Generalized Method of Moments (GMM) model was applied. This technique was chosen to effectively control for the heterogeneity of unobserved units given the dynamic nature of the dependent variables.

Findings: The article confirms the predictability and caution in the approach to monetary policy, which is crucial for economic stability. The results of the econometric model show strong inertia in the benchmark interest rate, which is typical for the cautious and well-considered decisions of central banks.

Originality/value: The article brings a new perspective to the analysis of monetary policy responses to exogenous shocks in the context of different economies. The results are relevant to both economic theorists and monetary policy practitioners.

Keywords: monetary policy, exogenous shocks, interest rates, central banks, inflation.

Category of the paper: research paper.

1. Introduction

The stability of monetary policy in the face of macroeconomic shocks is crucial for maintaining macroeconomic equilibrium and ensuring financial stability. Exogenous shocks introduce sudden and often unexpected changes in economic conditions, which require central banks to respond quickly and effectively, particularly in adjusting interest rates in response to changing inflation levels.

The years 2019-2023 were a period of significant exogenous shocks. The COVID-19 pandemic triggered a global health and economic crisis, leading to sharp declines in production and employment, and consequently, a deep recession. In response to these challenges, central banks implemented aggressive monetary policy measures, including interest rate cuts and quantitative easing programs aimed at stabilizing the economy (Guerrieri, Lorenzoni, Straub, Werning, 2020). Additionally, the energy crisis caused by the war in Ukraine led to sharp increases in energy prices, which further exacerbated inflationary pressures, forcing central banks to make difficult decisions regarding interest rate hikes to control inflation (Bachmann, Baqaee, Korinek, 2022).

These events had far-reaching impacts on the global economy, affecting inflation and unemployment in many countries. Analyzing the responses of central banks to these shocks is key to understanding how monetary policy can be effectively used to mitigate the negative effects of such events.

The object of the article is to analyze the responses of selected central banks to macroeconomic shocks occurring between 2019 and 2023. The analysis focuses on the use of benchmark interest rates by the central banks of seven countries/groups of countries: Poland, the Eurozone, the USA, Japan, China, Brazil, and India in response to rising inflation triggered by the COVID-19 pandemic and the energy crisis caused by the war in Ukraine. The selection of countries for analysis was based on their significant economic importance and diverse monetary policy strategies, which allowed for a more comprehensive and objective assessment of central banks' responses to exogenous shocks.

To achieve the formulated goal the article uses desk research, referencing monthly data published by the central banks of selected countries regarding monetary policy conducted between 2019 and 2023. To analyze the impact of inflation rates and other economic indicators, such as unemployment rates, Lombard rates, deposit rates on benchmark interest rates levels during the study period, a Generalized Method of Moments (GMM) model was applied. This technique was chosen to effectively control for the heterogeneity of unobserved units given the dynamic nature of the dependent variables.

2. Review of monetary policy of selected central banks during the crisis

The beginning of the current decade worldwide has been characterized by an extraordinary increase in prices. This occurred after years of low price growth and even periods of deflation. The causes of this phenomenon seem obvious. They are, in order:

1. The lifting of restrictions related to the COVID-19 pandemic and the unlocking of consumer demand;
2. The outbreak of the Russia-Ukraine war and the associated increases in commodity prices;

3. Local factors specific to each economy.

Each of these causes has led to the emergence of various types of inflationary phenomena. In particular, the following types of inflation can be distinguished:

- demand-pull inflation, where the cause of price increases is excessive demand relative to supply,
- cost-push inflation, where the cause of price increases is rising production costs,
- monetary inflation, where the general price level rises due to a mismatch between interest rates and the money supply relative to the current economic situation.

Currently, we are experiencing all these types of inflation simultaneously. Demand-pull inflation emerged as a result of lifting pandemic restrictions and unlocking economies; cost-push inflation is due to rising commodity prices; and monetary inflation is a consequence of the previous loose monetary policy of central banks and delays in tightening it (Wołowicz, 2023). The Figure 1 shows the annual changes in inflation rates, measured by Consumer Price Index (year-over-year) in the seven studied countries: Poland, the Eurozone, the USA, Japan, China, Brazil, and India from 2019 to 2023.

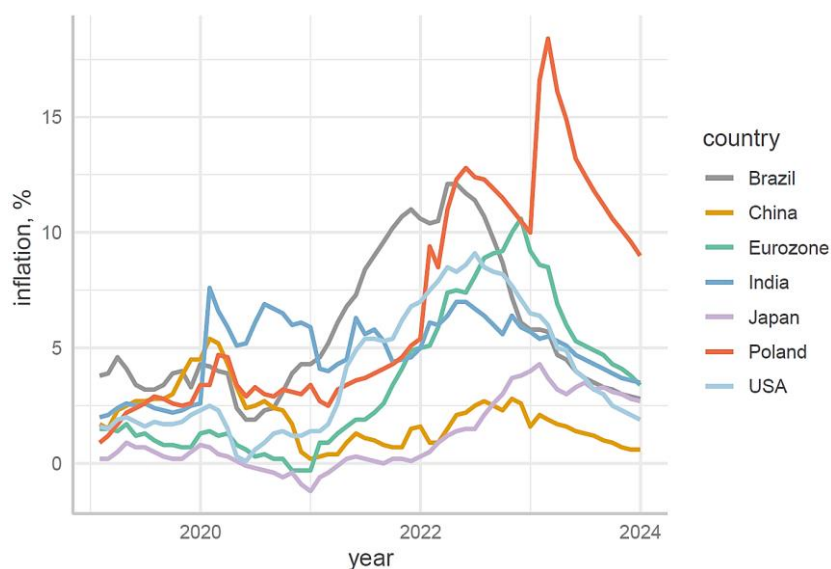


Figure 1. Temporal trends in inflation rates (%) by country, 2019-2023.

Source: own study based on: GUS, Eurostat, OECD.

This extraordinary increase in inflation prompted a response from central banks in the form of interest rate hikes. Especially since the monetary policy of the central banks in the discussed countries, to a greater or lesser extent, aims to stabilize prices in the economy. These actions were taken at different times and to varying extents. Figure 2 illustrates the changes in the benchmark interest rates of the central banks of Poland, the USA, Japan, the Eurozone, China, Brazil, and India from 2019 to 2023.

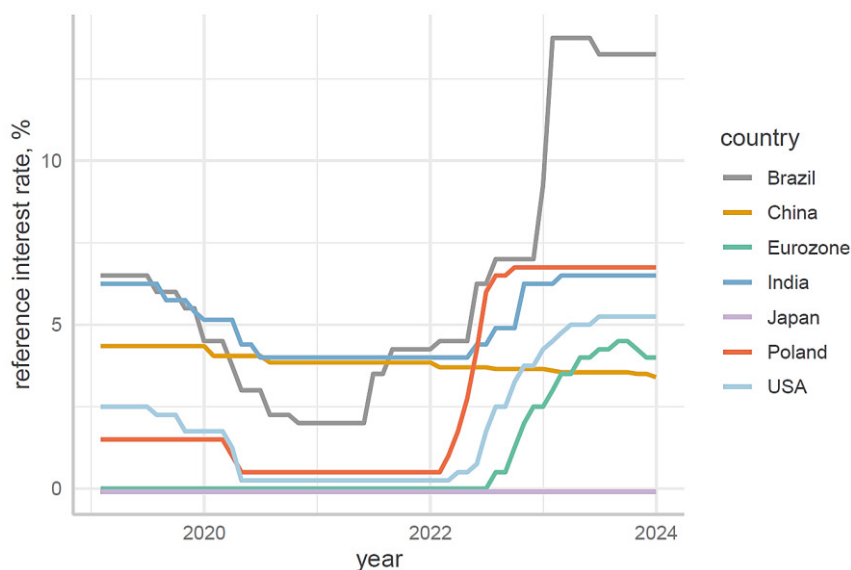


Figure 2. Temporal trends in benchmark interest rates (%) by country, 2019-2023.

Source: own study on the basis of central banks data.

Changes in benchmark interest rates are one of the most important tools of monetary policy that central banks use to combat excessive price increases. This is a highly sensitive tool, requiring particularly precise application. Improper use of it can have negative consequences for both the pace of economic activity and the level of inflation. Therefore, it is crucial to operate it with the appropriate sensitivity, at the right time, and on the right scale, remembering that it is not the only available tool in monetary policy.

Analyzing the actions of central banks, such as benchmark interest rate hikes in response to rising inflation, allows us to assess the restrictiveness of their monetary policy during macroeconomics shocks. Of course, it must be acknowledged that the level of central bank interest rates is only one aspect of this assessment.

2.1. European Central Bank (ECB)

A key factor that prompted the ECB to ease monetary policy in the Eurozone in 2019 was the persistently low inflation, which remained below the levels consistent with its target (below, but close to 2%). Since the ECB's main interest rate had been maintained at the zero lower bound since September 18, 2019, it could not be used for further economic stimulation in 2020. In its communication policy, the ECB emphasized that interest rates would remain at this level (or lower) until inflation was projected to approach levels that are close to, but below, 2%.

The COVID-19 pandemic in 2020 caused inflation to drop to 0.3%, and the ECB introduced the Pandemic Emergency Purchase Program (PEPP) program, keeping interest rates unchanged. In 2021, inflation rose to 5.0%, but the ECB kept interest rates low and continued asset purchases. In 2022, inflation reached 10.6%, prompting the ECB to raise interest rates to 2.5% by the end of the year. In 2023, inflation fell to 2.9%, and the ECB continued raising rates, reaching 4.0% for the deposit rate. Temporal changes in main interest rate and harmonized

index of consumer prices (HICP) in the Eurozone in response to the COVID-19 pandemic and the energy crisis are presented in Figure 3.

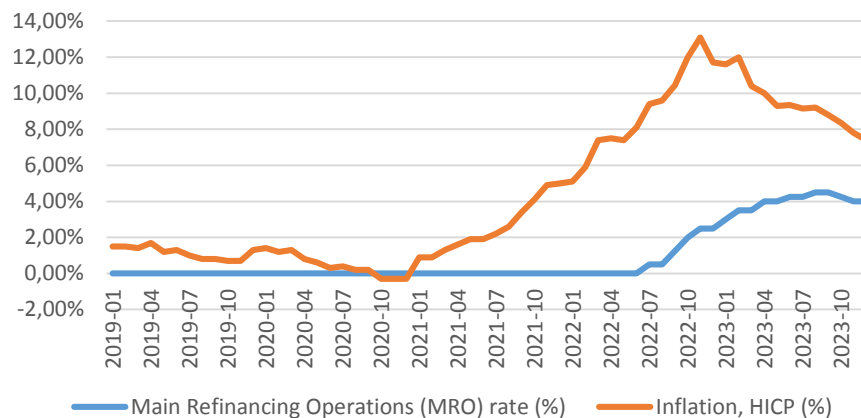


Figure 3. Temporal trends in main refinancing operations (MRO) rate (%) and HICP (%) in Eurozone, 2019-2023.

Source: own elaboration on the basis of central bank data.

2.2. Federal Reserve System (Fed)

The Federal Reserve (Fed) is the central bank of the United States, conducting monetary policy with a long-term inflation target of 2%. The key tool used by the Fed is the federal funds rate.

In 2019, inflation in the USA was 1.8%, and the Fed lowered interest rates in response to economic slowdown, ending the year at a level of 1.50-1.75%. Similarly to the ECB, in the United States, the Federal Reserve System could only respond to the crisis to a very limited extent by lowering the federal funds rate, as it stood at a low level of 1.75% at the beginning of 2020. The COVID-19 pandemic in 2020 caused inflation to further decline to 1.2%, prompting the Fed to cut interest rates to the range of 0.00-0.25% in March 2020. In August 2020, a modification of the monetary policy strategy was announced. The Fed raised its inflation target to an average inflation level to be implemented flexibly (flexible average inflation targeting). The length of the "average inflation level" was not specified. The approach to achieving the target also changed; after periods of inflation below 2%, the Fed would aim to keep inflation moderately above 2% for some time. Additionally, the Fed declared that it would consider employment shortfalls relative to its maximum level (previously deviations) from the estimated state of full employment (Bednarczyk, 2023).

In 2021, inflation rose to 4.7%, forcing the Fed to signal future rate hikes. In 2022, inflation reached 8.0%, and the Fed began aggressive rate hikes, reaching 4.25-4.50% by the end of the year. In 2023, inflation started to decrease, but the Fed continued raising rates to the level of 5.00-5.25%. Temporal changes in federal funds rate and consumer price index (CPI) in the United States in response to the COVID-19 pandemic and the energy crisis are presented in Figure 4.

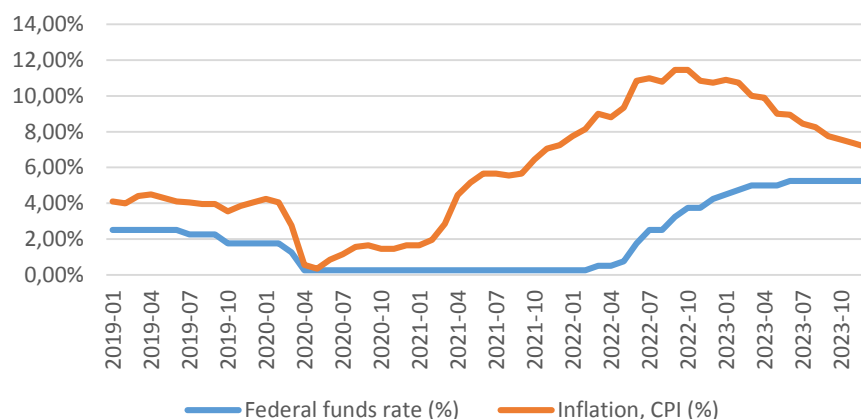


Figure 4. Temporal trends in federal funds rate (%) and CPI (%) in the USA, 2019-2023.

Source: own elaboration on the basis of central bank data.

2.3. National Bank of Poland (NBP)

The National Bank of Poland (NBP) serves as the central bank in Poland, implementing monetary policy with a primary inflation target set at 2.5% with a permissible deviation of +/-1 percentage point. The main tool used by the NBP is the reference rate. In 2019, inflation was approximately 2.3%, and the reference rate was maintained at 1.50%. In 2020, in response to the COVID-19 pandemic, inflation rose to 3.4%. In reaction to this and to support the economy, the NBP lowered interest rates to a record low of 0.10% in May 2020. However, inflation in Poland surged to 8.6% by the end of 2021, prompting the NBP to begin a cycle of interest rate hikes, reaching 1.75% by the end of 2021 and 6.75% by the end of 2022, in response to record inflation levels exceeding 15%. In 2023, inflation began to decrease to around 10%, and the NBP maintained interest rates at 6.75%. Temporal trends in NBP reference rate (%) and CPI (%) in Poland in response to the COVID-19 pandemic and the energy crisis are presented in Figure 5.

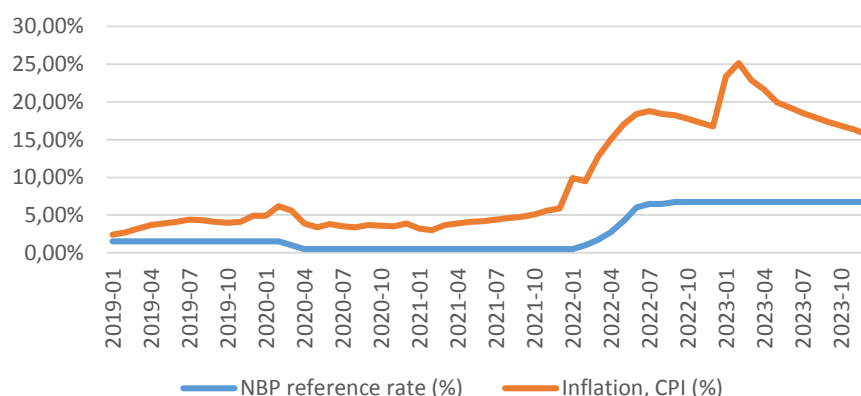


Figure 5. Temporal trends in NBP reference rate (%) and CPI (%) in Poland, 2019-2023.

Source: own elaboration on the basis of central bank data.

2.4. Bank of Japan (BoJ)

The Bank of Japan (BoJ) is responsible for monetary policy in Japan, with the goal of maintaining inflation at 2%. The BoJ has pursued a very accommodative monetary policy, featuring negative interest rates (-0.10%) and aggressive quantitative easing.

In 2019, inflation in Japan was approximately 0.5%. The Bank of Japan (BoJ) continued its loose monetary policy under the yield curve control policy by maintaining the main interest rate at a negative level of -0.1% (a level in place since January 2016) and controlling the yield on 10-year government bonds (JGBs) at around 0.0%. Additionally, the BoJ continued to purchase non-government assets in the financial market.

The COVID-19 pandemic in 2020 caused inflation to drop to -0.4%, in 2021 inflation rose to 0,1%. In 2020 and 2021, the Bank of Japan (BoJ) took actions aimed at ensuring smooth financing for businesses and maintaining stability in financial markets to prevent a deterioration in business and household sentiment. In 2020, the BoJ left interest rates unchanged at -0.1%.

Despite the increase in inflation to 2.5% in 2022, unlike other central banks in developed countries, the Bank of Japan (BoJ) did not decide to change interest rates. The main interest rate remained at -0.1% throughout 2022. The BoJ's lack of interest rate changes amid global monetary tightening by other central banks contributed to the weakening of the yen against the dollar. To strengthen the yen, the BoJ decided in September 2022 to intervene in the foreign exchange market to support the yen (the first such operation since 1998). Additionally, the BoJ continued its Quantitative and Qualitative Easing (QQE). In 2023, inflation stabilized at 2.5%, and the BoJ continued its monetary policy. Temporal trends in Short-term Policy Interest Rate (%) and CPI (%) in Japan in response to the COVID-19 pandemic and the energy crisis are presented in Figure 6.

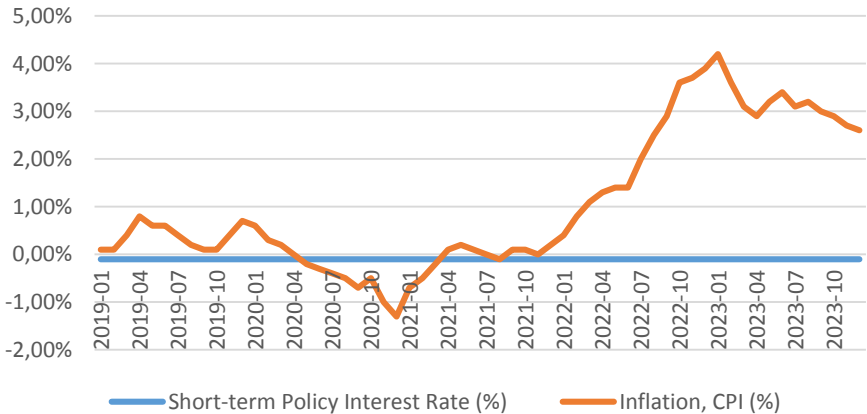


Figure 6. Temporal trends in Short-term Policy Interest Rate (%) and CPI (%) in Japan, 2019-2023. Source: own elaboration on the basis of central bank data.

2.5. People's Bank of China (PBOC)

The People's Bank of China (PBOC) is responsible for monetary policy in China. Although the PBOC does not have an officially declared inflation target, it aims to maintain inflation at a low level.

The PBOC conducted an accommodative monetary policy, lowering interest rates in response to the pandemic. In 2019, inflation was approximately 2.9%, and the PBOC reduced the Loan Prime Rate (LPR) to 4.25% (1-year) and 4.85% (5-year). In 2020, inflation rose to 5.4%, prompting the PBOC to further lower interest rates, maintaining the LPR at 3.85% (1-year) and 4.65% (5-year). In 2021, inflation fell to 0.9%, allowing the PBOC to keep interest rates low to support the economy. In 2022, inflation rose again to 2.1%, but remained controlled, enabling the PBOC to continue its accommodative monetary policy. In 2023, inflation dropped to 0.24%, allowing the PBOC to maintain low interest rates and continue supporting economic recovery. Temporal trends in Loan Prime Rate (LPR) (%) and CPI (%) in China in response to the COVID-19 pandemic and the energy crisis are presented in Figure 7.

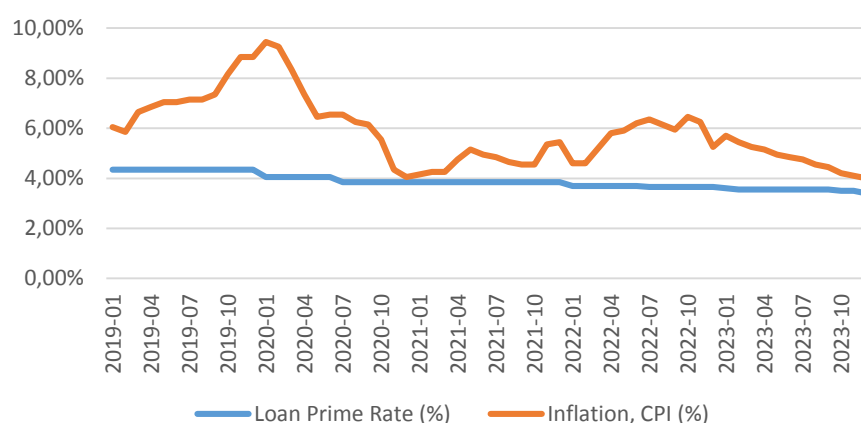


Figure 7. Temporal trends in Loan Prime Rate (LPR) (%) and CPI (%) in China, 2019-2023.

Source: own elaboration on the basis of central bank data.

2.6. Central Bank of Brazil (BCB)

The Central Bank of Brazil (Banco Central do Brasil, BCB) is responsible for monetary policy in Brazil, aiming to maintain inflation at a level of 3.75% with a permissible deviation of +/-1.5 percentage points. The official interest rate is the Special System for Settlement and Custody (SELIC) rate, which is the overnight lending rate.

In 2019, inflation was approximately 3.7%, and the BCB lowered the SELIC rate to 5.00% in response to economic slowdown. In 2020, inflation dropped to 2.1% at the onset of the pandemic, prompting the BCB to further reduce interest rates to a record low of 2.00%. However, in 2021, inflation surged to 10.1%, forcing the BCB to initiate a cycle of interest rate hikes, reaching 9.25% by the end of the year. In 2022, inflation climbed to 12.1%, leading the

BCB to continue raising interest rates, achieving 13.75% by the end of the year. In 2023, inflation fell to around 5.9%, and the BCB maintained a restrictive monetary policy to control inflation. Temporal trends in SELIC rate (%) and CPI (%) in Brazil in response to the COVID-19 pandemic and the energy crisis are presented in Figure 8.

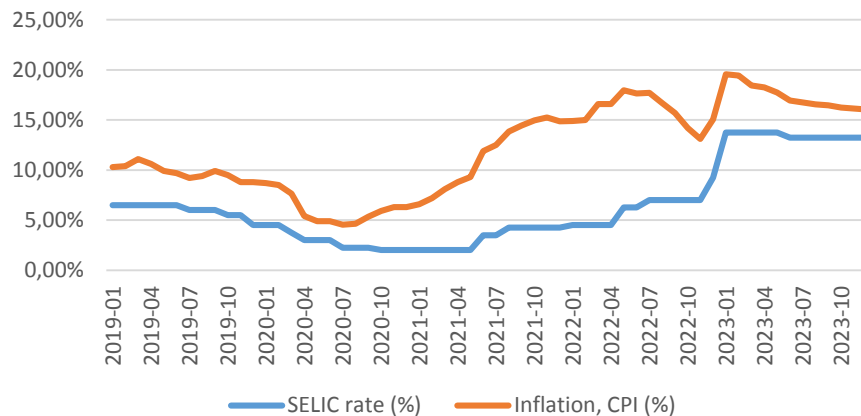


Figure 8. Temporal trends in SELIC rate (%) and CPI (%) in Brazil, 2019-2023.

Source: own elaboration on the basis of central bank data.

2.7. Reserve Bank of India (RBI)

In India, decisions regarding interest rates are made by the Central Board of Directors of the Reserve Bank of India (RBI). The official interest rate is the repo rate. In 2014, the primary goal of RBI's monetary policy became price stability, placing less emphasis on government borrowing, rupee exchange rate stability, and the need to protect exports. In February 2015, the government and the central bank agreed to set the consumer inflation target at 4 percent, with a tolerance band of ± 2 percentage points, starting from the fiscal year ending in March 2017.

In 2019, inflation in India was approximately 3.7%, and the RBI lowered the repo rate to 5.15% in response to the economic slowdown. The COVID-19 pandemic in 2020 caused inflation to rise to 6.6%, prompting the RBI to cut the repo rate to 4.00%. In 2021, inflation was around 5.1%, and the RBI maintained low interest rates to support economic recovery. In 2022, inflation increased to 6.7%, leading the RBI to raise the repo rate to 6.25%. In 2023, inflation fell to around 5.4%, and the RBI adjusted its policy based on economic conditions. Temporal trends in repo rate (%) and CPI (%) in India between 2019-2023 are presented in Figure 9.

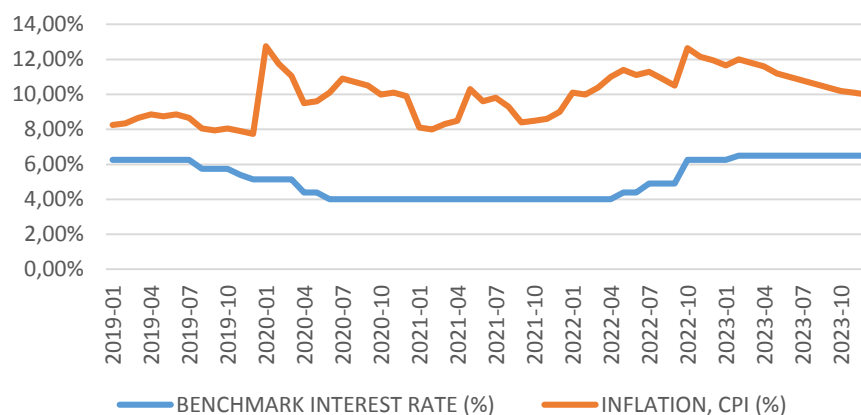


Figure 9. Temporal trends in repo rate (%) and CPI (%) in India, 2019-2023.

Source: own elaboration on the basis of central bank data.

3. Statistical analysis

The objective of the analysis was to identify the financial determinants that influence the benchmark interest rate levels in countries with major global economies during the macroeconomics shocks in 2019-2023.

3.1. Materials and method

In the analysis, we employed a one-way (individual) effect one-step system general methods of moments (GMM) model to address potential endogeneity and autocorrelation issues inherent in the panel data. This technique was chosen to effectively control for unobserved individual heterogeneity while taking into account the dynamic nature of the dependent variables.

The model was specified with the benchmark interest rate outcome variable regressed on its first lag to capture the dynamic relationships within the data. Instrumental variables such as inflation rate, unemployment rate, Lombard and deposit interest rates were selected based on their relevance and exogeneity, ensuring the validity of the GMM estimator.

The analyses were conducted using the R statistical language.

Instrument selection was critical to the model's effectiveness in addressing endogeneity. Instruments for the lagged dependent variable, in this case, the benchmark interest rate, included further lags of the dependent variable itself to mitigate weak instrument issues and reduce endogeneity bias. Specifically, the instruments used in the GMM estimator were the further lags of the benchmark interest rate, reflecting to ensure strong correlations with potentially endogenous regressors while maintaining orthogonality to the error term.

3.2. Pre-processing stage

The dependent variable (benchmark interest rate) underwent normalization through the application of the z-score technique to ensure a standard scale across all data points. This transformation aids in mitigating issues related to scale disparities and enhances the interpretability of regression coefficients. Concurrently, due to substantial variability observed in the data, the unemployment rate predictor was transformed using a logarithmic scale to stabilize the variance and reduce the impact of extreme values, thus facilitating a more reliable and accurate statistical analysis.

3.3. Model specification

The specification of the final model, as determined through rigorous sensitivity analysis, is delineated in Equation 1:

$$\begin{aligned} \text{benchmark interest rate}_{,it} = & \beta_1 \cdot \text{benchmark interest rate}_{,it-1} + \beta_2 \cdot \text{inflation rate}_{,it} + \\ & \beta_3 \cdot \text{unemployment rate}_{,it} + \beta_4 \cdot \text{lombard interest rate}_{,it} + \beta_5 \cdot \text{lombard interest rate}_{,it-1} + \\ & \beta_6 \cdot \text{deposit interest rate}_{,it} + \alpha_i + \epsilon_{,it} \quad (1) \end{aligned}$$

where: *benchmark interest rate*_{,it} represents the outcome variable at time *t* for unit *i*; *benchmark interest rate*_{,it-1} denotes outcome variable for unit *i* at time *t-1* (lagged); β_1 represents the regression coefficient for outcome variable, $\beta_2 \dots \beta_6$ denote the regression coefficients for explanatory variables; *inflation rate*_{,it}, *unemployment rate*_{,it}, *lombard interest rate*_{,it}, *lombard interest rate*_{,it-1}, *deposit interest rate*_{,it} these are values of the explanatory variables at time *t* and *t-1* for the *i*-th unit; α_i represents the component accounting for unobserved individual effects for *i*-th unit, $\epsilon_{,it}$ – is the error term for the *i*-th unit at time *t*.

In the model's instrumentation, the benchmark interest rate was utilized as an instrumental variable, which was crucial for identifying and estimating the impact of endogenous explanatory variables.

3.4. Model validation

To ensure the robustness and validity of the model's estimates, an analysis was conducted on the distribution of the model's residuals. The Sargan-Hansen test, based on the seminal works of Hansen (1982) and Sargan (1958), was implemented to confirm the validity of the instruments used. Additionally, Arellano-Bond tests (1991) were conducted to check for the absence of first and second-order serial correlation in the differenced errors. The Wald test was employed to determine whether the selected independent variables exert a significant collective impact on the dependent variable.

3.5. Characteristics of the data sample

The dataset subjected to analysis consists of panel data capturing the dynamics of five financial parameters: benchmark interest rate, inflation rate, unemployment rate, Lombard rate, and deposit rate (all in %). This dataset encompasses monthly observations from seven countries (units) over a five-year period from 2019 to 2023, resulting in 60 records per country. The countries included in the dataset are Poland, China, Eurozone countries, India, Japan, the United States, and Brazil.

3.6. Results

The GMM model was implemented on a dataset structured as a balanced panel, comprising 7 individuals monitored over 60 time periods with one-month step, resulting in a theoretical total of 420 observations. Nevertheless, the actual number of observations used in the analysis was 814, indicating a deviation from the expected count. This variation stems from the exclusion of certain observations, necessitated by the lag structure and the transformation requirements integral to the system GMM method.

The residual analysis of the GMM model provides critical insights into its validity and reliability. With the residuals ranging from a minimum of -0.32 to a maximum of 0.33 and both the first and third quartiles concentrated below 0.01 in absolute terms, the distribution indicates a strong central tendency around the median. This tight clustering suggests that the model fits the majority of the data points well, with no evidence of large-scale deviations that would suggest systemic errors in model specification or estimation.

The mean of the residuals oscillating around zero, specifically at -0.00025, further supports the model's accuracy. A mean close to zero in residual analysis generally indicates that the model does not systematically overestimate or underestimate the dependent variable.

Overall, the residual analysis indicates that the GMM model is valid and effectively captures the complex interactions within the data. The model's estimates can be considered reliable for interpreting the effects of the independent variables on the dependent variable within the context of this study.

Starting with the Sargan test, which assesses the validity of the over-identifying restrictions and, by extension, the appropriateness of the instrumental variables used, the test statistic is remarkably low $\chi^2(122) = 7.00$, $p = 1.000$. The high p-value suggests that there is no evidence against the null hypothesis of the instrument's validity. In other words, the instruments used in the model are appropriate and do not correlate with the residuals, confirming that they are indeed exogenous and suitable for the GMM estimation.

Moving to the autocorrelation tests, the first autocorrelation test, which checks for first-order autocorrelation, reports a statistic of -1.73 with a $p = 0.084$. This p-value, being slightly above the conventional significance level, does not provide sufficient evidence to reject the null hypothesis of no first-order autocorrelation. However, it is borderline, suggesting a slight

possibility of autocorrelation that might warrant further scrutiny or more conservative interpretation of the model results.

The second autocorrelation test, aimed at detecting second-order autocorrelation, shows a statistic of -0.017 with a $p = 0.987$. This result comfortably supports the absence of second-order autocorrelation among the residuals, reinforcing the model's appropriateness in handling the dynamic panel data structure without introducing undue bias from autocorrelation.

Lastly, the Wald test for the significance of coefficients presents a very high chi-square statistic, $\chi^2(6) = 111464152.00$ with $p < 0.001$). This indicates that the model coefficients are highly statistically significant, suggesting that the independent variables included in the model have a substantial and statistically undeniable impact on the dependent variable.

In conclusion, the combination of a valid instrument set (as indicated by the Sargan test), the absence of problematic second-order autocorrelation, and the significant impact of the predictor variables (as demonstrated by the Wald test) suggests that the model is both statistically robust and theoretically sound. The slight concern raised by the first-order autocorrelation test does not substantially undermine the model but should be acknowledged in interpretations and potential further model enhancements. These results collectively affirm the effectiveness of the GMM approach in this analysis, providing a strong foundation for reliable econometric inference based on the model outputs.

The following Table 1 presents the estimated coefficients from GMM model that was employed to assess the impact of various economic indicators on the benchmark interest rate. The results serve as a basis for understanding how past values and immediate economic conditions interact to influence central bank rate decisions.

Table 1.

The coefficients of the fitted GMM model with robust standard errors

Coefficients	Benchmark interest rate (z-score)			
	B	SE	z	p
Lagged outcome variable				
Benchmark interest rate, lagged by one month	0.983	0.011	91.48	< 0.001
Predictors				
Inflation rate	0.002	0.001	2.41	0.016
Logarithm of the unemployment rate	-0.015	0.009	-1.60	0.110
Lombard interest rate	0.324	0.012	26.33	< 0.001
Lombard interest rate, lagged by one month	-0.317	0.014	-22.60	< 0.001
Deposit interest rate	4.23×10^{-3}	0.002	0.27	0.791

Note. B – regression coefficient; SE – standard error (robusted); z – statistics of the Wald z test; p – p-value of statistical test.

Source: own study.

The lagged benchmark interest rate, lagged by one month, shows a near-perfect autoregressive coefficient of $B = 0.983$ with a $p < 0.001$. This finding strongly underscores the persistence of the interest rate over time, indicating that the benchmark interest rate is highly dependent on its previous month's value. The strong autoregressive coefficient for the lagged benchmark interest rate suggests a high degree of inertia in interest rate decisions, a common

characteristic in monetary policy. Central banks tend to move cautiously, adjusting rates in a gradual manner to avoid market shocks and to allow the economy time to adapt to new conditions. This inertia is also a reflection of the forward-looking nature of monetary policy, where decisions are based not only on current conditions but also on projected economic trends.

Moving to the predictors, the inflation rate shows a relatively modest but statistically significant effect on the benchmark interest rate, with a coefficient of $B = 0.002$ and a $p = 0.016$. This outcome suggests that as inflation increases, so too does the benchmark interest rate, albeit the magnitude of this effect is small, reflecting perhaps a cautious monetary policy response to inflation changes. The modest magnitude of this coefficient might indicate a tempered response to inflation, which could be due to the central bank's dual mandate to balance price stability with other economic objectives such as employment. This result also underscores the central bank's role in preemptively managing expectations to prevent runaway inflation without stifling economic growth.

In contrast, the logarithm of the unemployment rate presents a negative coefficient of $-B = 0.015$, although this estimate is not statistically significant ($p = 0.110$). This indicates a potential downward pressure on the benchmark interest rate as unemployment rises, typical of economic theory suggesting lower interest rates might be used to stimulate economic activity in the face of higher unemployment, though the data does not confirm this effect robustly.

The coefficients for the Lombard interest rate and its lagged value are particularly notable. The current month's Lombard rate has a substantial positive effect on the benchmark interest rate ($B = 0.32$, $p < 0.001$), while the previous month's Lombard rate exerts a nearly equal and opposite effect ($B = -0.32$, $p < 0.001$). The significant and contrasting coefficients for the current and lagged Lombard rates highlight the short-term adjustments and their delayed effects on the benchmark interest rate. This might reflect the transmission mechanism of monetary policy through which changes in policy rates take time to percolate through the economy, affecting various sectors differently. The immediate positive response and the delayed negative response could also indicate overshooting corrections or anticipatory adjustments by the market.

Finally, the coefficient for the deposit interest rate is positive ($B = 4.23 \times 10^{-3}$) but not statistically significant ($p = 0.791$), indicating that changes in this rate do not have a discernible impact on the benchmark interest rate within the given period. This lack of significance may point to the limited role that deposit rates play in influencing central bank benchmark rates, or it might reflect other macroeconomic factors that overshadow the influence of deposit rates. Deposit also rates often respond to changes in central bank rates rather than driving them, functioning more as a follower than a leader in the monetary policy framework.

4. Discussion

A review of central banks' actions indicates that all analyzed countries had to adjust their monetary policy strategies in response to the rapidly rising inflation caused by the COVID-19 pandemic and the energy crisis. In 2019, the discussed central banks were conducting a loose monetary policy. This was mainly due to the decline in inflation dynamics, reduced economic activity, and concerns about the effects of tightening trade policy between the United States and China. Interest rates were lowered (United States, Eurozone, China, Brazil, India) or maintained at negative levels (Japan) or at low levels (Poland). Additionally, central banks used unconventional monetary policy instruments such as asset purchases, providing liquidity to the financial market, and forward guidance on the future shape of monetary policy.

In 2020, central banks' actions worldwide aimed to counteract the negative effects of the COVID-19 pandemic. The global economic recession and low inflation dynamics prompted major central banks to implement various forms of monetary easing. The National Bank of Poland lowered the basic interest rates, while other banks maintained them at low levels (United States, Eurozone, China, Brazil, India) or negative levels (Japan), simultaneously introducing measures to increase liquidity in the banking sector and support credit activity for enterprises.

The sharp rise in energy and food prices, improvement in the economic situation due to increasing demand, and the implementation of fiscal stimulus programs by most governments in 2021 influenced the monetary policy stance of only some central banks. Despite rising inflation indicators, only Poland (from 0.1% at the end of 2020 to 1.75% at the end of 2021) and Brazil (from 2% at the end of 2020 to 9.25% at the end of 2021) decided to raise interest rates, with inflation remaining below targets only in China and Japan. The Fed in 2021 only issued a statement about the possibility of raising interest rates in the near future, while the ECB and RBI continued their low-interest-rate policies to support economic recovery after the pandemic.

The analysis shows that regulating interest rates during the period of overcoming the demand shock played a rather passive role. Interest rates became a mitigation tool only in the case of the supply shock in 2022, during the resolution of the energy crisis caused by Russia's armed aggression against Ukraine. At that time, the scale of monetary policy tightening worldwide significantly increased, associated with substantial deviations of inflation levels from the set targets in all analyzed countries. Central banks introduced changes to asset purchase programs, either ending them or gradually phasing them out. Monetary authorities decided to raise interest rates to levels unseen for a long time. The most restrictive approach was taken by Poland and Brazil, which continued raising basic interest rates (Poland: from 1.75% at the end of 2021 to 6.75% at the end of 2022; Brazil: from 9.25% to 13.75%). The USA, Eurozone, and India also responded with rate hikes but in a more moderate manner: Fed from 0.25% at the end of 2021 to 4.25% at the end of 2021 and 5.25% at the end of 2022;

ECB from 0% at the end of 2021 to 2.5% at the end of 2022 and 4.5% by mid-2023; RBI from 4% at the end of 2021 to 6.25% at the end of 2022 and 6.5% at the end of 2023. The exceptions were China and Japan, which maintained an accommodative monetary policy throughout the period, focusing on supporting economic growth.

However, the approach to using basic interest rates significantly differed from the standards and practices previously employed by central banks, especially during periods of economic recovery. The usual practice at that time was for banks to react quickly by raising interest rates as soon as signs of rising inflation expectations appeared. This reaction was stronger the more expected inflation exceeded the set inflation target (upper target range). In this way, the actions of central banks were in line with the logic of the Taylor rule, which links real GDP growth to maintaining stable price growth. The result of this policy was an increase in real interest rates preceding the rise in actual inflation, causing deflationary-stagnation processes.

During the period of overcoming the price shock caused by the energy crisis, central banks reacted with some delay to the rise in actual inflation indicators, adopting a seemingly accommodative stance towards economic growth. As a result, despite a fairly rapid increase in nominal values of official interest rates, their real values remained very low (in the case of Poland) or low (in the case of the Eurozone and the United States) (Bednarczyk, 2023).

This caution in the approach to monetary policy and the accommodative stance towards economic growth by central banks in response to recent exogenous shocks seems to be confirmed by the developed econometric model. Its results show strong inertia in the reference rate, which is typical for cautious central bank decisions. An autoregressive coefficient close to unity (0.983) with very high statistical significance ($p < 0.001$) suggests that the reference rate is highly dependent on its value from the previous month, especially during periods of supply shocks. High inertia may indicate a departure from quick reactions to rising inflation expectations, instead focusing on stabilizing the economy and avoiding additional shocks in unstable conditions.

A moderate, though significant, impact of inflation on interest rates ($B = 0.002$, $p = 0.016$) suggests that central banks were aware of the need to balance price stability with other economic goals, such as economic growth or employment, which may result from the dual mandates of central banks.

5. Summary

In light of the results presented above from the desk research conducted between 2019 and 2023, we observe various responses from selected central banks to macroeconomic shocks such as the COVID-19 pandemic and the energy crisis triggered by the war in Ukraine. The analysis reveals that monetary policy was conducted with significant caution and predictability,

which is crucial for economic stability. Specifically, the econometric model demonstrated strong inertia in the benchmark interest rate, typical of the prudent decisions made by central banks.

This study constitutes a significant contribution to the scientific discussion on monetary policy responses to exogenous shocks in the context of different economies. The findings have important implications for both economic theorists and monetary policy practitioners. An important observation is the departure from the traditional Taylor rule, indicating a shift towards more flexible and adaptive monetary policy approaches. This change reflects the need to address unprecedented economic conditions with strategies that may deviate from established norms to better manage macroeconomic shocks.

However, the study has certain limitations, primarily due to its focus on selected economies, which may affect the generalization of the results. To obtain a more comprehensive picture, future research should expand the analysis to include a larger number of countries and a variety of monetary policy tools. It would be particularly useful to explore issues related to the long-term effects of monetary policy, compare the effectiveness of different strategies in various regions, and examine the interactions between monetary and fiscal policy in the context of managing economic shocks.

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IMPACT OF FOREIGN DIRECT INVESTMENT ON INNOVATION IN THE CONSTRUCTION MATERIALS INDUSTRY

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Purpose: Although the impact of FDI on the Polish economy is relatively well recognised in the literature, analyses of sectoral differentiation of FDI in Poland are rarely undertaken, so the aim of this article is to establish the relationship between FDI inflows and the development of innovation in the construction materials sector.

Design/methodology/approach: The study employs a comprehensive desk research approach, analyzing statistical data on foreign investments. This methodology allows for a detailed examination of the correlation between FDI inflow and innovation of construction materials enterprises in the construction materials industry.

Findings: The article identifies the nature of innovations generated in the surveyed entities and their penetration into the national environment.

Research limitations/implications: If research is reported on in the paper, this section must be completed and should include suggestions for future research and any identified limitations in the research process.

The article is an attempt to answer the question: how innovative are entities with foreign capital operating in the construction materials industry in the Polish economy and whether there are spillover effects, to the domestic environment. To be used in economic policy in order to increase the absorption of capital in the form of FDI and increase the innovativeness of the economy.

Practical implications: Although the allocation of FDI is subject to market mechanisms that enforce innovation as a condition of competitiveness in order to remain competitive, the strengthening of the attractiveness of the capital allocation conditions indicated/identified in the article through a conscious government policy enhances innovation. To be used in economic policy in order to increase the absorption of capital in the form of FDI and thus increase the innovativeness of the economy.

Originality/value: Establishing the relationship and conditions between FDI inflows and innovation development in a specific low- and medium-technology sector.

Keywords: foreign direct investments, innovation, innovativeness, economic development, construction materials sector, spillover effects.

Category of the paper: Research paper.

1. Introduction

As a consequence of the exploitation of extensive sources of growth and economic development in Poland, such factors began to be identified that would allow the Polish economy to move from a traditional economy to a new economy - one based on knowledge, operating in a global environment, with a dynamic market in which innovation and knowledge become the source of competitive advantage. On the one hand, the technological gap, high costs of domestic innovations, insufficient internal savings and, on the other hand, sufficient capacity to absorb technology and knowledge became the driving force for the opening of the Polish economy to foreign investment - as a complementary way of raising capital and stimulating the development not only of the entire economy, but of specific regions or sectors (Jasek, 2017, pp. 63-64).

In the Polish economy, since its marketisation in 1989, there has been a systematic increase in the involvement of foreign capital in the form of foreign direct investment (FDI) and, consequently, a systematic increase in the number of entities established with foreign capital, the dynamics of which has only in recent years shown a downward trend. Available data and research results show that foreign investors have for more than thirty years perceived Poland as an attractive place to invest capital, both in the form of greenfield investments, i.e. new enterprises created from the ground up outside the investor's country, as well as brownfield investments involving beneficial takeovers and, in the next stage, restructuring of enterprises already operating in the market (Jasek, 2017, pp. 63-64).

There is considerable interest in the subject of foreign investment, but an analysis of the sectoral diversity of FDI in Poland is rarely undertaken, which would allow the identification of the precise relationship between FDI inflows and the development of innovation in specific sectors (in particular mid- and low-tech) and, subsequently, the whole economy, as well as forecasting the directions of further operation of a given sector and its impact on the environment.

The construction materials production and distribution sector is a specific area of foreign investment absorption, which is highly sensitive to economic changes, economic transformations and social conditions. Despite the high risk, foreign investors appeared in the sector relatively quickly (in the early 1990s) and the market for construction materials itself, has undergone huge/diametric changes. The presence of companies with foreign capital has fostered the transfer of knowledge and modern technology, which now results in advanced solutions that allow the sector to reduce the investment and innovation gap, as well as to modernise and improve competitiveness at regional and national level (Gorynia et al., 2006).

Undertakings implemented within the framework of FDI generate both direct effects - positive, negative - and indirect effects, the so-called spillover effects.

This article will present the results of an own study that identified the effects of FDI undertaken between 1990 and 2015 on the transfer and diffusion of innovations, including the mechanisms for their creation in the construction materials sector, with particular emphasis on the part of the sector that supports housing construction. The impact of FDI was considered primarily from the point of view of the host economy. It was also important to identify the motives behind the activity of foreign investors locating capital in enterprises producing construction materials used in housing construction in the context of the socio-economic conditions of Poland as a host country. This made it possible to determine the nature of the innovations transferred in terms of the scale of the changes, their degree of originality and their complexity. The subject of the study includes direct macroeconomic effects, intrasectoral spillover effects, transfer and diffusion of innovations to domestic firms and to the domestic environment, which occurred in the years 1990-2015, marking the timeframe of the study, which resulted from economic conditions, i.e. the opening of the economy and the legal enablement of FDI in Poland.

The research was conducted among executives of large and medium-sized FDI in Poland from the construction materials sector who started their operations between 1990 and 2015, and whose aggregate market shares in each subsector are approximately 15-50%. Most of the surveyed companies started before 2000 (64%), the others after 2000, with the oldest of the surveyed companies established in 1990 and the youngest in 2014. Among the surveyed entities were companies whose capital was sourced from Germany, Austria, Switzerland, France, the Netherlands, Denmark and the UK (7%). Greenfield investments dominated (64% of the surveyed companies), 21% of the companies were brownfield investments, 14% were investments defined as 'other' - not further defined.

Companies producing construction materials were classified in 6 product groups, i.e. chimneys and ventilation; wall, floor materials and ceilings; insulation materials; roofing; windows and doors.

2. Inflow of FDI into the construction materials sector

Poland's social and economic transformation initiated in 1989, resulting in the liberalisation and opening of the Polish economy internationally, also made Poland an attractive country for foreign companies to locate capital. Economic and legal conditions became new determinants, which generated effects in the economic field and allowed for safer and more profitable investments. This had a real impact on the number and volume of foreign direct investments in Poland (Figure 1), their spatial allocation or the dynamics of change in the motives for investment.

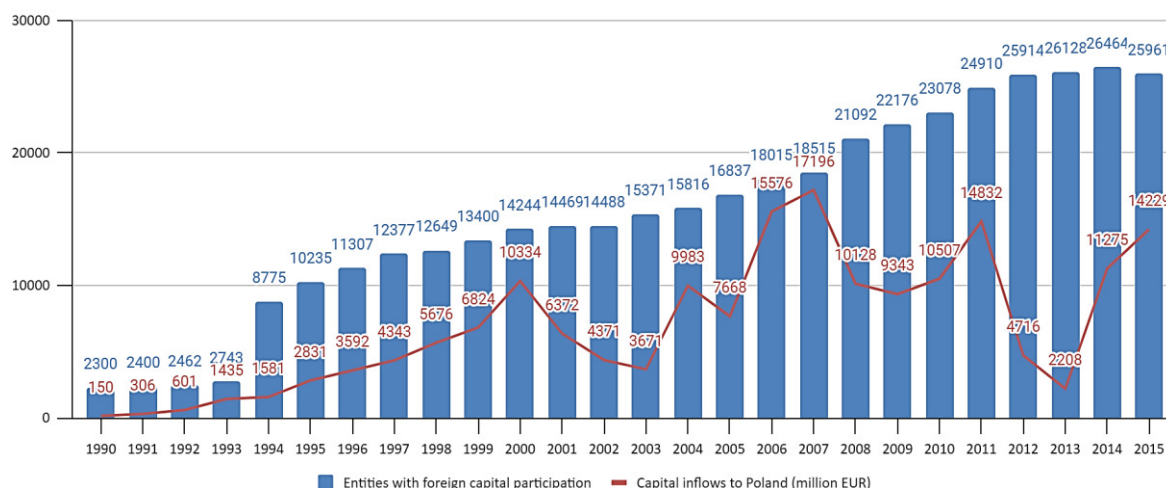


Figure 1. Inflow of foreign capital to Poland and number of entities with foreign capital in 1990-2015.

Source: Own elaboration based on Statistical Office data: *Działalność gospodarcza podmiotów z kapitałem zagranicznym w latach 2005-2015*, Warszawa and data from the National Polish Bank: *Zagraniczne Inwestycje Bezpośrednie w Polsce 2003-2015*.

Also the building materials sector, which finds its practical application in the area of single- and multi-family housing as well as non-residential construction, would not have developed so significantly without the inflow of capital from abroad. This sector, like the construction industry as a whole, is very much influenced by economic factors, cyclical developments, global economic changes and social conditions. It operates in close relation to the environment in which it is located. Hence, the study referred to the entire environment of the sector, in which a strong synergy effect can be observed, which means that ‘the results achieved by the industry are not a simple aggregate of the results achieved by individual companies’ (Dzierbunowicz, 2013, p. 29, cit. Jankowska, 2005).

The structure of the construction materials sector is quite diverse. As a result of incoming knowledge and changes in construction technology, the subsector of construction materials produced from clay, wood, concrete, expanded clay, perlite or steel has developed, with the consequent development of wood, brick, stone, concrete and steel construction. The main manufacturers in the building materials sector therefore include the manufacturers of: bricks, hollow blocks, wall materials, roofs, chimney systems, insulation materials, window and door joinery, finishing building products. These products differ from each other, taking the purpose of structures and buildings as the main dividing feature, which allows residential and non-residential construction to be separated, while construction materials can be divided into those used in single-family housing, multi-family housing or non-residential construction. The type of products produced and their performance characteristics define the subsector, its environment and its end customers.

In the early 1990s, when construction material manufacturers were oligopolistic or even monopolistic, it was they who began to form the construction material trade sector. At the same time, the development of building technology and techniques - the transition from basic-manual

technology to more and more developed products - resulted in the strong formation of two groups of customers, which became individual customers and institutional customers - investors, developers, contractors. The tremendous transformation in terms of both products and production and organization would not have been possible without the multinational corporations that decided to set up their operations in Poland. These investors were primarily interested in expanding their own markets, hence the importance of Poland's geographical location for foreign investors, as well as the increasing size and absorption capacity of the Polish market and the presence of national enterprises with their own resources of raw materials. Many of the state-owned enterprises that were taken over required recapitalisation and modernisation, but completely new investments also began to appear, intended to be a catalyst for change and a center for new profits. Consequently, many foreign companies invested in such construction material subsectors as wall materials, insulation materials, ceilings, roofing, chimney systems, finishing materials (windows, doors, etc.).

The capital transferred to the Polish market was mainly from Germany, Austria, France, the Netherlands, Belgium and Denmark, Switzerland, Sweden and Finland. At the moment, foreign concerns hold the largest market shares, amounting to up to 50-60 per cent of the total market.

A subsector of key importance in the entire construction materials sector is the wall materials one. The first foreign market player in this subsector was the Leier company, which appeared in Poland as early as 1988, i.e. before the period of great social and economic change. Investments in Środa Śl. were started in 1994 by L. Gumkowski, an emigrant from Germany, followed by the Röben company. (Wiśniewska, 2006, p. 94; Jasek, 2017, pp. 68-69). In the south of the country, a large producer of bricks and tiles was Biegonice company in Nowy Sącz, whose shareholders became the Belgian companies Vandensanden and Briqueteries de Ploegsteert. Leading the market for wall materials is the Wienerberger company. In Poland, the company was established in 1995. Its first investment was the purchase and complete modernisation of a brick factory in Lębork (Jasek, 2017, p. 69).

At the same time, one of the leaders in the production of cellular concrete, the Xella company, started its operations. The company was founded in 1995 under the name Ytong Ostrołęka Sp. z o.o. as the first company with foreign capital in the cellular concrete industry. The third company to enter the wall material market in 1995 is CRH Klinkier Sp. z o.o (Jasek, 2017, pp. 69-70).

In the area of plasterboard, the first foreign producer was Nida Gips, set up in 1990 by the Belgian Gyproc corporation. A large part of the plants in the wallboard subsector was and is still located in smaller towns, which is related to the existence of clay and gypsum resources. Not only the quality of the raw material was of great importance, but also the geographical location, which would be advantageous for the acquisition of markets - export of bricks and tiles to the East German market. Investments by entities already present on the Polish market

were not supportive of further entry into the Polish market of strong foreign producers so far absent in Poland.

The next subsector is the chimney systems one. Until 2015, it was divided into two product groups: steel and ceramic systems, with polypropylene chimney systems coming in later on. Due to the entry barriers, which are not as high as in the production lines of the other subsectors, this sector is characterized by a large number of players. In the area of steel systems, there are around 40 manufacturers, including four foreign-owned companies, holding around 33% of the total market in 2015. These are MK Żary, Jeremias, Pojoulat and Ontop, which was acquired by Schiedel Sp. z o.o. in 2021. There are no clear technological advantages in the market for steel flue systems. Production is relatively standardised, hence most of the players, in addition to their core production of flue gas systems, offer products made of stainless steel, not directly related to chimney systems. Much more diversified is the market for ceramic chimney systems, where there are currently around 80 companies competing, nine of which are foreign-owned and have held around 60% of the market share in recent years. Schiedel Sp. z o.o. was the first company to be established in 1995. Subsequently, German players entered the market: CRH Klinkier, Schreyer, Plewa Tona, Leier, Roosens, and two Danish companies IBF and Icopal (Icopal Danmark A/S).

The further sub-sector - roofing - has a wide product range from metal roofing, which represented about 33% of the market in 2014, through ceramic (28%), bitumen (22%), cement (7%), and membrane and other roofing (about 10%). The first foreign company to enter the Polish market was Braas. In the same period, in 1996, RuppCeramika Sp. z o.o. was established in Skrzyńsk near Przysucha. In 2004, just like Braas, the company was transformed into Lafarge Dachy Sp. z o.o., while in 2012 there was a complete merge of RuppCeramika and Braas brands into one Braas brand, currently BMI Icopal (after taking over Icopal's roof tile production) The history of another company - Creaton Polska - dates back to 1998. In 2011, Etex Building Materials Polska Sp. z o.o., based in Olkusz, is established in Poland as a result of the merger of three companies: Euronit sp. z o.o., CREATON sp. z o.o. and Etex Building Materials sp. z o.o. The rich clay resources in the vicinity of Środa Śląska, were the motive for Röben Polska's investment. Investment in Poland was also undertaken by the Swedish company Lindab, which opened a sales office in Szczecin in 1992. A large factory for coloured roof tiles was built on the premises of a brick factory in Kunice near Legnica by the German company BTS. The plant was then taken over by Wiekor Pokrycia Dachowe, later supervised by Wienerberger from Austria. Cembrit, a company focused on the production of fibre-cement corrugated panels and finishing accessories, has a long history in Poland. The company was founded on the basis of the state-owned company ZWAC, which had been in operation since 1968 and was renamed IZOPOL in 1971. Swisspor Polska also started its operations by purchasing Polmar in Jaworzno.

The last sub-sector is represented by numerous manufacturers of joinery (windows and doors), including manufacturers such as Lux Wood, Okfens company with plants in Czeladź, Spectus. Subsequently, companies such as Aluplast in Poznań (1995) were established. Currently, the largest window manufacturer in Poland is the VELUX Group, which belongs to the Danish VKR holding.

When analyzing the construction materials sector, it should be noted that the expansion of investments by foreign entities began in the mid-1990s. A large part of the investments were direct brownfield investments, consisting of takeovers of Polish state-owned enterprises, which were undertaken in order to gain access to raw materials (e.g. clay, sand, gypsum). After 2000, most of the investments were already greenfield investments, as the possibilities for privatization of state-owned enterprises had been run out. The inflow of new manufacturers with foreign capital depended on entry barriers and the capital needed to invest in a new production line. The result of the disparity between the advancement of technological lines was the development of a competitive market. In the case of capital-intensive production lines, competition grew more slowly and was actually limited to the majority participation of foreign-owned companies, of which the roofing sub-sector is an example. However, in sub-sectors with low barriers to entry (ceramic chimneys sub-sector, wall materials sub-sector, joinery sub-sector), there was a rapid increase in competitors. Mergers and acquisitions continued, but these mainly involved mergers of foreign-owned companies.

It should be noted that the majority of foreign direct investment was horizontal investment, which was based on the same activities as in the investor's country, i.e. investors introduced the same manufacturing methods and products - sometimes differentiated by assortment, adapting them to the development of building technology.

3. Factors and motives for undertaking FDI in the construction materials sector

An important factor in the spread of FDI is the opening up of economies to host new economic actors, who are driven by a number of motives that directly or indirectly affect the development of the country and local actors. Individual countries compete intensively for investor interest, creating a competitive environment fostering FDI inflows.

However, in addition to the country interested in attracting new investors, there remains another party - the direct investor, whose motives for expansion can vary widely. There are a number of theories that indicate the motives of the capital-holding enterprise. The roots of these theories range from the theory of international trade, location theory or directly from FDI theory.

Along with the legal and economic changes and the saturation of the market by FDI, the motives for undertaking foreign investments in Poland were changing. Between 1990 and 2015, systematic research on motives, including the investment climate in Poland, was undertaken by many institutions, including PAIZ, the Polish-German Society for Supporting the Economy, the American Chamber of Commerce in Poland, Price Waterhouse Coopers, the British-Polish Chamber of Commerce, Rödl&Partner, the Polish-German Chamber of Industry and Commerce, HSBK or Ernst&Young, as well as researches such as J. Witkowska, M. Stawicka (2007), M. Jaworek, W. Karaszewski, J. Róžański, Przybylska (2001), Lizińska (2012) or Garlicki and Błuszkowski (2000).

Most studies emphasise the cost motive for locating FDI in Poland in the 1990s and the change after 1999 towards market motives, including to a large extent the growth prospects of the Polish market.

The own research carried out allowed, on the one hand, to identify the motives for undertaking investments in Poland and to assess the socio-economic situation in which decisions to set up businesses by foreign investors were made, and, on the other hand, to identify the discrepancies between the Polish economy and that of the parent company in terms of specific gaps, in order to finally identify the factors influencing the decision to invest in Poland. As many as 64% of the respondent-managers were involved in the direct establishment of a company in Poland, the research provided insight into the genesis of investment in the sector under study. The question on the objectives of the parent company suggested the twelve most common objectives in the literature for investors who undertake activities outside their own country. The following were suggested as potential objectives: seeking to increase profits, the possibility of gaining/expanding into new markets, maintaining a position in existing markets, lowering costs associated with product transport, lower production costs in Poland, ensuring stable access to manufacturing factors, geographical nearness of the Polish market in relation to the home market, similarity of buyer behaviour on the Polish and home market, lowering operating costs through the possibility of taking advantage of tax reliefs in Poland, securing the necessary raw material, increasing the company's exports, reducing risk through its geographical diversification, other (Jasek, 2022, pp. 176-177).

A detailed overview of the goals determining investment in Poland is presented in Figure 2.

In the analyzed sector, the main motives for taking the decision to invest in Poland therefore included: the possibility of gaining control/further expansion of new markets and the desire to increase profits. Other factors were of minor importance. Among the 'other' objectives, respondents mentioned: market development, gaining market shares, market consolidation through acquisitions of local producers and benefits resulting from Poland's entry into the area of market forces.

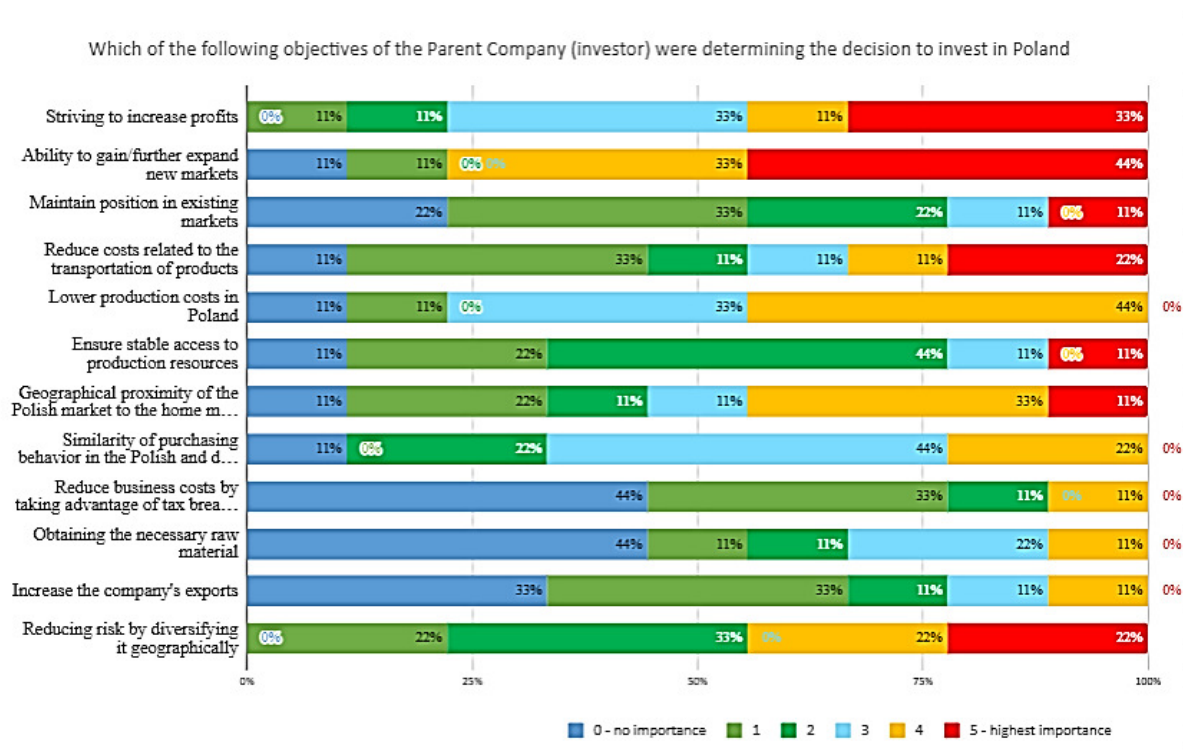


Figure 2. Parent company's objectives determining decision to invest in Poland.

Source: compiled from own research (Jasek, 2022).

The surveyed companies also assessed the degree of discrepancy between the investor country's economy and the Polish economy, based on the gaps defined earlier. The following gaps were included in the study: the conceptual gap - in terms of factors determining economic development, the skills gap, the technology gap, the pace of development gap, the capital gap - in terms of domestic capital, the entry barrier gap - defining how easy it is for a foreign company to enter the market in Poland compared to other countries, the cooperation gap in the economy, i.e. the the level of network links between enterprises, the research and development gap - characterized by the accessibility of research and development institutions, the science-business cooperation gap - the practice of cooperation between enterprises and scientific institutions, the social capital gap - the level of acceptance of FDI, the regulatory gap - the consistency of the law, and the institutional gap. The following were indicated as significant differences between the investing enterprise economy and the Polish economy: the regulatory gap, the technology gap and the capital gap. The following were indicated as medium differences: the conceptual gap, the pace of development gap, the research and development gap and the institutional gap. As very small differences between the economies, respondents indicated: the cooperation gap in the economy and the social capital gap (Jasek, 2022, pp. 177-178).

While many of the factors and considerations influencing the investment decision are fixed, there are some that are constantly changing over time. The literature uses catalogs of factors that overlap to a large extent. In the research conducted, the influence of individual factors on the decision to invest in Poland was also assessed. The analysis took into account factors that were divided into 6 categories, i.e. market factors, resource factors, competitive factors,

economic factors, socio-cultural factors and formal-institutional factors. Among the market factors, further market development prospects and market size and absorption were indicated as the most important in the decision to invest in Poland. Slightly lower importance was given to the degree of market development and specific consumer preferences. Of least importance among market factors were ease of market entry and market structure. Among the resource factors, access to labour/staff was of high importance. Of medium importance was the cost of labour force, the quality of labour force/staff, while of low importance was the cost of renting/purchasing land and facilities, the availability of technical infrastructure and the quality of available raw materials. Of very low importance in choosing Poland as an investment country were the and access to semi-finished products. Among the competitive factors, respondents indicated the technology gap as the most important, although the average response does not indicate that it was of very high importance compared to other factors. Other competitive factors such as the supplier network, low-intensity competition from local companies or low-intensity competition from foreign-owned companies were of little or no importance. Another group of factors examined were economic factors, among which access to regional markets was rated highest, although its importance should still be described as medium. Another factor was Poland's economic growth prospects. The remaining factors, i.e. membership in the EU, macroeconomic policy and the low level of investment risk, as well as access to global markets, had little or very little influence on the decision to invest. Among formal-institutional factors, none of the factors reached a sufficient average, which means that their influence on the decision to invest in Poland was very marginal and, in the case of many companies, played no role at all. Only one company indicated the political situation in Poland as the most significant factor. The last group of factors were socio-cultural ones, among which two of them stood out, i.e. friendly relations with Poland and cultural proximity. The remaining factors: social attitudes towards foreign investment, personal considerations and positive experiences of other companies with foreign capital were of less or little importance in the decision-making process.

Although the analysis of the parent company's motives and goals for investing in Poland seems to take place at the company - microeconomic level, it shows the existing macroeconomic background, which constitutes the socio-economic condition of the country, in which the company sees some potential (Jasek, 2022, pp. 179-185).

The opportunity to gain or further expand new sales markets was indicated as the most important objective by 78% of the surveyed companies. This is the objective that was also most frequently indicated in W. Lizińska's research (1991-2010), where 25%-27% of the surveyed companies considered it to be the primary motive for undertaking business in Poland in particular periods. This objective fits into the group of motives relating to market seeking investments, whose main objective is to gain access to the market and to maintain and expand market share. This means that the Polish economy has been positively assessed in terms of development opportunities and solutions offered to companies seeking expansion.

On the other hand, companies driven by the market-seeking motive try to follow market-driven needs, suppliers and customers, try to take advantage of the host country market, being close to customers while trying to set trends or trying to follow stronger and already existing competition. At the same time, respondents indicated as one of the highly rated motives the possibility of reducing risk through its geographical diversification, which shows that the Polish economy was also positively assessed in terms of opportunities arising from its location.

At the same time, it is not surprising that companies aim to increase profits (44% of companies surveyed). The motives of the respondents corresponded to the weight of the factors they indicated as important for the realization of their goals. The motive of being able to penetrate or further expand new markets is proportional to the factor of further market development prospects and the size and absorption capacity of the market. Lower production costs result from the cost of labour, which is significantly lower than in the country where the capital is sourced. Risk reduction through geographical diversification is possible through access to local markets, while the geographical proximity of the Polish market to the home market strongly influences the sense of cultural proximity.

4. Innovativeness of the construction materials sector

The thesis that the rational use of material resources was the main objective of management until recently was dominant. However, the industrial sector so far has been systematically replaced by the knowledge sector, tending towards the development of a knowledge-based economy. This approach is mentioned by Etzkowitz and Leydesdorff, who write about a breakthrough taking place on the basis of the operation of the 'triple helix', i.e. science, industry and the government, which through their interactions influence the economic development of the country (Cai, Etzkowitz, 2020, p.11). The driver and source of innovative activity and innovation creation therefore becomes knowledge in its broadest sense as the primary factor. As a result of good quality relations and cooperation between market actors, i.e. organizations producing, distributing and sharing knowledge (primarily scientific, technological, market, economic, organizational or management knowledge), as well as needs expressed by users, innovation is produced and technology transfer influencing technological progress takes place. The cooperation and contacts of individuals and organizations with the environment allow the diffusion of knowledge, which influences the innovative activities of other entities, sectors, and finally the entire economy (Baruk 2016, pp. 91-94).

Innovation process models have been evolving over time, involving more and more actors and their changing role in the innovation process.

The contemporary models (fifth and sixth generation) that have developed in the 21st century are highly integrated and networked models. The main driver in the simultaneous (fifth-

generation) model is collaboration, which includes strategic alliances of companies and cooperative links in R&D and new product development. Open innovation model (6th generation) - is based on an open networked innovation process. According to Chesbrough - the author of the model - the search for, creation, accumulation of knowledge and its transfer should go outside - beyond the framework of the enterprise. Great importance is attributed to the processes of learning, obtaining and managing knowledge and the use of research and development activities, resulting in the creation of a system that learns on its own and takes advantage of opportunities arising in the environment.

M. Noga even defines science, knowledge and innovation (scientific knowledge capital) as long-term indirect third-order determinants of economic development (Noga, 2008, p. 6).

Construction materials present on the Polish market until the second half of the 1980s were very simple materials, produced even manually, with a simple structure, using little developed technological lines. In the first years of the inflow of FDI to Poland, unknown products flowed in with the capital, which required, on the one hand, a change of mentality on the demand side and, on the other hand, the training of people who were to handle and use them in the construction process. Foreign companies entering the market introduced products that were new on the host country's market, and thus innovative. The source of product innovation in the building materials sector for the construction of buildings can be found on the demand side. The second half of the 1990s was marked by major qualitative changes in the area of construction materials, resulting in a change of market structure. The implementation of modernized technological processes, which at the same time improved and accelerated building construction techniques, even forced manufacturers into high demand. As R. Kania emphasizes: 'It was precisely the need to eliminate time-consuming and outdated solutions originating from building traditions and, at the same time, fast assembly time and solidity that founded the invention of the "new" (...) necessity is the mother of invention' (Kania R., 2009, p. 195). Unfortunately, regressive innovations have also started to appear among the solutions, which 'may be regressive and cause economic losses or bring no benefit to either the company implementing the new solution or its environment. This applies mostly to domestic imitator companies that, seeking favorable cost effects, deform the products that are the right medium for consumer benefits' (Kania, Nowak, 2015, p. 74).

Thus, the entry of the first FDIs in Poland - chimney manufacturer: Schiedel, roof manufacturer: Braas, wall material manufacturer Leier, etc. resulted in the establishment of a group of trend-setters of the new technology and apostles of the rapid diffusion process. Bricks began to be replaced by hollow blocks, there was a transition from single-wall to four-layer walls, brick chimneys gradually began to be replaced by chimney blocks, and finally single-, double- and even triple-wall systems were implemented. In the area of roofs, the development of roof coverings and tiles determined by the needs of the consumer took place, also in the following years, technologies based on wood or plastics (joinery, insulation materials, finishing materials) gained in importance. Wooden windows began to be replaced by plastic windows,

and metal pipes were also replaced by plastic pipes (Bolkowska, 2003, p. 311) . Prefabrication to speed up construction processes became common.

Innovation in the construction materials sector was therefore based on the adoption of foreign construction techniques, which was associated not only with the adoption of modern products, but also with a huge transfer of knowledge into the environment of the entire sector, including construction companies, which triggered further technical and organizational changes. In later periods, as a result of intensively developing competition, innovation took on a multiple role. In order to maintain their high market shares, the existing FDI companies were still forced to introduce further improvements, new management methods, improved production processes, as Polish companies, in order to survive on the market, took over and used the knowledge of foreign companies, imitating products with similar properties, but at a later stage also looking for their own new solutions. In Polish companies, due to less bureaucracy in comparison to international companies, innovations started to be introduced faster and on a larger scale. Unfortunately, there were also opinions that the technologies introduced, innovative for the Polish market, were old technologies from a global point of view. This can be illustrated by the example of the technological tree of the dust exhaust systems. In the 1960s, a two-layer prefabricated chimney with a ceramic insert was already used in Germany or Austria, while a three-layer chimney appeared as early as in the 1980s. Until 1995, brick chimneys dominated the Polish market, and it was only with the arrival of the Schiedel company in Poland that the so-called system chimney was introduced. And although it was an innovative product from the point of view of the Polish market, from the point of view of general technological development, it was not a new product. We are therefore talking about regional (national) product innovation against an international background.

For many years, the construction materials sector benefited from solutions that emerged in Poland in the 1990s. In the following years, as a result of the diffusion of knowledge, innovation took on an imitative character. Competition caused domestic companies to produce better and cheaper, stimulating their own resources to look for similar, cheaper solutions that met similar requirements.

The phenomenon of technological spillovers had a strong impact not only horizontally, but also vertically, being part of feedback occurring in other sectors or in the area of building construction services.

Analyzing the above changes caused by the inflow of FDI, the question that arises is what form innovation has taken in the construction materials sector.

From the research perspective, therefore, an important point was to determine the nature of innovations occurring in the enterprises against the background of the entire construction materials sector. In the surveyed companies, as well as in the sector as a whole, small innovations definitely dominate, although medium innovations are also important. As construction materials companies do not belong to the high-tech sector, it is definitely difficult to speak of large or disruptive innovations (Jasek, 2022, p.195)

In terms of the degree of originality, the surveyed enterprises look slightly different compared to the sector as a whole. Creative innovations, i.e. completely new innovations, dominate among the surveyed enterprises. The surveyed companies did not show the occurrence of regressive solutions, i.e. disruptive changes creating danger, as well as pseudo-innovations, where 72% of respondents strongly or rather disagreed with the existence of such innovations in the company. The situation is slightly different in the sector as a whole, where a greater share was attributed to imitative innovations, i.e. those that are replications of existing solutions. Creative innovations are another group, followed by pseudo-innovations, i.e. changes that are not really innovations. In the case of these innovations, as many as 71% of respondents had no opinion on the occurrence of this type of innovation, similarly, in the case of imitative and creative innovations, it was 43% of respondents each. Both in the group of surveyed enterprises and in the entire sector, investment innovations represent the largest share. The last question on the nature of innovation referred to the complexity of the innovations being implemented. The survey aimed to determine whether the innovations occurring are bundled innovations, i.e. forcing innovation activity on co-operators, or perhaps isolated innovations, i.e. not involving additional innovation among partners. Among the surveyed companies, bundled innovations have a higher share. For the sector as a whole, 29% of respondents agreed with the existence of bundled innovations, the remaining respondents disagreed or had no opinion.

In order to analyze changes in sector innovation, respondents were asked about perceptions of the concept of innovation itself. The surveyed were asked what they think supports innovation in the sector studied. An important part was the analysis of their own advantages over companies with Polish capital and the factors that allow them to achieve this advantage, including in terms of introducing innovations to the Polish market (Jasek, 2022, pp. 196-198).

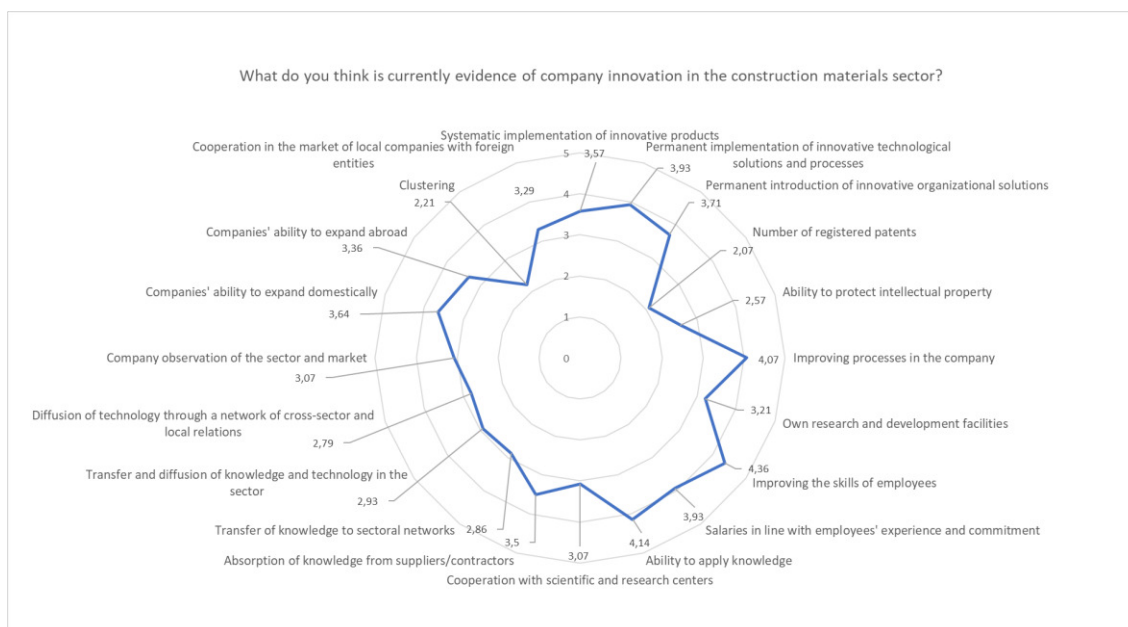
Respondents defined the characteristics or indicative features of innovative enterprises. Of the 20 proposed characteristics, three factors were rated highest, i.e. the improvement of employees' qualifications, the ability to use knowledge and the improvement of processes in the enterprise. Slightly lower rated were another 11 factors, i.e. continuous introduction of innovative solutions and technological processes, salaries adjusted to the experience and involvement of employees, continuous introduction of innovative organizational solutions, systematic introduction of innovative products, ability of companies to expand domestically, absorption of knowledge from suppliers and cooperators, ability of companies to expand abroad, cooperation on the market of local companies with foreign entities, having their own research and development facilities, cooperation with scientific and research centres, monitoring of the sector and market by companies.

The remaining factors can be regarded as those that respondents generally did not consider significant in assessing innovation, i.e. knowledge transfer to sectoral networks, knowledge and technology transfer and diffusion in the sector, technology diffusion through inter-sectoral and local networks, ability to protect intellectual property, clustering, number of registered patents.

When analyzing the highest rated characteristics, i.e. improving the qualifications of employees, the ability to use knowledge and the improvement of processes in the company, it can be seen that they all carry an element of 'knowledge' which makes it possible to undertake any innovation process. The lowest importance was attributed to clustering, the number of registered patents and the ability to protect intellectual property, which confirms observations that the construction materials sector as a low- and mid-tech sector does not need legal protection for its products. However, the factor: transfer and diffusion of knowledge and technology in the sector was surprisingly low rated. Among others, one respondent mentioned 'creation of system solutions' (Jasek, 2022, pp. 186-188).

The results (with the average of the scores on a scale of 1-5, where one - don't agree at all, 5 - fully agree) are shown in radar chart (Figure 3).

Figure 3. Average characteristics of innovative companies as seen by survey respondents



Source: Own research (Jasek 2022).

The study attempted to demonstrate the advantages of the surveyed companies with foreign capital over companies with Polish capital. Respondents assessed to what extent individual factors were sources of advantage. Respondents indicated the following as decisive advantages: quality of launched products, access to intra-group financing, organizational know-how. Among the advantages of high importance, the following were indicated: experience and education of the management, technological skills in introducing, developing and improving products and technologies, group purchasing within the group, own distribution network, cooperation with research centres in the home country. Other factors were reported by respondents as either difficult to assess or of low advantage: speed of launching new products to meet changing consumer needs, marketing expertise, speed of innovation, investment in research and development, access to research facilities in the home country.

Respondents also indicated factors that support innovation in their own companies. Staff training and support from the parent company, cooperation with national buyers, were rated as the highest. Among others, respondents mentioned: own project groups consisting of employees from different departments, and personal ambitions of employees. Other factors, i.e. international cooperation with suppliers, the possibility of using internal sources of financing, and innovation, education and tax policy in Poland were found to be of little importance in supporting innovation or difficult to assess. However, it is important to note that in the case of employee training, as many as 79% of respondents considered this factor to be the most important, and 57% of respondents indicated international cooperation with both domestic buyers and international cooperation with suppliers, which on the one hand indicates a desire to satisfy the product needs of one's own buyers, and on the other hand to provide products of the highest possible quality (Jasek, 2022, pp. 190-191).

5. FDI effects in the construction materials sector

FDI is mainly focused on those industries where foreign investors expect the highest returns and to meet their own objectives. However, their inflow always has an economic impact on the host economy. First there is the impact at the micro level, i.e. the appearance of a new company or the restructuring of an existing one, then at the meso level, where the new investor has a significant impact both on the sector in which it appears and its links in the environment, and also often on the local dimension, to finally, through the multiplier effect, have an impact on economic growth, and even more often and to a greater extent on the development of the country - the macro level. Hence, some of the analyses are purely quantitative, but more and more importance is being given to qualitative analyses based on descriptive models. Analysis of the effects of FDI on host countries implies a distinction between its direct and indirect effects. Both have a huge impact on development and the transformations taking place. The literature distinguishes between many types of effects associated with FDI inflows. The importance of differentiating between externalities, spillovers and linkages is emphasized. Externalities refer to the effects of foreign investors' actions that are made available to other economic actors (e.g. domestic firms) at no cost. Spillovers are externalities that pass from one company to another in the process of transferring broad knowledge and learning by the receiver company, as a result of formal or informal linkages between these entities. The term is also referred to the 'spillover effect'. Spillovers are also described in the literature as side effects of investments that affect local partners, sub-suppliers, cooperators, both within the sector itself and in other vertical linkages (Weresa, 2012; Domanski, 2008; Golejewska, 2008).

A difference should be made between spillovers to companies in the same industry/sector - so-called horizontal spillovers (intra-industry spillovers) - and spillovers to companies in related industries/sectors - vertical spillovers (inter-industry spillovers). Intra-industry spillovers of FDI affect companies (competitors) in the same industry. These effects arise, for example, from product and process imitation, competitive effects and labor market impacts. Intersectoral FDI externalities, on the other hand, are economic and technological spillovers generated by vertical linkages between companies in different industries. (Eden, 2009, p. 1067; Szczepkowska-Flis, 2008, p. 172). Vertical linkages with suppliers and customers are considered the most effective channel for positive spillover effects in the host economy, although empirical studies investigating the occurrence of vertical spillovers of FDI technologies are still limited.

The literature also points to so-called agglomeration spillovers (agglomeration effects). These refer to the financial and technological intra- or inter-sectoral effects that arise from the cooperation of enterprises within clusters and networks (Eden, 2009, p. 1067).

In the analysis of FDI effects, the internal market formed by the parent foreign investor and the subsidiary or affiliate located in the host country cannot be overlooked either. According to internalization theory, in addition to capital flows, there is a flow of technology and know-how in this system, which are direct ownership effects of FDI (own-plant effect, direct effect) (Szczepkowska-Flis, 2008, p. 172). It is this type of effect that drives the impact on other actors within and outside the sector. The potential FDI effects resulting from FDI inflows are illustrated in Figure 4.

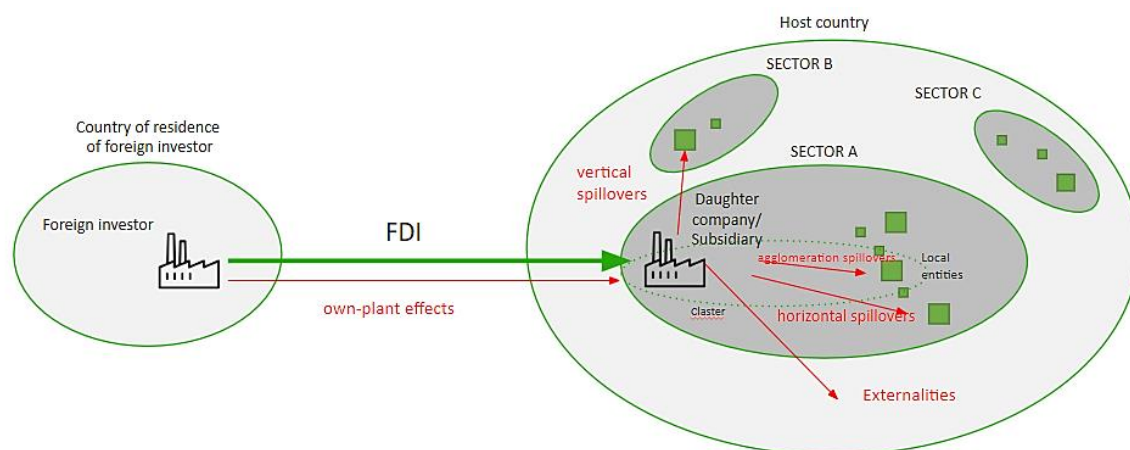


Figure 4. Types of foreign direct investment effects.

Source: own elaboration.

The survey questioned respondents about the impact of their companies (FDI) on the performance of competing Polish companies and also on the performance of their environment, in particular their cooperators and suppliers. This allowed an analysis of the forms of impact and effects of FDI (positive and negative) on their environment.

In the case of the impact of FDI on the performance of competitive Polish enterprises, i.e. enterprises with only Polish capital, an intensification of competition between companies in the sector was indicated as the most frequent impact. As many as 79% of respondents agreed with the statement that competition between companies in the sector has intensified. As a result of the inflow of FDI, local companies have restructured their operations in order to cope with foreign competition - 71% of respondents responded positively to this statement, which is at the same time linked to the acceptance of another statement according to which the productivity of competing local companies has increased (57% positive responses). A large proportion of respondents (64%) responded positively to the statement that the quality of products and services provided in the market has improved and 57% said that local companies have started to introduce innovative products previously unknown on the Polish market.

Some of the FDI effects described in the literature have not been confirmed among respondents from the construction materials sector, e.g. the two-way transfer (foreign companies - Polish companies) of skilled and semi-skilled staff. Also in the area of R&D, respondents did not notice companies increasing their R&D investments or building their own R&D centers. Most surprising was the negative response to the statement that the entry of FDI into the market had pushed out competing local firms.

In terms of the impact of the respondents on the environment (cooperators and suppliers), the respondents strongly agreed that their activities and cooperation with the environment resulted in the flow of knowledge and modern technology (79% of the respondents), while as many as 86% of the companies required their cooperators to adapt and improve their technology, which was reflected in an increase in their productivity. More than half of the surveyed companies responded positively to the statement that the scope of cooperation has increased, the co-operating companies have increased development expenditures, undertaken new investments and the cooperation has forced the business partners to innovate. One of the surveyed companies indicated that 'In many areas there are very limited possibilities to cooperate with co-operators - raw material limitations - like cement, sand'. Significantly, among those surveyed, no company with which FDI collaborated broke off cooperation due to the lack of adaptability.

One of the questions in the survey concerned the influence of Polish and foreign-owned companies on the shaping of innovation in the sector. In accordance with respondents' answers, as many as 64% agreed with the statement that their company, together with other foreign-owned companies, determines the direction of the sector's activities, 57% of companies agreed and strongly agreed with the statement that both Polish and foreign companies have a similar impact on shaping innovation in the sector. 57% of respondents tended to agree that their company dominates innovation in the sector due to continuous development. Only 7% of respondents said they fully agreed with the statement that Polish companies have taken control of innovation in the sector.

Respondents also pointed to other additional effects, i.e. owners of Polish companies that have been taken over by foreign companies invest in companies with a similar business profile and FDI has contributed to eliminating overuse/waste of natural resources and improving the environment.

When analyzing the set of 23 statements relating to the impact of FDI on the sector and its environment and comparing them with the impact of the surveyed FDI, it can be seen that most of the statements follow the general trends and impacts of other companies with foreign capital. Competitiveness increased/strengthened, the quality of products and services offered increased, FDI became a kind of role model for companies with Polish capital, which was reflected in the implementation of innovative products. The negative impact described in the literature, such as a decrease in employment, introduction of outdated technologies, overexploitation of raw materials or mere imitation of foreign companies, was not noticeable (Jasek, 2022, pp. 199-216).

6. Conclusions

The economic transformation of the Polish economy and its opening up to international cooperation have enabled a systematic inflow of foreign capital into Poland.

The inflow of foreign capital into the construction materials sector began relatively early.

Among the parent company's objectives determining the approach of investments in Poland were the possibility of entering new markets, further expansion and the desire to increase profits, which covers the main objectives found in most economic sectors.

Among the wide range of location factors (market, resource, competitive, economic, socio-cultural and formal-institutional), respondents indicated further development prospects of the Polish market and its size and absorptive capacity as being of greatest importance, i.e. market factors.

By assessing the degree of divergence between the economy of the investor's country economy and the Polish economy, on the basis of the previously defined gaps, as those which the most significant differences between the two economies, respondents indicated the regulatory, technological and capital gaps.

The effects of the inflow of construction material manufacturers were observed both at the micro level, where the impact occurred on the basis of ownership effects resulting from the transfer of knowledge and technology from the parent company to the subsidiary, but also at the meso level. This was reflected in the level of development of technological progress, the transfer of knowledge between individual foreign and domestic entities, the impact on the labor market, as well as far-reaching effects and outcomes resulting from relations with the sector's environment. The in-depth metamorphosis of the entire sector has transformed the

operation of both the market itself (change in its structure, product quality, development of consumer awareness), but also within the entities dependent on its operation (subcontractors, suppliers), generating a wide range of spillover effects - spreading to the entire environment.

Thus, the opening of the construction materials sector to foreign competition, and the purchase of state-owned enterprises by foreign investors, enabled changes to take place within the framework of inter-entity linkages and the implementation of adaptation processes in the construction industry to the needs of a modern market economy. Although FDI has been a factor in creating the sector and influencing technical and technological progress in the entire construction sector, they have also had an impact on the occurrence of negative effects such as the reduction of employment or the increase in the number of Polish imitators, offering products that do not always meet standards or current trends.

Based on the empirical research carried out, the assumption that the inflow of foreign capital in the form of direct investment was a factor stimulating innovation in the construction materials sector and, consequently, in a part of the Polish economy, was verified. Poland's socio-economic situation between 1990 and 2015 and the technology gap in the residential construction materials sector determined the inflow of FDI. The analysis of the problems related to the impact of FDI on the economic development of the country allows us to conclude that this type of investment (mainly through the transfer of capital and modern technologies) effectively contributes to accelerating economic development and increasing the competitiveness of the economy. Foreign direct investment in the construction materials sector should be considered as an effective catalyst for raising the level of innovation in the Polish economy.

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THE IMPACT OF SAFETY TRAINING FREQUENCY ON THE LEVEL OF SAFETY

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Purpose: The aim of this article is to investigate the impact of the frequency of safety training on the formation of a safety culture in a Polish company.

Design/methodology/approach: The study was conducted in the first half of 2024 in a Polish company. Data were collected on the organisation of health and safety training courses and the reporting of near misses. Statistical and qualitative methods were used in the analysis to establish a correlation between the frequency of training and the number and type of reported incidents.

Findings: Studies have shown that frequent and well-structured safety training significantly reduces the number of potential accident incidents. However, this effect diminishes over time, suggesting the need for regular reminders.

Research limitations/implications: The study was limited to one company, which may affect the limited generalisability of the results. Future studies could cover different industries and organisations to verify the results in a broader context.

Practical implications: The results suggest that companies should increase the frequency and variety of training to maintain a high level of employee safety awareness. It is also crucial to foster a positive culture of hazard reporting, which enables problems to be identified at an early stage.

Originality/value: The article provides new insights into the long-term effectiveness of safety training and highlights the importance of the frequency and variety of such training in developing an effective safety culture. It is a valuable analysis for safety managers, HR professionals and organisational leaders who want to raise health and safety standards in their companies.

Keywords: safety culture, safety training, near misses, awareness.

Category of the paper: Research paper.

1. Introduction

Modern organizations are increasingly recognizing that a safety culture is not merely a formal requirement but a key element influencing employee efficiency, morale, and overall

productivity. A high level of safety culture translates into fewer accidents, reduced downtime costs, and improved work quality. One of the most important tools supporting the development of this culture is regular safety training, whose effectiveness depends on its frequency, quality, and adaptation to the specific characteristics of the organization (Liu et al., 2023; Lafuente et al., 2018).

The frequency of safety training plays a key role in reinforcing good habits (Mahan et al., 2014) and responding quickly to new risks emerging in the workplace. Regular training allows employees to stay up to date and raises awareness of potential hazards (Taylor et al., 2015). On the other hand, training that is too infrequent can lead to reduced vigilance and the unconscious disregard of existing procedures, which increases the risk of accidents.

Interest in safety culture worldwide has significantly increased due to the growing humanization of work, particularly evident after World War II. This is directly linked to the rising awareness among company management of the importance of employee safety and maintaining their health (Cooper, 2000; Cox, Cheyne, 2000), as well as risk management and safety issues (Ramos et al., 2020; Dahler-Larsena et al., 2020; Swustea et al., 2020). As this topic gains prominence, safety culture has become a subject of study for researchers around the world. Based on a literature review from the Elsevier - Science Direct database, I have made a statistical summary that reflects the growing interest in this subject within academia. An analysis of articles containing the term "safety culture" identified 377,848 papers published between 2021 and 2024. These results (Figure 1) clearly show that interest in safety culture is growing year by year. The trend line in the graph takes on an exponential function and explains as much as 98% of the data ($R^2 = 0.9863$), indicating an excellent fit and that companies will increasingly develop effective occupational health and safety management systems to better protect their employees (Reason, 2016; Li, Guldenmund, 2018).

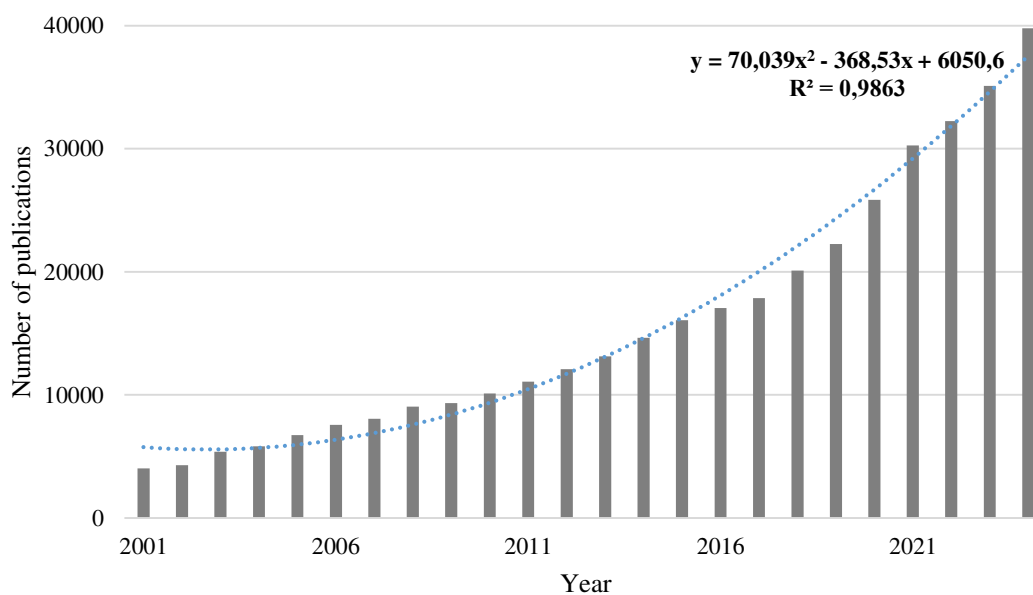


Figure 1. Number of publications on "safety culture" in particular years.

This article will analyze various time intervals between training sessions and their impact on employees' perception of safety, as well as on shaping the overall safety culture within the organization. I will also present conclusions from research on training effectiveness and provide practical recommendations for managers and occupational health and safety specialists who wish to implement effective training strategies in their companies.

2. The role of training in developing a safety culture

Workplace safety training is one of the most important elements in building and maintaining a safety culture in organisations. Through them, employees acquire not only theoretical knowledge, but also practical skills that allow them to better recognise hazards and respond appropriately in emergency situations. Effective training contributes to increasing employees' awareness of the applicable health and safety rules, which in the long term leads to an improvement in the overall level of safety in the workplace (Brinia et al., 2012; Nkomo et al., 2018).

A key aspect that determines the effectiveness of training is its regularity. Frequent training allows for continuous updating of knowledge and the consolidation of good habits. On the other hand, training carried out too infrequently can lead to a weakening of the educational effect, with a consequent decrease in vigilance and safety. Workers who regularly participate in training are more likely to consciously observe safety rules and are aware of the potential consequences of disregarding them.

An important element of training is also that it is tailored to the specific industry and working conditions of the company. For example, in high-risk industries such as construction, chemicals or transport, training should be more intensive and include detailed procedures for dealing with emergency situations. By contrast, in lower-risk sectors such as administration, training can focus on basic ergonomics, stress or first aid.

Moreover, the effectiveness of training also depends on its form and methodology. Traditional theoretical training is increasingly being complemented by modern tools such as simulations, virtual reality (VR) or interactive e-learning courses (Stefan et al., 2023; Rokooei et al., 2023). Such innovative approaches allow for more engaging and hands-on experiences that can prepare employees much better for real-world risks.

Based on the literature review and empirical studies, regular and appropriately tailored training not only improves employees' individual safety awareness, but also supports the formation of an organisational culture based on responsibility and mutual trust (Tong et al., 2023; Varchenko-Trotsenko et al., 2019; Wang et al., 2021). Organisations that invest in the development of their employees through comprehensive training enjoy higher levels of safety, resulting in fewer accidents, better productivity and higher team satisfaction.

3. Training frequency versus effectiveness

The frequency of safety training is crucial to its effectiveness. Regular, systematic training is essential so that workers can keep their knowledge up to date and improve their skills in complying with health and safety rules.

One of the main objectives of safety training is to prevent accidents by building awareness of hazards and forming appropriate habits (Eiris et al., 2020). The more often employees have the opportunity to participate in training, the better prepared they are to recognise potential hazards and respond appropriately in hazardous situations. Research shows that organisations that provide regular training have fewer workplace accidents, which in turn translates into reduced costs related to downtime, compensation and treatment of employees (Kabiesz, Bartnicka, 2019).

For example, in companies operating in high-risk sectors such as heavy industry, construction or energy, health and safety training should take place even every few months. With this frequency, employees have the opportunity to constantly remind themselves of the most important rules and procedures, as well as to improve their practical skills in handling protective equipment or dealing with emergency situations. This regularity of training creates a natural cycle to remind them of safety priorities.

On the other hand, training that is too infrequent can lead to what is known as procedural drift, a situation where employees gradually drift away from accepted safety standards as a result of forgetting or ignoring them. When training is infrequent, workers' awareness of hazards decreases and their reactions in emergency situations become less adequate. This can lead to an increase in accidents and safety incidents.

Training that is too infrequent can also give the impression that safety issues are not a priority for the organisation. Failure to do so on a regular basis can undermine employee confidence in safety management systems, which can have a negative impact on the company's safety culture. As a result, employees may perceive training as a one-off formality rather than a real support in their daily work.

While regularity of training is key, too much training can lead to information overload and so-called 'material fatigue'. Employees may feel fatigue if training is too intensive or repeated too often without introducing new content. This situation can lead to a reduction in commitment to training and treating it as a formal obligation rather than a valuable source of knowledge.

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To avoid this effect, organisations should tailor the frequency of training to the needs and specifics of the job, and the training itself should be varied in content and form. For example, practical training, such as emergency simulations or workshops on the use of safety equipment, can be interspersed with theoretical courses or e-learning training. Introducing interactive elements, such as simulation games or case studies, can increase employee engagement and ensure that even frequent training is perceived as valuable (Gleason et al., 2022).

The optimal frequency of training depends on a number of factors, including the specific industry, the level of job risk, and the level of knowledge and experience of employees (Jamil et al., 2024). In high-risk organisations, frequent training - e.g. quarterly - is warranted, while in lower-risk sectors, annual or semi-annual training may be sufficient.

An example would be an IT company, where cyber security training may be held every six months to consolidate employees' knowledge of current threats and safeguards. In the construction sector, on the other hand, health and safety training may take place much more frequently, due to the rapidly changing working conditions on construction sites and the need for constant reminders of safe practices.

In summary, the frequency of safety training should be tailored to the specific nature of the organisation and the risks involved in the work. Regular and thoughtful training programmes are one of the most effective tools for building a sustainable safety culture that not only protects workers, but also contributes to the organisation's performance (Peng, Chan, 2019). In the next chapter, we will look at methods to evaluate the effectiveness of training and how to monitor its impact on safety culture in companies.

4. Evaluating the effectiveness of safety training

For safety training to be truly effective, it is necessary not only to conduct it regularly, but also to systematically evaluate its effectiveness. Without the right measurement and analysis tools, organisations may not be able to determine whether training is actually improving safety culture and reducing accidents at work. In this chapter, we look at methods for evaluating the effectiveness of training, key performance indicators and how to monitor its long-term impact on the organisation.

One of the most commonly used training evaluation models is the Kirkpatrick Model, which involves a four-level assessment of training effectiveness (Hutchinson et al., 2022):

- **Reaction** - the first step is to assess the reaction of the trainees. How employees perceive the training is an important indicator, as their engagement and positive attitude can influence the future application of the acquired knowledge in practice. Evaluation of reactions can be done by means of surveys or questionnaires completed by participants after the training.

- Learning - this level measures how much knowledge and skills participants have acquired during the training. This can be assessed through knowledge tests, practical exercises, as well as an analysis of how employees deal with simulated hazardous situations or tasks requiring the application of new skills.
- Behaviour - the next step is to assess whether employees put the knowledge they have acquired into practice. Has the training influenced their daily working behaviour? This assessment can be made by observing employees, talking to supervisors and evaluating safety indicators such as the number of accidents or reported incidents.
- Results - the most important level that assesses the long-term effects of the training on the organisation. These results may include a reduction in the number of accidents, a reduction in absenteeism due to occupational accidents, a reduction in compensation costs and an improvement in the company's overall safety culture.

To measure the effectiveness of training, organisations often use a set of key performance indicators (KPIs). Key indicators include (Moore et al., 2019):

- Number of accidents at work - one of the most obvious indicators to directly assess whether training has improved safety in an organisation. A decrease in the number of accidents following the introduction of systematic training demonstrates its effectiveness.
- Number of incidents reported - this indicator reflects both the level of employee awareness and the effectiveness of training. An increase in the number of reported incidents does not necessarily indicate a deterioration in safety, but rather an increased awareness of risks and a better response to potentially dangerous situations.
- Accident-related costs - an analysis of the financial impact of accidents at work makes it possible to assess whether investment in training translates into real savings. The reduction of costs related to compensation, downtime or treatment of employees is one of the most important measures of training success.
- Training attendance - regular employee participation in training is a signal that the organisation is effectively motivating safety. Low attendance may indicate problems with employee engagement or a need to change the way training is delivered.
- Level of engagement - this can be measured through surveys, evaluation interviews and analyses of employee behaviour after training. Higher levels of involvement in safety processes (e.g. hazard reporting, adherence to procedures) indicate a positive impact of training on organisational culture.

To fully understand the impact of training on a company's safety culture, it is essential to monitor its long-term effects (Rey-Becerra et al., 2019). In addition to the ongoing assessment of effectiveness, organisations should track changes in employee behaviour and the evolution of safety indicators over months or even years. This makes it possible to identify trends and correlations between the regularity of training and the company's safety performance.

It is also important for organisations to openly communicate the results of training effectiveness assessments among employees. Transparency in this regard can motivate employees to become more involved in safety processes and build confidence in the company's risk management (Kabiesz, Tutak, 2024).

Evaluating the effectiveness of training does not end with measurement alone. An important part of this process is to adjust training programmes based on the results obtained. If the analysis indicates that current training is not delivering the expected results, the organisation should consider changing the approach - for example, introducing more interactive methods, reducing or increasing the frequency of training, or adapting the content to the specific needs of employees.

Findings from training effectiveness monitoring can also help identify areas that require additional support, such as specialised training for selected groups of employees or the introduction of new technologies such as VR (virtual reality) training.

5. Research methodology

The research took place between January and June 2024 at a Polish company with more than 500 employees. This company manufactures disposable packaging that comes into direct contact with food. During this time, data was collected regarding all safety-related training that was carried out in the company. The information collected related to:

- Training dates - each training session was recorded with the exact date it was held.
- Target group - the groups of employees who attended training sessions were identified, taking into account their positions and the department in which they work.
- Type of training - training topics were analysed, including initial training, periodic training, specialised training (e.g. related to machine operation, health and safety, evacuation, etc.).

The second key element of the research was the collection and analysis of near miss reports. Employees of the company were given the opportunity to report such incidents through an internal incident reporting system. The following information was collected from these reports:

- Date of the incident - each reported situation was recorded with the exact date, which made it possible to analyse the frequency of incidents in the context of the dates of the training provided.
- Location of the incident - the reports identified the exact location where the incident occurred, allowing the identification of areas in the workplace where the risk of accidents is highest.

- Description of the incident - each report provided a detailed description of the situation that could have led to the accident. The description included what happened, what hazard occurred and what factors may have contributed to the incident.
- Actions taken - reports also included information about immediate actions taken by staff or management to minimise the hazard. These included immediate preventive measures and further remedial actions taken by the company.

The data collected was analysed qualitatively and quantitatively. The analysis included:

- Relationship between training dates and incident reports - it was examined whether there was a correlation between the training provided and the incidence and reporting of near misses.
- Type of training versus type of incidents - it examined whether specific types of training (e.g. specialised training) had an impact on reducing the number of reported incidents in a particular area of the company.
- Location of incidents - analysis of the locations of incidents made it possible to identify areas in the company that require special attention and possible modification of safety procedures.

The following research tools were used to analyse the data:

- Questionnaires and report forms - standard forms available in the company were used to collect data on training and incidents. Employees completed incident reports using a dedicated computer system.
- Databases - all information was archived in company databases, allowing easy aggregation and analysis against specific dates and areas of the company.
- Data analysis software - the statistical analysis used analytical tools to identify trends and correlations between training dates, the type of groups trained and the number of near-misses reported.

The study provided valuable information on the effectiveness of the training provided and its impact on safety in the organisation. The conclusions of the study will allow further improvement of training programmes and the safety culture within the company. In the next chapter, we will discuss the results of the analysis and present the conclusions of the study.

6. Results

Based on the collected data, the impact of training on safety in the company and the frequency of reported near misses were analyzed. The research results provide important information on the effectiveness of training and identify areas requiring improvement.

Figure 2 presents the number of reported incidents and information on the months in which OHS training was conducted for all employees of the plant. In the first half of 2024, employees reported a total of 116 near misses. General OHS training in the company for all employees took place in January and June. Analysis of the collected data showed a clear relationship between the time of training and the number of near misses reported. In the periods immediately after training, the number of incidents dropped significantly, which indicates a short-term increase in employee safety awareness. The largest decrease in the number of incidents was observed in the first two months after the training, when employees showed greater vigilance and knowledge of safety procedures. During this period, the number of reported threats was significantly lower compared to the months preceding the training, which suggests that OHS education has a direct impact on improving behavior and increasing caution in the workplace.

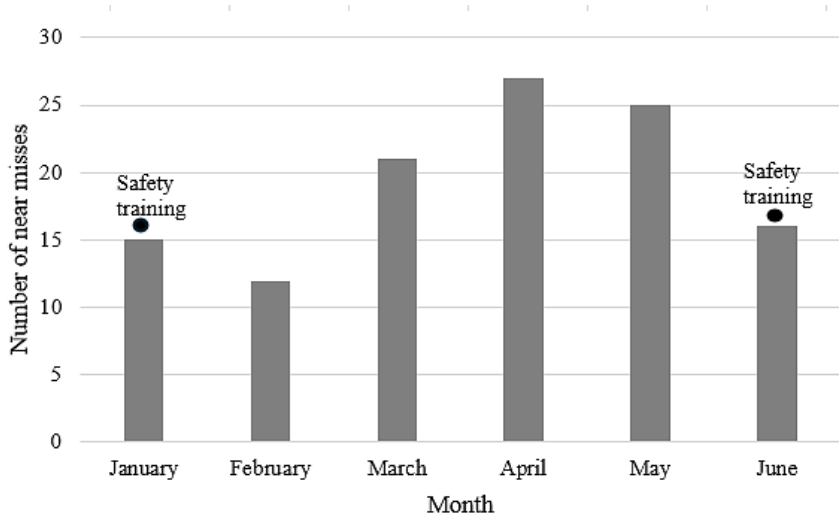


Figure 2. Number of near misses.

Analysis of reported near misses revealed that the highest risk of incidents was concentrated in specific areas (Fig. 3). Identified risk zones are an important element in the risk assessment process and planning of preventive actions.

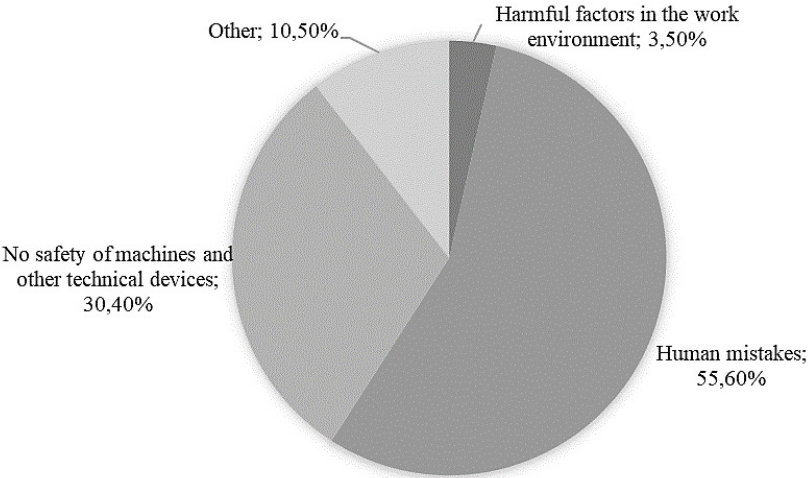


Figure 3. Type of near misses.

Detailed analysis showed that the causes of potential accidents can be divided into several key categories:

- Human mistakes (55.60%). This is the most important risk factor, which indicates a high number of incidents caused by inappropriate decisions and actions of employees. Human errors can result from many reasons, such as lack of knowledge, improper training, stress or fatigue. In order to reduce this percentage, it is necessary to introduce systematic training and programs for improving qualifications, which will emphasize the importance of safe work practices. It is also crucial to create an atmosphere in which employees feel responsible for their own safety and the safety of their colleagues.
- No safety of machines and other technical devices (30.40%). Incidents related to machines and technical devices indicate the need to introduce regular inspections and maintenance of equipment. Many accidents are the result of improper technical condition of machines, which can lead to failures or damage. Therefore, managers should invest in modern technologies and implement safety procedures related to the operation and use of machines, which will minimize the risk.
- Harmful factors in the work environment (3.50%). Although this percentage seems relatively low, these factors can significantly affect the health and safety of employees. This category includes, among others, inadequate lighting conditions, noise and chemicals. Employers should take action to eliminate or reduce exposure to these factors, which includes regular audits of the work environment and the use of appropriate personal protective equipment.
- Other (10.50%). This category includes a variety of factors that are not directly related to the areas mentioned above. These may be unpredictable situations or one-off incidents that require analysis and understanding to prevent their recurrence in the future. It is important to collect data on these incidents and analyze them thoroughly to better understand the sources of risk in the future.

Based on the descriptions of incidents, several categories of reported hazards can be distinguished, which occurred most frequently. These were:

- Falls and slips: They constituted the largest percentage of reports, especially in storage and production areas. Many reports concerned improper maintenance of order in workplaces, which contributed to the occurrence of such incidents.
- Equipment failure: Incidents related to machine and equipment failures were most often reported in technical departments. They were the result of both improper handling and faulty equipment.
- Chemical hazards: Reports regarding chemical leaks and problems with their storage appeared sporadically, but were of great importance due to the potentially serious consequences of such incidents.

Each report included actions taken by employees to minimize the risk. Most remedial actions consisted of:

- Immediate removal of the risk (e.g. tidying up the workplace, marking dangerous zones).
- Reporting the problem to the appropriate supervisor or technical department to repair the faulty equipment.
- Introducing ad hoc protective measures, e.g. additional personal protective equipment.

In addition, an analysis was conducted to determine which department of employees most often reports near-miss incidents. This analysis aimed to identify areas where the risk of such incidents is the highest, which may indicate a greater risk in these workplaces or better employee awareness of reporting incidents. The results were presented in relation to the number of employees employed in individual work areas, which allows for comparison between departments regardless of their size (Fig. 4).

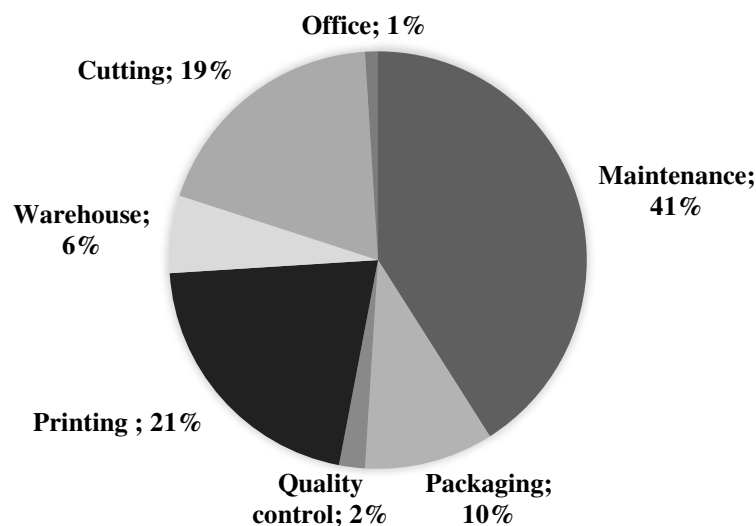


Figure 4. Percentage of reported near misses in each department in relation to the number of employees in those departments.

The highest percentage of reports came from the Maintenance department, which accounts for 41% of all reported incidents. This may indicate specific working conditions that are associated with greater risk or a particularly good safety culture in this department, where employees are more aware of reporting potential hazards. The next most reported department is Printing, with 21%. This department is characterised by specific risks related to the operation of printing machines and chemical materials, which may explain the high number of reports. The Cutting department accounts for 19% of reported incidents, which may be related to the use of sharp tools and machinery that pose a potential risk to employees. The remaining departments report incidents less frequently: Packaging – 10%, Warehouse – 6%, Quality Control – 2%, and Office – just 1%. The low percentage of reports from the office may be explained by the fact that office work is associated with a lower level of accident risk compared to production departments.

The Maintenance department, which reports the most near misses in the company, was subjected to a detailed analysis. The nature of the work performed by this department involves various hazards, which requires special attention to compliance with safety rules and regular training. In the analyzed company, employees of the Maintenance department participate in specialist training once a month, which is tailored to the specific hazards they may encounter in their daily work.

The training schedule is as follows:

- January – First aid training. Employees learn basic life-saving skills to be able to respond effectively in the event of accidents at work.
- February – Training in working at heights. It focuses on the correct use of equipment and techniques for minimizing the risk of falls, which are one of the most common hazards in industrial environments.
- March – Training in the safe handling of chemicals and hazardous substances. Employees are educated on the proper handling of hazardous substances to prevent leaks, spills and exposure to harmful effects.
- April – Training on the safety of operating selected machines and technical devices. Its aim is to ensure that employees operate complex machines efficiently and safely, which reduces the risk of mechanical accidents.
- May – Training entitled "Harmful factors in the work environment". It covers the identification, mitigation and protection against environmental hazards such as noise, dust or contact with toxic materials.
- June – Fire protection training. Prepares employees for a quick and effective response in the event of a fire, including evacuation procedures and the use of fire extinguishers.

Figure 5 shows a detailed analysis of near-miss incidents reported by the Maintenance Department over the six-month period.

The data from the six-month analysis indicates that the lack of safety in machinery and technical equipment remains a persistent issue, especially in the early months of the year, with the highest recorded number of 5 incidents in January. The situation improves in the following months, which may suggest the effectiveness of the machinery operation training conducted in April. Hazards related to working at heights are a regular but less frequent issue, with several incidents reported in the first quarter of the year. Chemical spills were most frequent in February, followed by a significant decrease after the chemical safety training in March, which suggests a positive impact of the training on reducing this hazard. Fire incidents are rare, with one reported case in May, coinciding with the planned fire safety training in June. Harmful factors in the work environment were reported sporadically, with the highest number of incidents in February and April, which may be related to the topic of the May training. The analysis of trends in incident reports shows a direct relationship between the types of accidents and the timing of specialized training. This highlights the importance of ongoing safety education and the need for further improvement of safety procedures within the company.

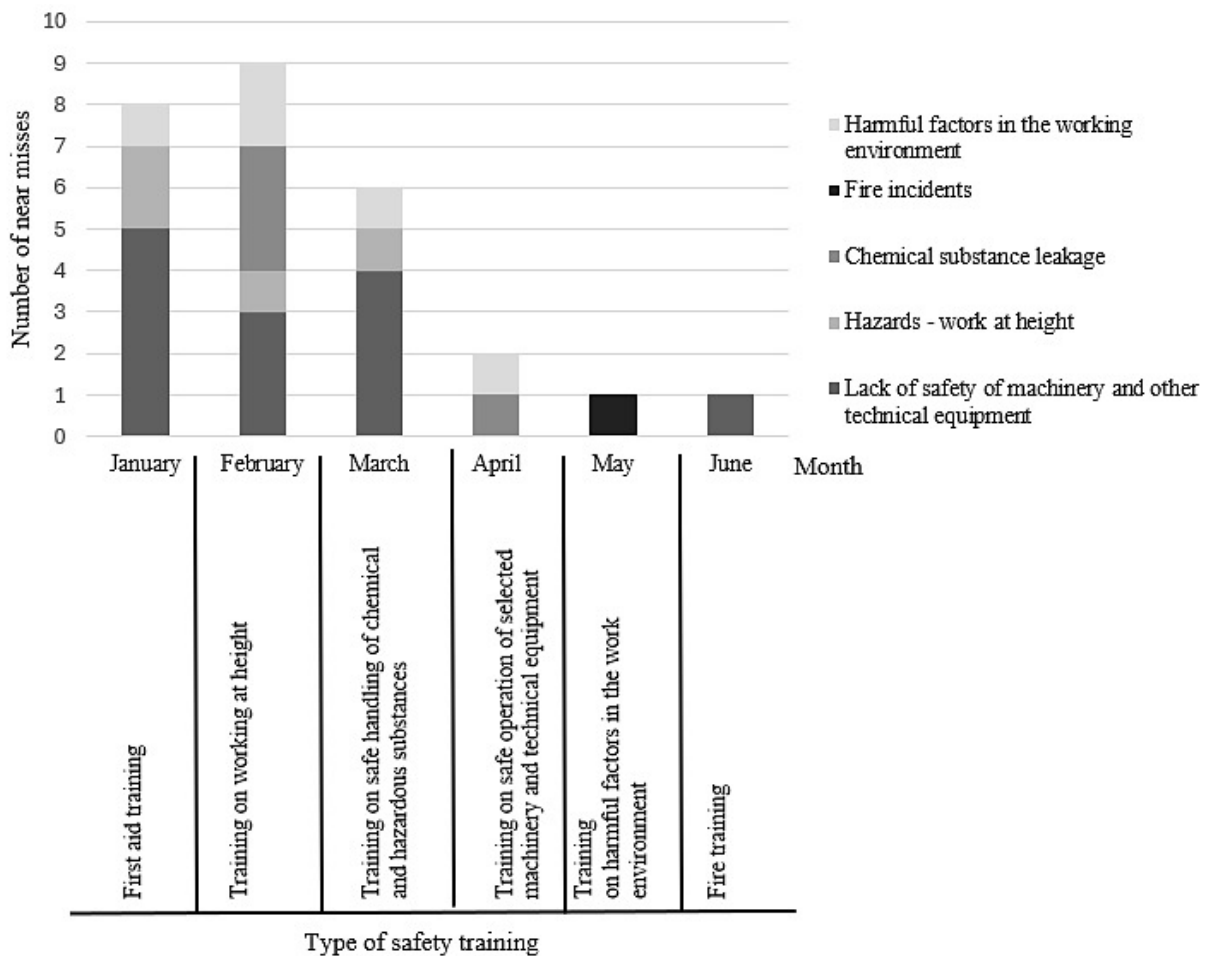


Figure 5. Detailed analysis of near misses reported by the Maintenance department over the six months.

7. Discussion

The conducted analysis of the impact of occupational health and safety (OHS) training on workplace safety and the frequency of reported near-miss incidents provided key insights into the effectiveness of such preventive measures. The research results indicate that safety training has a significant effect on reducing the number of incidents, which is corroborated by the literature on the subject.

In our studies, a clear decrease in the number of reported incidents was observed in the months immediately following the training sessions. This effect, as indicated, may stem from increased employee vigilance shortly after acquiring new knowledge and their greater willingness to adhere to safety procedures. These findings align with those of Beś and Strzałkowski (2024), who also noted that the effectiveness of OHS training is highest in the first two months after completion, suggesting that the effectiveness of such programs may gradually diminish over time unless reminders or additional periodic training are implemented.

One of the key findings in this analysis is that as many as 55.60% of incidents were attributed to human errors. These results emphasize the importance of not only safety training but also stress and fatigue management to improve employee performance and alertness. Research by Liu et al. (2023) demonstrated similar relationships, indicating that stress and fatigue are among the primary factors affecting workplace safety, particularly in high-risk environments. This author also highlighted the need for implementing psychological support programs in companies, which is reflected in our recommendations.

Our study results indicated that 30.40% of incidents were related to safety issues with machines and technical equipment, underscoring the need for regular maintenance of equipment and modernization of technology. Similar conclusions were drawn by Colim et al. (2022), who pointed out that improper maintenance of machinery increases the risk of accidents, and regular technical inspections can significantly improve workplace safety. Their research showed that companies investing in modern technologies and systematic equipment audits report a significant decrease in incidents related to machine failures.

Another important aspect that emerged both in our research and in the literature is the high frequency of falls and slips. They constitute the largest percentage of reported incidents, suggesting the need for additional preventive measures in high-risk areas such as warehouses and production halls. Research by Reinhold et al. (2014) also emphasizes that slips and falls are among the most common hazards in workplaces, especially where appropriate preventive measures, such as modifying floor surfaces or using protective footwear, have not been implemented.

The results of this analysis also suggest that OHS training should be conducted periodically to maintain a high level of safety awareness among employees. Such a recommendation also appears in the work of Laberge et al. (2014), who indicate that regular training and reminders are essential for sustaining the long-term effectiveness of preventive actions. Their studies showed that companies conducting training every six months experience fewer incidents compared to those that organize such training less frequently.

In summary, our research results align with the literature and confirm the importance of regular OHS training, psychological support for employees, and investments in modern technologies and equipment maintenance. Implementing periodic preventive measures, as well as fostering a culture of reporting hazards, can contribute to further reductions in the number of incidents in the workplace. However, further research is necessary to assess the long-term impact of these actions on improving safety culture in enterprises.

8. Recommendations

Based on the analysis conducted, several key actions are recommended that can significantly improve safety within the organization. First and foremost, regular occupational health and safety (OHS) training should be organized at least every six months to maintain a high level of employee awareness regarding safety principles. Additionally, research suggests that the effectiveness of training diminishes after two months, so it is advisable to implement systematic reminders or shorter refresher courses to reinforce the skills acquired.

Another recommendation is to implement psychological support programs, particularly focusing on stress and fatigue management, which can affect employee performance and alertness. Psychological support can help reduce the number of incidents caused by human errors, which account for a significant percentage of workplace accidents.

Regular technical inspections of machines and equipment are also advised, as a considerable portion of incidents has been associated with technical problems. Routine maintenance, technical condition audits, and investments in modern technology can significantly reduce the risk of equipment failures and associated accidents.

Moreover, in response to the most frequently reported hazards, such as falls and slips, it is recommended to implement preventive programs aimed at improving safety in high-risk areas like warehouses and production halls. These could include infrastructure modifications, such as non-slip flooring, better lighting, and the provision of appropriate protective footwear.

An essential element of improving safety is also promoting a culture of hazard reporting. It is important to create a work environment where employees feel comfortable reporting potential issues. Motivational systems that encourage active hazard reporting can significantly enhance the effectiveness of preventive measures.

Finally, monitoring and analyzing reported incidents is recommended, as this allows for the identification of patterns and areas requiring special attention. Regular reviews of data can assist in making ongoing adjustments and optimizing safety procedures. Considering the integration of modern technologies, such as monitoring systems for working conditions, can also improve employee safety.

Implementing these recommendations can contribute to a significant improvement in workplace safety and a reduction in the number of incidents. Regular monitoring of their effectiveness and further research will be crucial for maintaining long-term results.

9. Summary

The article presents the results of the analysis of the impact of occupational health and safety training on safety at work and the frequency of reported near-miss incidents in the company. The research results clearly indicate a significant relationship between employee education and a reduction in the number of incidents. It was noted that in the months immediately following the OHS training, there is a significant decrease in reports, which suggests an increase in safety awareness among employees.

The analysis of reported incidents reveals that the highest risk of incidents is concentrated in areas related to human errors, which constitute as much as 55.60% of all reports. This indicates the need to introduce systematic training and programs for improving qualifications, which will emphasize the importance of compliance with OHS rules. Additionally, a significant percentage of incidents (30.40%) is related to the lack of safety of machinery and technical devices, which emphasizes the need for regular inspections and maintenance of equipment.

To sum up, the research results confirm that effective safety management at work requires not only systematic employee training, but also continuous analysis and adjustment of procedures in response to identified threats. The implementation of recommended actions, such as periodic OHS training, psychological support programs and regular equipment audits, can contribute to creating a safer work environment and reducing the number of accidents. Further research in this area will be crucial to better understand the long-term effects of the implemented actions and to develop a safety culture in companies.

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NON-AGRICULTURAL BUSINESS ACTIVITY AS A SOURCE OF INCOME OF FARMERS' HOUSEHOLDS IN POLAND

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Purpose: The main objective of the study is to evaluate the importance of the non-agricultural business activity of farmers in shaping the income of farmers' households in Poland in 2002-2022.

Design/methodology/approach: The scale of farmers' non-agricultural business activity, its share in the income structure of farmers' households, and its links to agricultural production were assessed. Qualitative analysis and descriptive statistics were used.

Findings: In sectoral representation, non-agricultural business activities play a minor role in shaping farmers' households income, although after 2002 there was a relative increase in interest in this form of business activity among farmers. There is also substitutability between sources of income from agricultural and non-agricultural business activities.

Research limitations/implications: The limitation in the availability of full time series data and the differences in the methodologies for collecting data on agricultural businesses raise specific challenges at the stage of data compilation, analysis, and formulation of conclusions.

Practical implications: There is a polarisation in farmers' attitudes towards non-agricultural business activities: either they are the main source of the farm family's livelihood, or they are of marginal importance in shaping farmers' household income.

Social implications: Additional business activity is an important element in the financial security of those farms where agricultural activities are more often orientated toward self-supply.

Originality/value: The additional business activity of farmers is a topic little studied in the literature. Exploring its mechanisms is important for the design of effective policy tools aimed at reducing the instability of farmers' incomes.

Keywords: households, income, farmers, non-agricultural business activity, Poland.

Category of the paper: research paper.

1. Introduction

Farmers' non-agricultural business activity may be linked directly to the agricultural holding (using the resources of the agricultural holding, such as agrotourism farm), or it may be a business activity completely independent of agricultural production (the so-called non-agricultural other activity according to the Statistics Poland).

Farmers who start non-agricultural business activities are mainly driven by the motivation to obtain additional income or diversify their sources of income, due to the necessity to face the seasonality of agricultural production or the impact of climatic, weather, and biological factors (Antón et al., 2013; Soliwoda et al., 2016; Ellis, 2000). The level and stability of income of households are the basis of their financial security, i.e., their ability to satisfy their basic needs and cope with financial problems of a medium- and long-term nature (Kata et al., 2021).

From a sector-wide perspective, an increase in the share of non-agricultural income mitigates net income fluctuations of farmer households (Zegar 2014; Kata, Wosiek, 2024). From a within-sector perspective, there is a stronger tendency to seek income outside agriculture in small family farm holdings, where this type of activity is more likely to be forced by low agricultural income (Brünjes, Revilla Diez, 2012). Large farm holdings also engage in non-agricultural business activities, but more often due to the search for new opportunities to utilise farm holding resources, which fits in with the characteristics of opportunity entrepreneurship (Fairlie, Fossen, 2020).

Furthermore, the issue of non-agricultural business activities, either farm-related or carried out independently from it, fits into the concept of the European Farming Model (EFM) based on rural and agricultural multifunctionality. The essence of EFM is to preserve the multifunctional character of agricultural production, the agricultural system, and rural areas, while considering the market orientation of agriculture and the necessity to meet consumer needs (Poczta, 2010). The implementation of EFM can be supported by the transformation of the agricultural sector leading from specialisation to diversification of the sources of income of farming families. In this aspect, those forms of additional business activity of farmers that are linked to the farm holding (e.g., agrotourism farm, renewable energy production) and create multifunctional agriculture can play an important role. Similarly, business activity of farmers and farm holding members completely unrelated to agriculture can create jobs in the countryside (Adamowicz, 2005). Each of these forms of business activity directly contributes to increasing the dynamics of the development of the economy in rural areas, and for farming families creates the possibility of additional income.

In the literature, the problem of income in agriculture is examined within three main issues:

- income disparities, i.e. the relatively lower income level of farmer households compared to households in other socio-economic groups (Mishra et al., 2002; Sulewski, 2011; Czyżewski, Kryszak, 2015; Zegar, 2019; Kisielińska, 2018; Czyżewski et al., 2020);

- the much higher income diversification in the farmer household sector compared to the income diversification of households in other socio-economic groups (Kata, Wosiek, 2020; Skarżyńska, Grochowska, 2020; Czyżewski et al., 2022);
- the causes and ways of reducing the relatively high instability of farmer household incomes (Meuwissen et al., 2008; Soliwoda et al., 2016; Severini et al., 2019; Kata, Wosiek, 2024).

Studies of agricultural income generally consider the general division in agricultural and non-agricultural activities, and attention is less often directed to the structure of farmers' non-agricultural income. With regard to non-agricultural sources of farmers' household income, issues concerning budget transfers to agriculture (Czyżewski et al., 2020; Harkness et al., 2021) or taking up remunerated jobs (Kisielińska, 2018) are relatively more frequently addressed, while mechanisms related to farmers' additional business activity are less well understood.

This context raises the question: to what extent can non-agricultural business activity contribute to mitigating the income problems of farmers' households and the sector as a whole? In order for non-agricultural business activity to fulfil these functions, or expectations, it should be of the appropriate scale, both at the microeconomic and sectoral levels. It should also be differentiated in relation to the economic sectors and industries of business activity.

Hence, the main objective of the study is to assess the relevance of farmers' non-agricultural business activity in shaping the income of farmers' households in Poland in 2002-2022. Statistics Poland data from the cyclical survey *Household Budgets* and the results of the General Agricultural Census (2002, 2010 and 2020) have been used. Due to the scope and nature of the data, qualitative analysis and descriptive statistics indicators were used in the evaluation.

The study of the level and nature of farmers' non-agricultural business activity, particularly in dynamic representation, i.e. the observation of the strength and direction of changes in this area, appears to be necessary, even only to provide the information necessary for the shaping of policy towards agriculture and rural areas. Support for farmers' non-agricultural business activities should be a permanent and important objective of agricultural policy instruments aimed at the sustainable and multifunctional development of agriculture.

2. Study methodology and data sources

The main question of the study is: What role does income from non-agricultural business activities play in shaping the income of farmers' households in Poland? In search of an answer, the following hypotheses have been proposed:

H1: Between 2002 and 2022, income from non-agricultural businesses played a minor role in shaping the income level of farmers' households in Poland.

H2: After 2002 there was an increase in interest in undertaking non-agricultural business activities by farmers' households in Poland.

H3: Farmers' households in Poland are characterised by substitutability of income sources from agricultural and non-agricultural business activities.

The source of data on net income of households was the Statistics Poland cyclical survey entitled *Household Budgets*. The main source of data on non-agricultural business activities were the results of the 2002, 2010 and 2020 General Agricultural Census. These two surveys are characterised by different methodologies for collecting data on agricultural businesses, also within successive editions of the same survey (Bład, 2013), which raises specific challenges and limitations at the stage of data compilation, analysis, and formulation of conclusions.

In the *Household Budgets* survey, the economic classification of households is based on the criterion of the main source of family income. In the case of farmer households, this main source is income from the use of an individual farm holding¹. Such entities do not represent the full set of farm holdings, they account for about 30% of them.

In the present study, in the analysis of *Household Budget* data, farmer household income is referred to interchangeably as farmer income or farm household income. The income of agricultural households includes income from *strictly* agricultural business activities, i.e., from the farm holding, but also income from non-agricultural sources, both accompanying agricultural business activities (e.g., feed trade or plant protection products) and completely unrelated (e.g., remunerated jobs, budget transfers). Among these sources, in this study attention is focused on income from non-agricultural business activities, which in statistical researches on household budgets is referred to as income from self-employment.

The agricultural censuses are conducted periodically, more or less every 10 years. Their scope covers the general population of households that own a farm holding (including a farm user). The census, although not explicitly, makes distinction between two types of farm holdings conducting non-agricultural business activities. Most attention is paid to households with non-agricultural business activities directly related to agricultural production (using farm resources). The second group consists of households carrying out non-agricultural activities unrelated to the farm holding. Together, these two groups represent farmer households with income from non-agricultural business activities.

The scale of non-agricultural business was assessed in terms of the number of farmer households (also referred to as households with the holder of an agricultural holding) and their share in the total population of farm holdings in Poland. The research also included determining the relevance of income from non-agricultural business activities in the structure of total (net) income of farmers' households. The analyses were conducted from the sector perspective.

Due to data availability, the analyses cover the years 2002-2020 when it comes to data from the censuses and the years 2003-2022 in the case of data on the net income of farmer households. Due to the limitations in the availability of full time series data, their non-uniform

aggregation and presentation in the different editions of the census, the research is based mainly on qualitative analysis. In the analysis of quantitative data, descriptive statistics, structure indicators, and dynamics indicators were used.

3. Results

Between 2003 and 2022, the share of non-agricultural income in the net income of a farming family (living mainly from the use of an individual farm holding) averaged 32% (Figure 1). By 2016, and especially after 2007, the above mentioned indicator showed an upward trend, as it increased from 29.3% to 37.9%. This trend reversed in 2017. At the end of the reviewed period, in 2022, non-agricultural income accounted for 30.6% of net income in farmers' households. This was about 5 pp. less than in 2003.

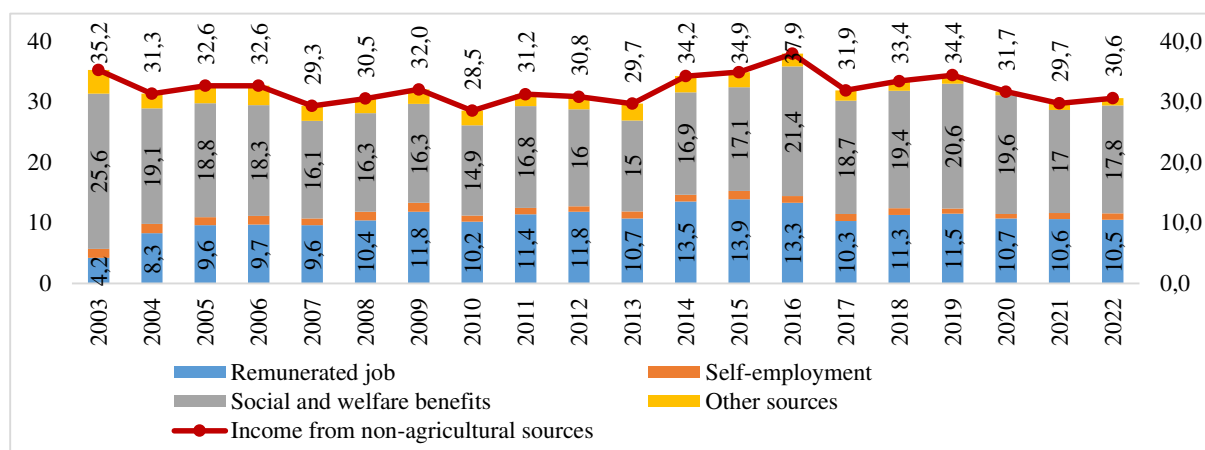


Figure 1. Structure of non-agricultural average monthly net income per 1 person in farmers' households in 2003-2022 (%).

Source: own calculations based on Statistics Poland data from cyclical publications: *Household budget survey 2006-2022; Situation of households in 2003, 2004 and 2005 in the light of the results of household budget surveys*, <https://stat.gov.pl/obszary-tematyczne/warunki-zycia/dochody-wydatki-i-warunki-zycia-ludnosci/budzety-gospodarstw-domowych-w-2022-roku,9,21.html> (2024.04.11).

The highest complementation of the budgets of farmers' households was income from social and welfare benefits. In the years 2003-2022, they constituted on average 18.1% of monthly *per capita* net income. Traditional Polish farm holdings are multi-generational, hence in 2020 almost 30% of households were receiving financial funds from pensions (Table 1). However, the percentage of farmer households receiving income from this source has decreased over the past two decades (from 57.5% in 2002 to 29.0% in 2020).

On average, income from remunerated jobs accounted for 10.7% of *per capita* net income. The results of successive censuses indicate that this was the source that most often (almost every second farm holding) fed the farmers' household. Moreover, the percentage of farmers' households receiving income from this source increased between 2002 and 2020. In 2020, it was 44.5% of households.

Table 1.

Number and percentage of farmer households engaged in agricultural business* by source of income (census data)

Year	Number of agricultural holdings (in thousands)		Percentage of agricultural holdings with income from:				
	total	with non-agricultural business activity	agricultural business activity	remunerated job	non-agricultural business activity	retirement and disability pensions	other non-profit sources
2002	2174.0	363.4	100.0	42.1	11.8	57.5	8.2
2010	1886.9	373.2	100.0	46.5	19.7	29.6	6.7
2020	1309.9	190.7	100.0	44.5	14.6	29.0	15.8

* in the census, these are the so-called households with a holder of an agricultural holding.

Source: own calculations based on: *Systematics and characteristics of agricultural holdings* (2003). Warsaw: Statistics Poland; *Non-agricultural activities of agricultural holdings* (2004). Warsaw: Statistics Poland; *The Characteristics of Agricultural Holdings. Agricultural Census 2010*. (2012). Warsaw: Statistics Poland; *The Agricultural Census 2020. Characteristics of agricultural holdings in 2020*. (2022). Warsaw: Statistics Poland.

Non-agricultural business activity was to a small extent complementary to farmers' household budgets (living mainly from the use of an individual farm) – Figures 1, 2. Income from the above accounted on average for 1.2% of net income *per capita* in farmers' households. The importance of this source in the income structure was subject to fluctuations in the reviewed period, against which a downward trend in the indicator in question is marked (from 1.5% in 2002 to 1.06% in 2022) – Figure 2.

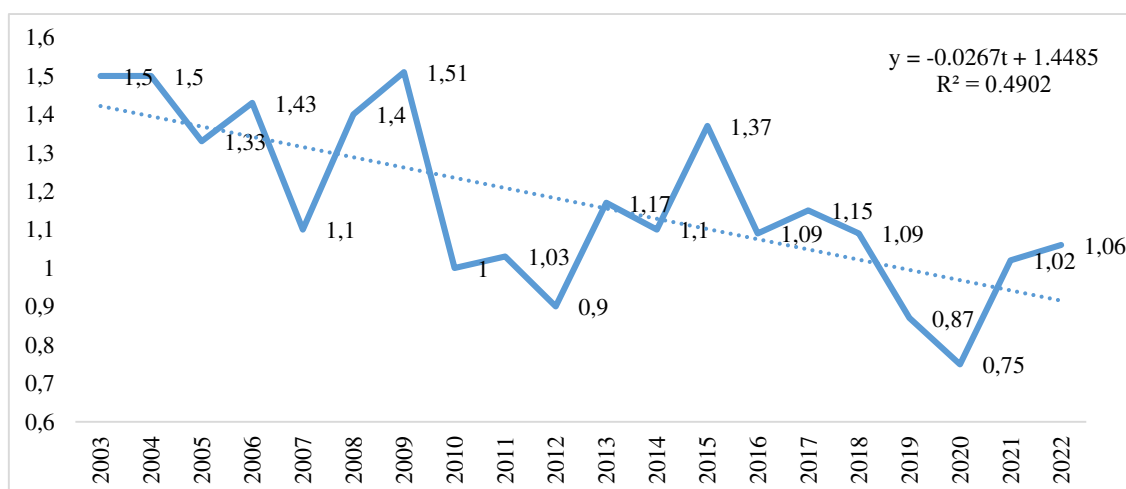


Figure 2. Share of income from non-agricultural business activity in the average monthly net income per capita in farmers' households in Poland in 2003-2022.

Source: as Figure 1.

However, it is worth emphasising that the data presented in Figures 1 and 2, come from the cyclical household budget surveys of Statistics Poland. Therefore, they refer to the household incomes of farmers, for whom the main or only source of livelihood is income from an individual farm holding. This set is therefore not identical to the general set of households that own a farm holding (with a holder of an agricultural holding).

To assess the relevance of non-agricultural business activities for farmers' household incomes, the results of the general agricultural censuses are more meaningful. These results indicate that the relevance of non-agricultural business activities grew particularly rapidly after Poland's accession to the EU (Figure 3). In 2010, almost one in five farms received income from this source. In 2020, income from non-agricultural business activities complemented the income of nearly 15% of households with a holder of an agricultural holding, in other words around 191,000 (Table 1, Figure 3). This was less than in 2002 and 2010, but the number of agricultural holdings in Poland also decreased during this period. The population of farms covered by the census of 2020 comprised just under 1,310 thousand farm holdings, which was approximately 44.7% of the set covered by the census of 2002 and 57.6% of the number of farm holdings covered by the census of 2010. In relative representation, the share of non-agricultural business activities in the number of total farm holdings in 2020 was 5.1 pp. lower compared to the census of 2010, but 2.8 pp. higher compared to the census of 2002.

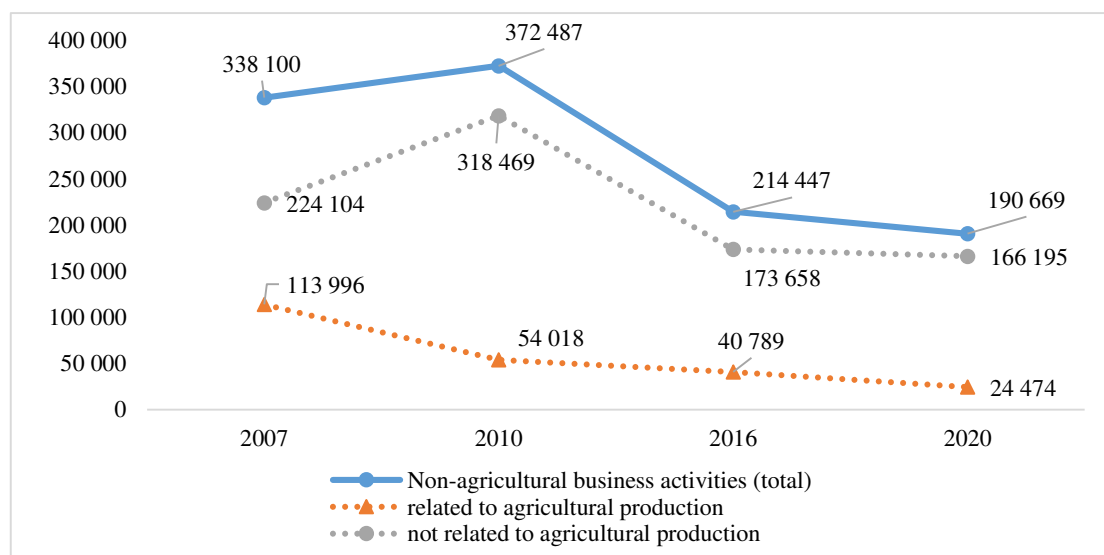


Figure 3. Number of households with income from non-agricultural business activities – by type of activity.

Source: own calculations based on: *The Agricultural Census 2002; 2010; 2020; The characteristics of agricultural holdings in 2016*. (2016). Warsaw: Statistics Poland.

It is characteristic that until 2010, despite the decrease in the number of total farm holdings in Poland, the number of entities in which additional business activity was not related to agricultural production was increasing. As a result, in 2010, this type of entities accounted for approximately 85.5% of farms obtaining income from non-agricultural business activities, and in 2020 it was 87.2%.

In 2020, one in seven farm holdings (14.6%) received income from non-agricultural business activities, and for 8.1%, this income was the main source of income (Table 2). In comparison, of the total farm holdings covered by the 2002 Agricultural Census, 11.8% received income from non-agricultural businesses, while 5.8% lived mainly on this income². Thus, between 2002 and 2020, a relative increase in interest in non-agricultural business activities can be seen among farm holdings.

Table 2.*Structure of farmer households by main source of income – Agricultural Census data*

Agricultural Census of:	Percentage of farm holdings by main source of income from:					
	agricultural business activity	remunerated jobs	non-agricultural business activity	retirement and disability pensions	other non-profit sources	Other households *
2002	27.9	24.9	5.8	28.9	3.0	9.5
2010	33.8	28.8	9.4	15.3	2.7	10.0
2020	30.3	33.1	8.1	15.5	2.0	11.0
Average	30.7	28.9	7.8	19.9	2.6	10.2

* The group of "other households" includes entities in which none of the sources of income exceeded 50% of the total income of the household. This is dominated by "bi-professional" units, which receive income from agricultural business and remunerated job. The percentage of households where the combined income from agricultural business and remunerated job exceeded 50% of income accounted for 4.7%-6% of total households.

Source: own calculations based on data as Table 1.

The group of households receiving income from non-agricultural business is not homogeneous. For 45.4% of them (2020), it was the only or main source of income for the farming family. At the same time, there was also a numerous group of households (28.2%) for which income from non-agricultural business was of marginal importance (constituted less than 10% of total household income³). Households making their living mainly from non-agricultural business were characterised by a lower importance of agricultural production as a source of market income. This is evidenced by the 2-3 times higher percentage of households producing mainly for self-supply (Figure 4).

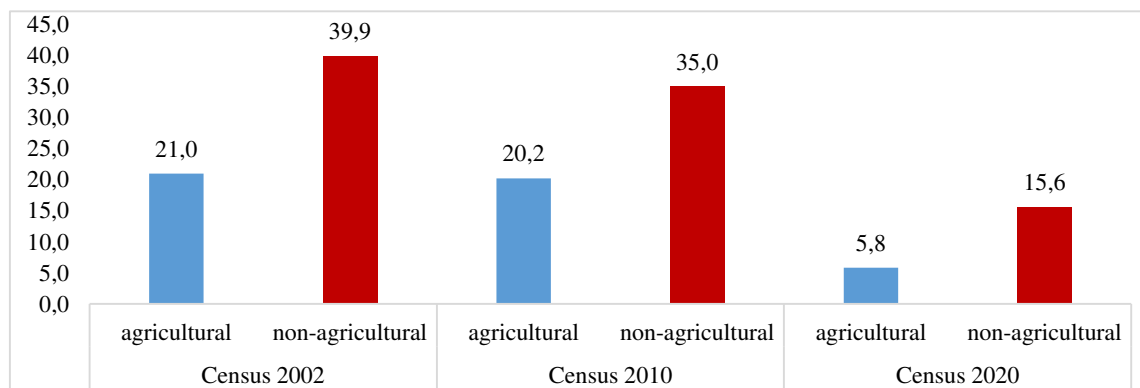


Figure 4. Percentage of households producing mainly for self-supply in households of farmers making their living mainly from agricultural/non-agricultural business activities in Poland.

Source: own calculations based on data as Table 1.

Differences are also noticeable in terms of groups distinguished by the type of non-agricultural business (related vs. unrelated to agricultural production). In the group of farm holdings with additional businesses related to agricultural production, the relevance of income from non-agricultural activities would decrease over time. In 2010, they were the main source of income for 44.5% of such entities, and in 2020, only for 27.5%. In turn, income from agricultural businesses was the main source of income for household budgets for 19% of such entities in 2010, and in 2020 for 30%.

4. Discussion

In the whole set of farm holdings (with a holder of an agricultural holding), income from non-agricultural businesses complemented the household budget for about 15% of them, and in the group of those (about 30%) living mainly from agriculture, it constituted on average about 1.2% of the total income obtained. This indicates the validity of the first research hypothesis that this source of income played a minor role in shaping the income level of farmers' households in Poland in the period 2002-2022.

Income obtained from non-agricultural businesses, in addition to income from remunerated job and income from social security benefits (pensions), contributes to the stabilisation of farmers' household income (Zegar, 2014). A study by Kata and Wosiek (2024) shows that in Poland, between 1996 and 2021, the variability of *per capita* net income in farmer households increased as the share of farm income in farm family net income increased. In this context, additional non-agricultural business can be treated as a complementary measure in efforts to reduce the instability of farmers' incomes, in addition to the primary instrument of subsidies under the Common Agricultural Policy (Severini et al., 2016; Castañeda-Vera, Garrido, 2017; Enjolras et al., 2014). In contrast to subsidies, which have the nature of budget transfers, the popularisation of non-agricultural business activity is an action for broader use of market instruments in the agricultural income stabilisation policy.

After 2002 an increase in the relative interest in undertaking non-agricultural business activities, especially those not related to agricultural production, by farmer households in Poland is observed. With a decrease in the total number of farm holdings in Poland between 2002 and 2020 by almost 33%, there was an increase in the percentage (by 2-3 pp.) of those obtaining income from non-agricultural business and those for whom this type of income was the main source of livelihood. This is a premise that confirms the validity of the second research hypothesis. These transformations are a component of the processes observed in the Polish countryside after accession to the EU, consisting in the growing importance of non-agricultural employment (Polska Wieś 2024..., 2024, p. 71). Nevertheless, the dissemination of farmers' non-agricultural business may lead to a gradual departure of farm holdings from agricultural production, as the majority of entities with such activity (in 2020, about 87%) did not associate it with farm resources. This was particularly true for smaller area farm holdings of up to 5 ha. At the same time, the number of such farm holdings decreased the most in Poland between 2002 and 2020 (Polska Wieś 2024..., 2024, p. 71). Thus, undertaking non-agricultural business may be an intermediate stage of change in the activity profile of small farm holdings, which in the long run translates into structural transformations of the Polish countryside.

Although the census data indicate that non-agricultural business activity is the domain of small and very small farm holdings, a relatively high percentage (10%) of entities with such activity also occurred among households with an area of 100 ha and more (census of 2020).

This is reflected in the polarised approach to non-agricultural business activity. Either it is a business that is the main source of livelihood for a farming family, or it is only complementary or even marginal (it is a source of income obtained as if by the side of agricultural business, e.g., occasional and seasonal income from services delivered with agricultural equipment). At the same time, there are indications that income from non-agricultural business is substitutive to income from agricultural business (as assumed by the third research hypothesis). This is related to the type of non-agricultural business conducted. When the non-agricultural business was related to the farm, the income from agriculture was more important. Moreover, in this group of households the importance of income from agricultural business increased over time, while the importance of income from non-agricultural business decreased. The opposite trends occurred among households undertaking business activity not related to their farm holding.

5. Conclusions

1. Non-agricultural business activity plays a relatively minor role in shaping the level of income of households of farmers living mainly from agriculture. For such entities, income from non-agricultural business accounted for only between 0.75% and 1.51% in the structure of average monthly net income per 1 person in the period 2004-2022. However, such households account for about 30% of households with an individual farm user. Considering the entire set of farm holdings in Poland, the results of the general agricultural censuses indicate that income from non-agricultural business complemented the total income of a farm family for less than 12% of farm holdings in 2012, after nearly 20% of holdings in 2010, and in 2020 it complemented the income of nearly 15% of farmer households. After 2002, there was a relative increase in interest in this form of business activity among farmers, especially that not related to agricultural production.
2. Income derived from non-agricultural business activities improves the material status of many farming families. In addition, they reduce the instability of farmers' income generated by significant fluctuations in income from agricultural production. The instability of farmers' income in general is very high and constitutes a fundamental problem today, more relevant even than the issue of farmers' income disparity, which has been clearly reduced over the last two decades. In this context, non-agricultural business can be a complementary tool in the policy of stabilising farmers' incomes. Its value is of market nature rather than the transfer nature.

3. The results of the research indicate a kind of substitutability of income sources from agricultural and non-agricultural businesses. On those farms where income from agricultural business was high, there non-agricultural business was of additional and complementary importance to the farmer's total household income. It was also more often linked to agricultural production and based on farm resources. In contrast, where agricultural income was low, non-agricultural business activities were more important as a source of livelihood for the farming family. It was also more often an activity completely unrelated to the farm holding and agricultural production.

The conducted analyses allow us to identify the basic mechanisms involved in undertaking non-agricultural business activity, but are not sufficient for statistical verification of cause-and-effect relationships (due to limited data availability). This indicates the need to complement the presented sector based approach with research of a microeconomic nature, conducted directly among farm holdings. This would allow for a more in-depth conclusions on the motivations, determinants, and effects of conducting non-agricultural business activity by farm holdings with different characteristics of owners, production profiles, or spatial location.

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Footnotes

1. This income is calculated as the difference between the value of sales of agricultural production and subsidies associated with the use of the farm holding and the current inputs incurred in agricultural production and taxes associated with running the farm holding (*Household Budget Survey in 2022, 2023*, p. 121).
2. In 2010 the income from non-agricultural business was earned by 19.7% of all census farm holdings. This activity was the main source of income for 9.5% of farm holdings and 9.3% of households with more than 1 ha.
3. The total income of a household is considered to be the total income (from agricultural and non-agricultural business, as well as from: remunerated job, receipt of pensions, social assistance allowance, child care allowance, child support, scholarships, possession of capital deposits, receipt of foreign aid, winnings from draw-based games and lotteries, etc.) of all persons living together with the farm user and making their living jointly (*The Agricultural Census 2020, 2022*).

TRENDS IN ENVIRONMENTAL MANAGEMENT IN CRUISE SEAPORTS

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Purpose: The main objective of the article is to identify and evaluate activities undertaken in the area of environmental management in selected sea cruise ports in Europe resulting from the dissatisfaction of local communities caused by environmental pollution by cruise shipping companies.

Design/methodology/approach: The article presents the findings of a research project that employed a triangulation approach, utilising three distinct methods: data mining, desk research, and case studies.

Findings: Public authorities, seaport authorities, and cruise travel organizers implement a diverse array of strategies to prevent environmental degradation and mitigate adverse impacts on their surroundings. These strategies encompass formal-legal frameworks, organizational and technical initiatives, substantial investments, and crucially, social measures. By integrating these multifaceted approaches, they aim to foster sustainable practices and enhance environmental stewardship within the cruise industry.

Research limitations/implications: The deliberate selection of popular cruise seaports in Southern Europe limits the scope of the study, as it does not encompass a broader range of seaports.

Originality/value: The findings of this research could serve as a valuable resource not only for seaport authorities but also for local governments of coastal cities and cruise ship operators. Additionally, the article highlights various technological innovations employed in seaports to mitigate the detrimental environmental impacts of port activities.

Keywords: environmental management; seaports; cruise ships.

Category of the paper: Case study, literature review.

1. Introduction

Taking into account the growing dissatisfaction of the inhabitants of coastal tourist destinations from the fact that numerous giant cruise ships are handled in the seaports. As a result, seaport authorities are facing new challenges to develop a policy in which the interests of different groups are reconciled, On the one hand, cruise ship owners and entities involved in the service of tourists with the interests of local communities and local governments. The solution may be the introduction of environmental management in the context of micro, macro, and meso where the micro approach refers to actions that port authorities should take within the organization in the field of pro-ecological investments, an adaptation of procedures, certification, and accreditation of environmental management systems; on a macro scale in order to build an understanding with the immediate environment, i.e. residents and business entities and local governments in the port city, and on a meso scale, to respect international regulations and to join the European network of seaports that comply with environmental systems and standards (*EMS, ISO 14001, PERS, EMAS, SEM Code* etc.).

The activities of seaports are of great importance for the state of the natural environment, especially in the field of reducing greenhouse gas emissions, increasing energy efficiency, and using renewable energy sources. In this context, seaport authorities are currently facing enormous challenges imposed on them by various national and international institutions on the one hand, and other stakeholders on the other, including the local community of coastal tourist destinations and local authorities of coastal cities on the other. The main objective of the article is to identify and evaluate activities undertaken in the area of environmental management in selected sea cruise ports in Europe resulting from the dissatisfaction of local communities caused by environmental pollution by cruise shipping companies. In addition, three main research questions were posed, i.e.: 1) What factors determine the activities of seaport authorities in Europe in the area of environmental management? 2) What are the environmental management systems and models that take into account the specificity of port operations? 3) What environmental management measures are being taken by seaport authorities in Europe?

The findings of this research could be highly valuable not only for seaport authorities but also for local governments of coastal cities and cruise ship operators. The article also showcases various technological innovations implemented in seaports to reduce the negative environmental impacts of port activities. Additionally, it highlights several technological solutions aimed at enhancing energy efficiency and monitoring pollution in the analyzed seaports. The importance of legal regulations and international conventions relating to the issue of environmental management in seaports was also discussed and the need to develop relationships and multi-level cooperation between port authorities and the environment for sustainable development.

2. Literature review

2.1. Environmental management in seaports resulting from legal provisions imposed on seaports

Environmental management is "a part of an organization's management system, used to develop and implement its environmental policy and manage its environmental aspects" (ISO 14001:2004). Zurlini et al., (2008) define environmental management as "the factual policy and practice decisions and practices concerning how resources and the environment are assessed, protected, allocated, managed, used, reclaimed, reclaimed, and restored".

Dramatic climate changes caused by environmental pollution in recent years, as well as strong pressures from various interest groups on seaport authorities to reduce the harmful impact of port activities on the environment, compel port authorities to engage in dialogue and cooperation with various stakeholders.

The actions of seaports are determined by numerous factors, primarily legal, economic, social, technological, and environmental (Figure 1). Strong pressure from both local communities and international institutions to diminish the adverse environmental effects of economic activities will compel seaport authorities to take action by implementing new technological solutions and collaborating with diverse communities.

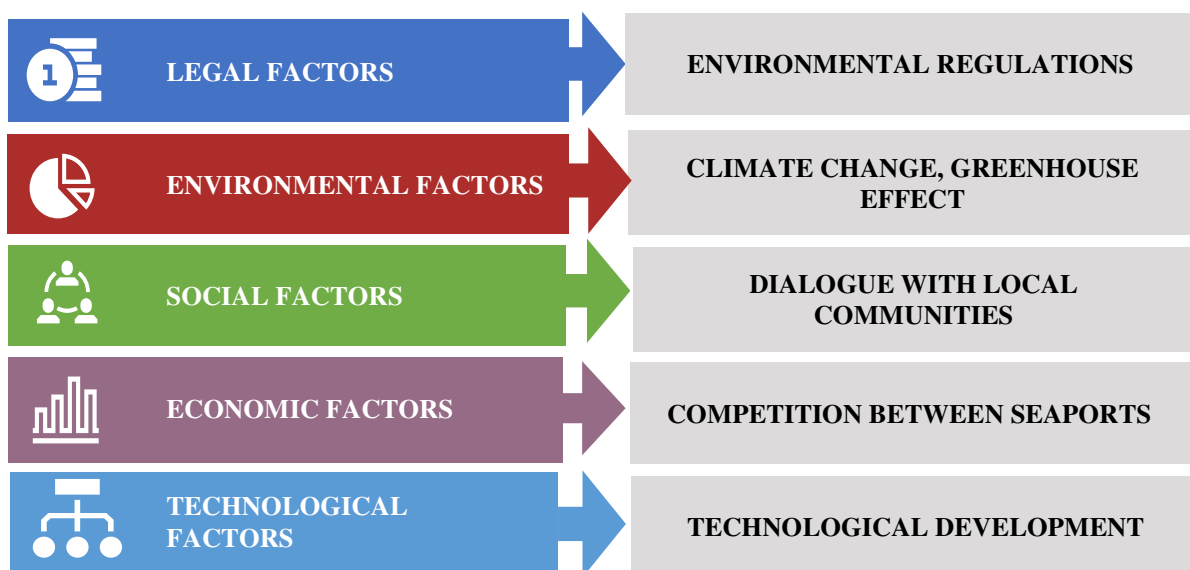


Figure 1. Factors influencing environmental management strategies in cruise seaports.

Source: Author's own elaboration.

Among the numerous factors influencing the decisions of seaport authorities, legal frameworks should be regarded as paramount for fostering investment and collaboration with entities. The extent of influence of legal regulations governing the operations of economic entities regarding the utilization and impact on the natural environment is determined by the authority responsible for formulating such laws.

The provisions contained in conventions adopted by the United Nations (UN) have the widest scope. The global scope of influence of this institution and its agencies gives direction to the actions of states and, through national law, to entities registered in them, including seaports.

In the field of protection of the marine natural environment, conventions, and strategic goals set by the UN, the implementation of which is also the responsibility of seaports, are included in universal provisions, for example in General Assembly Resolution A/RES/70/1: Transforming our world: the 2030 Agenda for Sustainable Development (United Nations, 2015) containing 17 Sustainable Development Goals (SDG) and regulations closely related to the marine natural environment, for example:

- United Nations Convention on the Law of the Sea – UNCLOS (United Nations, 1982).
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter – London Convention, (United Nations, 1972).
- Convention on Biological Diversity – CBD Convention (United Nations, 1992).

The UN agency dedicated to the safety and protection of the marine environment and the economic activities conducted within this environment is the International Maritime Organization (IMO). The most important conventions prepared under the auspices of the IMO that have an impact on port operations include:

- International Convention for the Prevention of Pollution from Ships – MARPOL (International Maritime Organization, 1973).
- International Convention for the Control and Management of Ships' Ballast Water and Sediments – BWM Convention (International Maritime Organization, 2004).
- International Convention on the Control of Harmful Anti-fouling Systems on Ships – AFS Convention (International Maritime Organization, 2001).

The scope of obligations imposed on ports due to the state's ratification of a given convention is presented in Table 1.

The column relating to the 17 Sustainable Development Goals indicates the goals and tasks referred to in the Resolution, which concern, among others, the activities of seaports. Most areas related to the exploitation of seas and oceans are covered by the so-called Constitution of the Seas and Oceans. The remaining conventions refer to selected, detailed issues related to the safety of navigation and the safety of the marine environment. Their common feature is the need, or even obligation, for international cooperation, ship support, and waste management. Two conventions (London and CBD) mention the possibilities of ports conducting educational campaigns promoting environmentally friendly behaviour and raising society's awareness of issues related to the protection of the natural environment of marine waters.

Table 1.

Laws regulating the safety and protection of the marine environment and activities conducted in the marine environment on a global scale that affect port operations

Thematic scope	United Nations						
	UNCLOS	London Convention	SDG	CBD	IMO		
					MARPOL	BWM	AFS
Navigation safety	+						
Environmental Protection	+	+	14.1; 14.3; 14.6	+	+	+	+
Anti-pollution	+		14.2	+	+		
Port security	+						
International cooperation	+	+	14.a	+	+	+	+
Ensuring freedom of navigation	+						
Cooperation with other ports	+		17.17				
Ban on dumping waste		+					
Waste management collection and disposal (from ships)		+	14.3		+	+	
Waste management ballast water			14.3			+	
Control and inspections		+			+	+	+
Technical support for ships					+	+	+
Education and awareness raising (optional)		+	17.17	+			

Source: own study based on conventions.

On a slightly narrower scale, legal provisions are created taking into account the specificity of the sea areas to which they apply. These are regional marine protection programs developed under the United Nations Environment Program (UNEP). In Europe, these are:

- Convention on the Protection of the Marine Environment of the Baltic Sea Area (the Helsinki Convention) – HELCOM covering all Baltic Sea countries and the EU as a party to the convention aimed at preventing and removing the pollution of the Baltic Sea (HELCOM, 1992).
- Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention) – signed by 22 countries of the Mediterranean basin, the aim of which is the sustainable management of marine resources (UNEP, 1976).

In the case of European ports, there are two regional maritime programs (conventions) dedicated, among others, to regulating the operation of ports and the ships and economic entities serviced there in the field of environmental protection at the regional level. These are intergovernmental agreements:

- Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention, 1992), covers 15 coastal states of the Atlantic Ocean (North), the North Sea, and Switzerland, the aim is to protect the marine environment (OSPAR Convention, 1992).
- The Bonn Agreement is a mechanism under which 10 countries, plus the EU as a party, cooperate to protect the North Sea from oil pollution and harmful substances (Bonn Agreement, 2019).

Within the European Union, many regulations have been developed dedicated to environmental protection, including the marine environment. However, the mere fact of a Member State's participation in the program does not force ports to take action, as is the case with international conventions ratified by the state. The most important programs ensuring sustainable management of natural resources, including marine ones, include the Marine Strategy Framework Directive (MSFD), Water Framework Directive (WFD), European Marine Networks (EMD), European Ecological Network Natura 2000, and LIFE Programme.

Due to the specific nature of some regions (separated in the EU space as macro-regions), the European Union has prepared political frameworks - strategies for joint, efficient problem-solving and better use of the region's potential related to natural conditions.

Due to the subject of the article, it is worth mentioning two macro-regions covering member states around sea areas: the EU Strategy for the Baltic Sea Region (which is a prototype for subsequent macro-regions) and the Strategy for the Adriatic Sea and the Ionian Sea. The solutions included in the strategies are not mandatory for ports. Nevertheless, some of them undertake pro-ecological activities – as important entities implementing the Sustainable Development Goals in the Baltic, Adriatic, and Ionian Sea (Table 2).

Table 2.

Areas of possible active role of ports in the EU strategy for selected macro-regions implementation

Areas of the active role of ports		EUSAIR ¹	EUSBSR ²
Protection of the marine environment (ecological technologies, monitoring of pollutant emissions, waste management)		+	+
Sustainable development of	Ports	+	
	Local communities		+
Cross-border cooperation of ports		+	+
Development of port infrastructure	Increasing accessibility	+	
	Modernization		+
Development of maritime tourism		+	
Promotion of R&D in the field of port activities		+	
Promoting maritime transport			+
Maritime safety (accident prevention)			+

Note. European Union Strategy for the Adriatic and Ionian Region, ² European Union Strategy for the Baltic Sea Region.

Source: Author's own elaboration on the base of the EU Strategy for the Adriatic and Ionian Sea Region, EU Strategy for the Baltic Sea Region.

Both strategies, as the basic goal for which they were developed, are to contribute to taking actions, also by ports, that will protect the environment of water areas and coastlines. Achieving this goal requires the cooperation of coastal states, hence the second point common to both strategies – cross-border cooperation of ports. The remaining points of both strategies are the result of the level of development of the countries constituting macro-regions, port infrastructure, and the most important directions of economic development for individual regions.

2.2. Environmental management in seaports resulting from decisions made by seaport managers

Environmental management in seaports results from several reasons: economic, legal, and social. Making an effort to adapt the organization and its processes to the requirements of the standards whose fulfillment results in obtaining a certificate is part of sustainable development activities. By implementing environmental management systems, ports can reduce operating costs (optimizing the organization of processes, improving operational efficiency) and improve economic results thanks to greater trust of stakeholders (e.g. banks, and insurance institutions). Environmental management systems implemented in seaports include systems based on universal solutions and systems created specifically for ports as implementing entities (Figure 2).

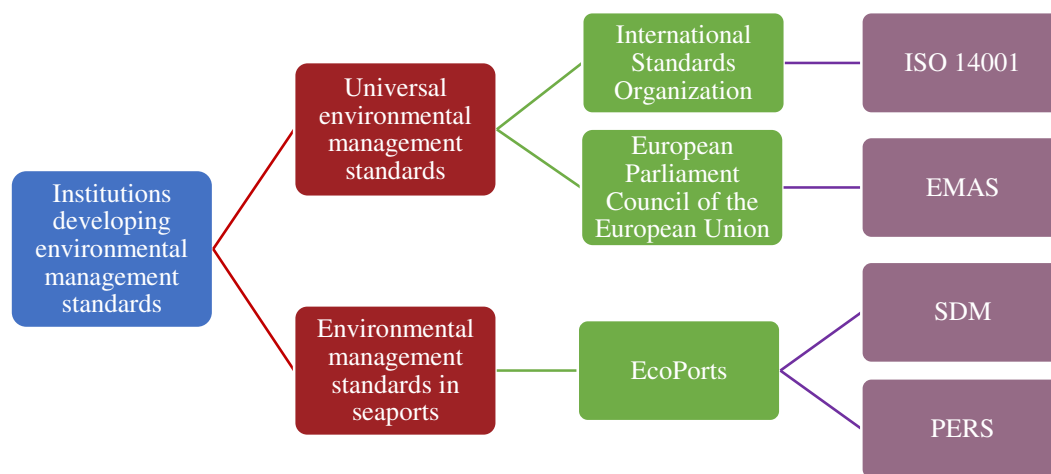


Figure 2. Environmental management systems implemented in seaports taking into account the institution of the organization defining the conditions of implementation and certification.

Source: Author's own elaboration.

The ISO 14001 standard is a framework for an Environmental Management System based on a process approach. The standard does not contain categorical requirements for the effects of environmental activities, but only specifications and guidelines for the use of the system. It was prepared to support the activities of enterprises and institutions in the field of environmental protection. In the case of ports, implementation of the standard means identifying areas of activity that have an impact on the environment, assessing environmental threats and risks, defining environmental protection activities to minimize the negative impact on the environment, and ongoing monitoring. The essence of the environmental management system is the permanent improvement of activities related to environmental protection.

ISO 14001 refers to the requirements of EMAS (Eco-Management and Audit Scheme) developed and adopted by the European Parliament in 1993, initially only for industrial enterprises, and after its amendment in 2001 also for non-industrial organizations (Peris-Mora et al., 2005; European Parliament and of the Council, 2009). It is the most important instrument for implementing the environmental policy of the EU (formerly EC). Compared to the ISO 14001 standard, EMAS has a much more restrictive approach to the implementation of the

environmental management system by entities belonging to the EMAS system: it requires compliance with applicable legal provisions in the field of environmental protection, an obligation to reduce the negative impact on the environment to the extent that is guaranteed use of the best available technique, determines the frequency of audits, obliges to prepare reports available to stakeholders (Erauskin-Tolosa et al., 2020; Testa et al., 2014).

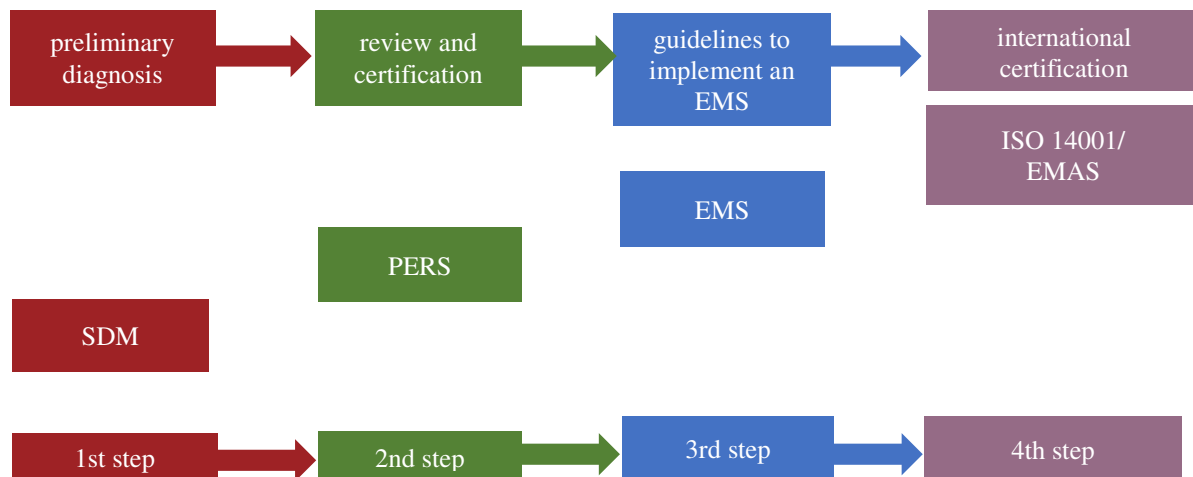


Figure 3. EcoPorts tools and International/EU environmental management standards.

Source: Darbra, 2004, pp. 420-428.

The higher requirements resulting from the implementation of the EMAS system do not bring marginal benefits to ports compared to the benefits resulting from the implementation of the ISO 14001 system. This is reflected in the number of ports with individual environmental management systems. Among the European ports belonging to the EcoPorts network, only nine have the EMAS certificate. These are: Igumenitsa in Greece and 8 Spanish ports: Valencia, La Coruna, Barcelona, Vigo, Cartagena, Algeciras, Ceuta, Bilbao. There are currently 53 ISO 1400-certified ports (EcoPorts, 2024).

Environmental management systems are also developed by port organizations. The specific nature of the activities of these complex business entities is then taken into account. The main pro-environmental initiative in European ports is the EcoPorts network – a non-profit organization that has created a platform connecting ports for 'information exchange and impact assessment for enhanced environmentally conscious operations in European ports and terminals' (Wooldridge, 2017). Since 2011 operates within the structures of the European Seaports Organization (ESPO). EcoPorts provides two tools for implementing and monitoring the functioning of environmental management systems: Self Diagnosis Method (SDM) and the Port Environmental Review System (PERS) (Figure 3).

SDM is an online tool that allows you to identify threats to the marine environment conduct a comparative analysis of the results for a given port with the European average and obtain expert recommendations on further steps. Port Environmental Review System (PERS) – this is an environmental management system dedicated to seaports. The standard applies to all key tasks assigned to seaports in the field of environmental protection: waste management,

emission management, water management, energy efficiency, and protection of the marine environment. Currently, 35 ports associated with ESPO have the PERS certificate. Dedicated tools for preparing and implementing environmental management systems in ports are an introduction to the implementation of universal environmental management systems ISO 14001 or EMAS (EcoPorts, 2024).

3. Research methodology

For the purpose of this article, a thorough query of available literature was performed. The article contains the results of the research carried out by using triangulation of several methods, i.e.: data mining method, desk research method, and case studies. The three most popular cruise seaports in the Mediterranean Sea were analyzed, i.e.: the Port of Venice, the Port of Dubrovnik, and the Port of Barcelona. Numerous law regulations issued by the international institutions, reports published by cruising organizations, strategies and reports developed by the seaports, as well as research papers were used in the studies and analysis. A descriptive, comparative and critical analysis were carried out. and the results of the analysis were presented in the form of tables and figures to illustrate the analyzed phenomena.

3.1. Environmental management standards and systems in cruise seaports – case studies

CLIA (2022) reports that in 2027, the number of cruise ship travelers will reach 39.5 million. An estimated 218 cruise ships operating in Europe emitted 509 tons of Sulphur oxides in 2022 (Elton, 2023) and 45 ships are responsible for pollution that compares to almost 10 times worse than pollution from 93,000 cars (Ensor, 2023). Among the most polluted cruise seaports in Europe are: 1) Barcelona (Spain), 2) Civitavecchia (Italy), 3) Piraeus (Greece), Palma Mallorca (Spain), Lisbon (Portugal), Hamburg (Germany), Southampton (UK), Mykonos (Greece), Thira (Greece) and Funchal (Portugal).

Thanks to the measures taken by the city authorities in consultation with the port authorities, Venice moved up from first place in 2019 to 41st place in the ranking of the most polluted cruise seaports (Ensor, 2023). Venice is ISO 14001 certified, which proves that it adheres to the highest standards in terms of caring for the natural environment (Table 3).

Table 3.

Environmental Management Standards and Systems in Cruise Seaports in the Mediterranean

Name of the cruise seaport	SDM	PERS	EMAS	ISO14001
Port of Venice	-	-	+	+
Port of Dubrovnik	-	-	+	+
Port of Barcelona	-	-	+	+

Source: Author's own elaboration on the base of ZAL Port, 2024; Port Authority of Dubrovnik, 2022; The Port of Venice, 2024.

The port authority also assures that since 2021 a permanent monitoring network for noise control and management in port areas has been in place. Ultimately, they plan to create an acoustic map of the port showing noise pollution from ships moored in the port. In addition, they declare that monitoring of air quality is carried out in the seaport to present the level of air pollution. The port authorities also declare that sustainable development is a priority for them and they undertake some activities in the field of: "energy efficiency improvements, electrification of docks, electric mobility and the promotion of LNG and hydrogen" (The Port of Venice, 2024).

The Port of Barcelona, as mentioned above, is considered as the most polluted port in Europe, has also implemented an environmental management system and respects the requirements of the ISO 14001 standard (Table 3). The port authorities prioritize environmental protection, increasing energy efficiency through the use of renewable energy sources and the introduction of new technologies (ZAL Port, 2024).

It should also be noted that the Port of Dubrovnik is ISO 14001 certified. In addition, the port authorities developed the document called *Plan for Reception and Handling of Waste in the Area Managed by the Port Authority of Dubrovnik* (Port Authority of Dubrovnik, 2022), which is a kind of guide to the handling of environmental management in the port. The port authorities take a very serious approach to environmental management. Which, as it was proved above, is manifested both in activities aimed at improving the natural environment and the quality of life of the city's residents.

3.2. Overview of actions in the scope of environmental management in cruise seaports – case studies

In the past, the Port of Venice (Italy) and in Barcelona (Spain) have been a model for other cruise seaports in the world. Passenger terminals were located in the centers of historic cities, which were a huge attraction for cruise ship travelers. Cruise ship owners sought the possibility of mooring cruise ships right in the city centers. Nevertheless, in recent years the situation has changed dramatically due to the huge pollution of the environment and the rapid development of mass tourism.

The city of Venice is an example of a cruise tourist destination, where the local community, together with NGOs, started a movement to reduce the negative effects caused by cruise ships and cruise travelers in the city and its surroundings. Venice struggles annually with a strong influx of masses of tourists from all over the world. Currently, The Port of Venice handles an average of more than 250 giant cruise ships per year (Figure 4), which bring more than 0,5 million travelers (Figure 5) (The Port of Venice, 2024). The situation changed after the COVID'19 pandemic, as in 2019 Venice was visited by 500 giant cruise ships, which brought more than 1.6 million cruise travelers.

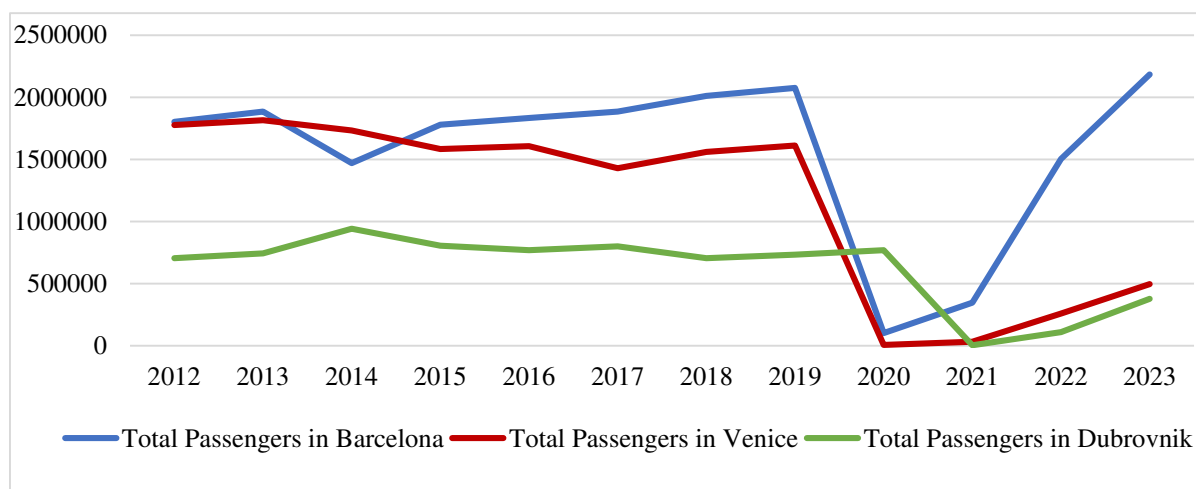


Figure 4. Number of cruise travellers in studied cruise seaports (2012-2023).

Source: Author's own elaboration on the base of ZAL Port, 2024; Port Authority of Dubrovnik, 2022; The Port of Venice, 2024.

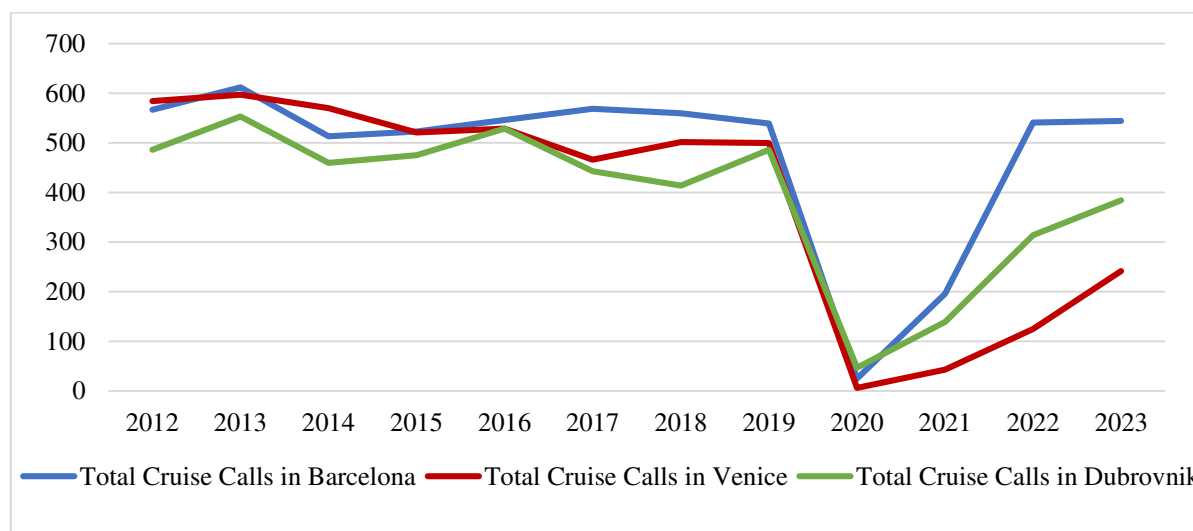


Figure 5. Number of cruise ships calls in studied cruise seaports (2012-2023).

Source: Author's own elaboration on the base of ZAL Port, 2024; Port Authority of Dubrovnik, 2022; The Port of Venice, 2024.

Venice becomes an unbearable city to live in. Local residents are moving to Mestre, selling off their apartments in the city center. The municipal authorities are afraid that Venice will lose its status as a city of World Cultural Heritage and will be removed from the UNESCO World Heritage List. Venice was considered for Europe's most polluted cruise seaport in 2019 (Elton, 2023). In order to meet the expectations of the local residents, the municipal authorities of Venice initiated a movement to reduce the negative impact of cruise ship traffic in the city. In 2007, an agreement on the Blue Flag of Venice was signed with the owners of cruise lines, which aimed to introduce standards for the use of fuel with lower Sulphur emissions. This was followed in 2013 by another Blue Flag II agreement, which required cruise ship owners moored at Venice berths to use only green fuel (Asero, Skonieczny, 2017). These activities brought measurable results and had an impact on the improvement of the

environment (Terranova et al., 2015). Another action taken by the authorities to reduce the negative impact of the cruising market on the city was the introduction of the Clini-Passer Decree 79/2012 of 2014 r. which introduced a restriction on the tonnage of vessels that may enter the Venetian lagoon, i.e. max do 40 000 GT. In 2017, a referendum organized by the *No Grande Navi association was held in Venice*, as a result of which 25,000 residents voted in favor of restricting ship traffic in the city, and the interest in participating in the referendum was much greater than the organizers expected, which may indicate the mood of the inhabitants (Terranova et al., 2015). An interesting study was carried out by the team of Bertocchi et al. (2020) presenting several scenarios to optimize tourist flows in the main tourist destinations of Venice in order to mitigate negative effects on the environment.

Other popular cruise tourist destinations, such as Dubrovnik (Croatia), are also following the example of Venice. The Port of Dubrovnik handles an average of more than 400 giant cruise ships per year (Figure 4), which bring about 0,7 million travelers (Figure 5) (Port Authority of Dubrovnik, 2024). UNESCO World Heritage List warned Dubrovnik of the possibility of losing its World Heritage status – *List of World Heritage in Danger*. In response to the emerging threat, the city authorities have introduced various solutions to reduce tourist traffic in the city. Cruise ships and coach operators must book their stops in Dubrovnik in advance. The city uses cameras to monitor and control this traffic. High fees have also been introduced for coach operators who arrive unannounced in the city center. In addition, cruise line operators are encouraged to stay longer and are offered discounts on port fees so that cruise travelers can purchase more goods and services in the city through a longer stay (Abbasian et al., 2020). In 2018, the cooperation between the Dubrovnik Port Authority and the Dubrovnik City Authority resulted in the introduction of a restriction that two cruise ships with 5,000 passengers on board can call at the port per day. In 2021, a system was introduced under the name the Digital Nomads-in-Residence (DN-I-R, 2021), which inform visitors how many cruise ships and tourists will be expected on certain days during the year.

The Port of Barcelona is another port that has followed the example of Venice and has taken action to promote environmental management. In 2022, the Port of Barcelona was ranked among the most polluted seaports. (Elton, 2023). The Port of Barcelona handles an average of more than 540 giant cruise ships per year (Figure 4), which bring more than 2 million travelers (Figure 5) (The Port of Barcelona, 2024). A few years ago, a modern passenger terminal, the World Trade Centre, was built in the center of the city, which could simultaneously handle several giant cruise ships. Climate change, pollution and disruption caused by hundreds of thousands of tourists arriving in Barcelona on cruise ships led to the fact that the seaport authorities, under pressure from the local community and local authorities, decided to close the terminal at the city's Muelle Barcelona Norte northern docks at the World Trade Centre in October 2023. As a result of this, almost 350 giant cruise ships per year have been diverted to the Moll d'Adossat pier south of the Catalonian capital, which is located a 30-minute shuttle bus ride from the city center. The port authorities also declare that in order to reduce the level

of pollutants emitted by ships during their stay in the seaport, they will implement an investment in electrifying the Adossat Quay for almost €80 million in 2024, and it will be equipped with shore power supply and LNG bunkering (CLIA, 2022a). The relocation of the terminal from the city center give opportunities for the development of space for public services for local residents.

The activities undertaken in cooperation between the Port of Barcelona and the local authorities was initiated by an agreement in 2018 and aimed at reducing the level of environmental pollution and reducing the negative impact of mass tourism on the environment. In addition, a daily limit of calls of giant cruise ships has been introduced to 7 vessels instead of 10 as it was before (Symons, 2023). In addition, the local authorities has taxed the hospitality industry and cruise ships, and now plans to introduce taxes on tour operators to increase travel costs for tourists to reduce their number.

Other cruise seaports in Europe are also following in the footsteps of the Port of Venice and Barcelona, which are struggling with overtourism and environmental pollution caused by giant cruise ships. Examples include Palma (Spain), Marseille (France), Santorini (Greece) and others.

4. Discussion

Environmental management in cruise seaports, as mentioned above, pertains not only to monitoring pollution levels in port basins but should be considered in a broader context, encompassing social, legal, and economic aspects. In this perspective, they should be considered as a striving towards sustainable development of coastal areas. Numerous entities are involved in this process, including primarily cruise seaport authorities, local governments, residents of coastal destinations, non-governmental organizations, as well as economic entities involved in the development of cruising and cruise ship operators.

The residents in cruise tourist destinations complain about vibrations and noise caused by the engines of giant cruise ships moored at docks in the immediate vicinity of tourist destination centers and historic parts of the cities. Cruise ships waiting for passengers who are exploring visited port cities during the day often wait with their ship engines running for up to 10-12 hours to power all the devices on board, consuming huge amounts of fuel and energy. The seaport authorities are blamed for problems related to pollution of port waters, air pollution, as well as congestion and overcrowding of seaside destinations due to the handling of even several giant cruise ships at the docks in ports. Additionally, the frustration of local communities in port destinations is exacerbated by the escalating, drastic climate changes caused by greenhouse gas emissions. To manifest their discontent with the actions, the local community along with non-governmental organizations protest against the movement of ships and demand dialogue and

the implementation of restrictions for shipowners. On the other hand, cruise ship operators and organizers conduct intensive campaigns promoting sustainable development of the cruising market (Figure 6).

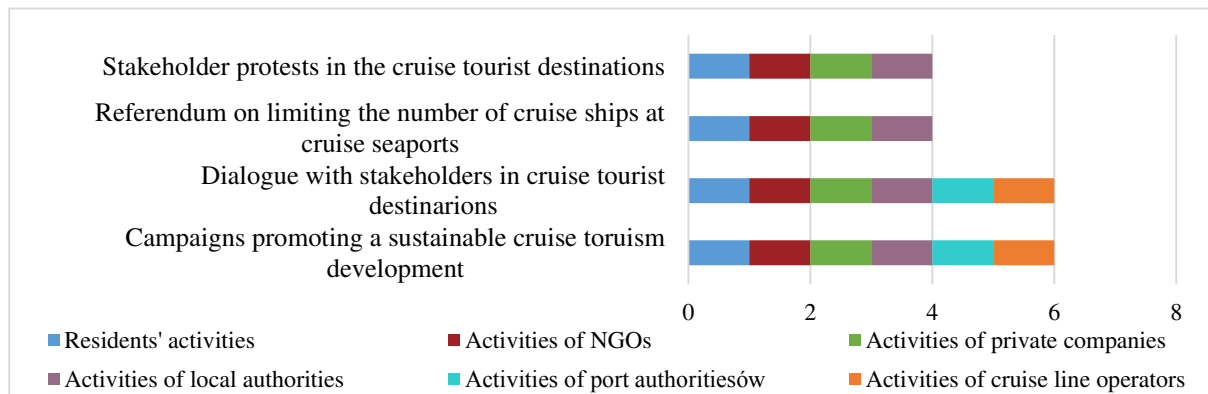


Figure 6. The actions of entities in cruise destinations in the scope of social dialogue for environmental management.

Source: Author's own elaboration.

Actions are also being taken to monitor cruise ship traffic, tourist movement in the city center, traffic congestion, as well as agreements are being made to jointly address issues related to excessive tourism and environmental pollution (Figure 7).

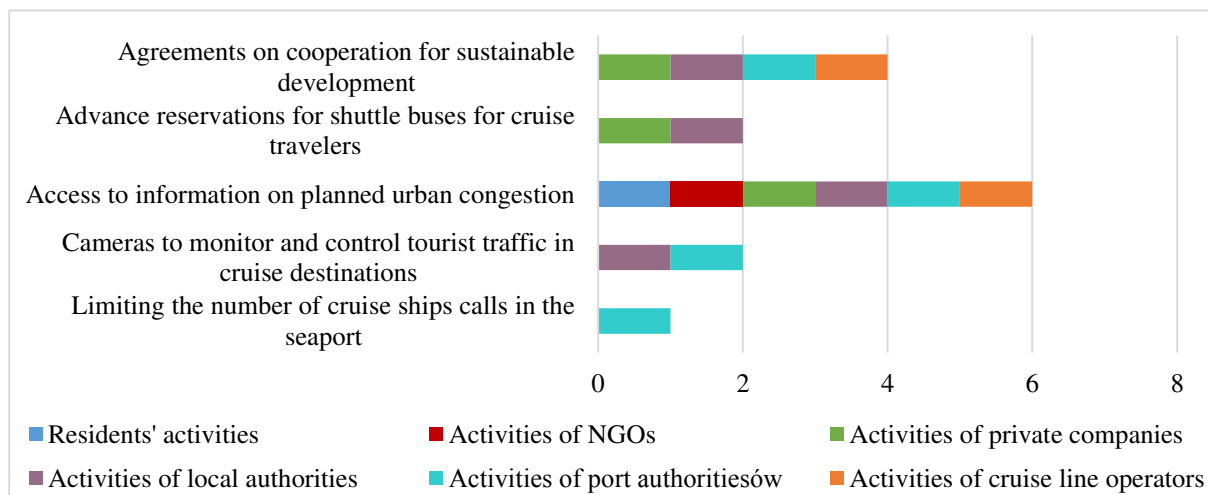


Figure 7. The actions of entities in cruise destinations regarding organizational solutions for environmental management.

Source: Author's own elaboration.

In response to various social movements and pressures from international organizations, entities involved in the development of the cruising market in cruise seaports are implementing a range of solutions aimed at minimizing the negative impact of the cruising market's development on the environment. An important aspect of environmental improvement efforts are legal restrictions imposing limits on cruise ship operators regarding the level of emissions of harmful substances into the environment during port stays, as well as limiting ship traffic in coastal destinations through various fees and taxes, as well as reservation systems.

Port fee discounts for cruise ships apply to vessels equipped with engines powered by liquefied natural gas (LNG) or compressed natural gas (CNG), or electric engines (Figure 8).

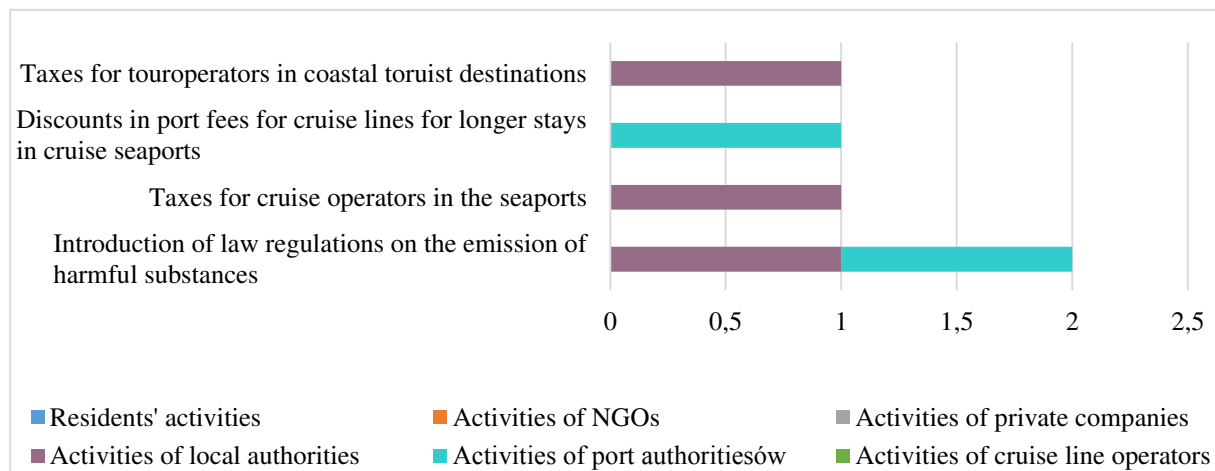


Figure 8. The actions of entities in cruise destinations regarding formal-legal solutions for environmental management.

Source: Author's own elaboration.

Even though electrically powered ships are quiet, clean, and efficient, their servicing in seaports requires costly infrastructure that would enable ships to be connected to onshore power supply. Such vessels can be powered by batteries, power generators, or alternative energy sources such as solar panels or wind turbines.

Port authorities, in collaboration with local government authorities, undertake investment actions to improve the state of the natural environment, particularly in terms of reducing the level of pollution emitted by ships moored at the docks (Figure 9).

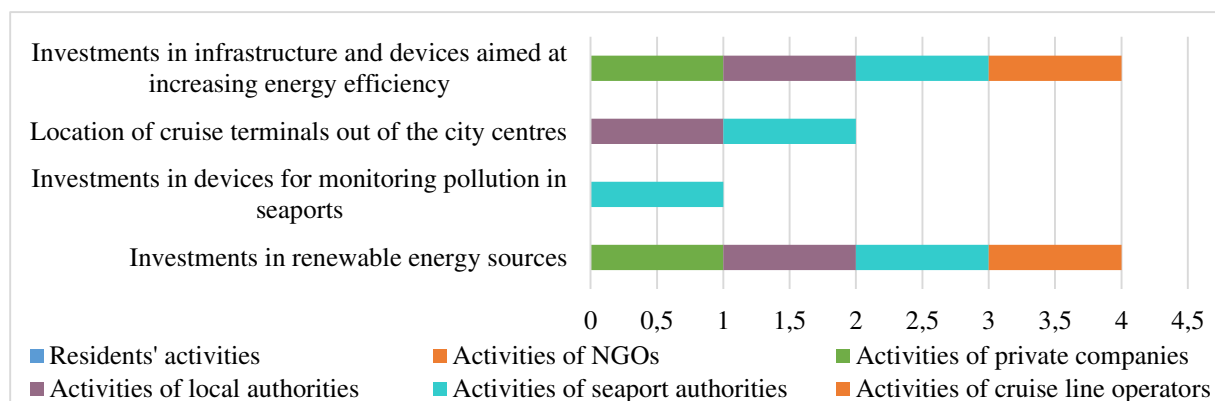


Figure 9. The actions of entities in cruise destinations in the area of investments for environmental management.

Source: Author's own elaboration.

Investments are being made in pollution monitoring systems (underwater sensors, monitoring software, underwater and aerial drones), infrastructure aimed at increasing energy efficiency (energy consumption monitoring systems, onshore power supply, marine shore power, solar panel installations, solar cell systems, LED lighting, hybrid energy recovery systems, automatic mooring systems, etc.) and investment in noise reduction (soundproof

windows, noise-reducing ramps for vehicles, etc.). The most important thing, however, is that, port authorities, in cooperation with local authorities, relocate passenger terminals outside city centers to alleviate tourist traffic and improve the quality of life for residents.

5. Conclusions

In summary, it must be noted that public authorities, seaport authorities, as well as cruise travels organizers, are aware of the risks associated with the development of cruise shipping for coastal tourist destinations. The conducted analysis demonstrates that they undertake a variety of actions in different fields to prevent environmental degradation and mitigate negative impacts on the surroundings. As demonstrated, they undertake actions in the areas of formal-legal solutions, organizational-technical initiatives, as well as investment, and most importantly, social measures. Among the most important trends in environmental management undertaken in cruise seaports, the following should be mentioned:

- In the SOCIAL AREA – collaboration and stakeholder engagement of various groups of interests in seaport areas for environmental management (regulatory agencies, city and seaport authorities, tourist companies, local residents, and environmental organizations etc.).
- In the ORGANIZATIONAL AREA – the development of alternative tourism offerings in destination areas to reduce overcrowding and ensure adequate experiences for visitors, as well as the development of the tourism market as part of a broader tourism destination management system, including aspects such as transportation and mobility, public space preservation, local economy, and housing.
- In the ECONOMIC AREA – sustainable and eco-friendly infrastructure and facilities in the seaports (renewable energy sources, onshore power supply, monitoring systems to track energy efficiency, air and water quality, water reuse systems, and waste management systems, etc.) and also the location of cruise passenger terminals outside the city centers.
- In the FORMAL-LEGAL AREA – introducing new or modified fee regulations for cruise ships in seaports, taxation of tour operators and tourists in coastal areas, and promoting cruise tourist destinations through lower taxes and local fees that attract higher-spending travelers with less environmental impact.

The conducted analysis has shown that all surveyed ports, i.e.: the Port of Venice, the Port of Dubrovnik, and the Port of Barcelona, are certified with the internationally recognized ISO 14001 certificates for environmental management systems (EMS). This indicates that the authorities of the surveyed ports adhere to guidelines and principles of sustainable development. They set goals and establish policies for development aimed at

minimizing the negative impact of economic activities on the natural environment and surroundings.

6. Limitations and recommendations

The article presented actions undertaken in the field of environmental management by only a few of the most popular cruise seaports in Southern Europe. The selection of the analyzed cases was deliberate, and it would certainly be worthwhile to analyze other seaports, especially in Northern Europe, which are leaders in implementing eco-friendly solutions for renewable energy sources and onshore power supply systems. Supplementing the research with additional case studies and preparing a map of solutions used in various cruise destinations would allow for the creation of a catalog of recommendations that could be useful for others stakeholders in cruise destinations. In addition to the analyses conducted in this article, it would be worthwhile to conduct a diagnostic survey with various stakeholders in cruise destinations to assess their attitudes and approaches towards environmental management. The results of the surveys could have significant value for addressing issues related to environmental management.

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DETERMINANTS OF ORGANIZATIONAL AGILITY IN THE AREA OF PERSONNEL MANAGEMENT

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Purpose: The purpose of this article is to examine the key determinants of organizational agility in HR management, with an emphasis on structural and decision-making aspects of organizational functioning. The article aims to assess how these determinants affect effectiveness and the ability to adapt in a dynamically changing business environment.

Design/methodology/approach: The study was conducted using a survey method among 312 respondents who assessed various aspects of HR management in their organizations. The analysis of the results was based on Pearson correlation, which allowed for determining the relationships between key determinants of organizational agility.

Findings: The research results indicate strong correlations between the lack of decision-making superiority, equality in relationships, co-decision-making and the real impact of employees on the development of the organization. Reducing hierarchy and supporting cooperation promotes greater organizational agility and more effective personnel management.

Research limitations/implications: The study is limited by the relatively short time of implementation and the subjective nature of respondents' answers, which may result in an incomplete picture of reality. It is advisable to conduct research on a larger sample and in various sectors of the economy for a more complete verification of the results.

Practical implications: The results can serve as a guide for organizations that want to increase their flexibility by introducing more balanced relationships in teams and increasing employee participation in decision-making processes.

Social implications: Promoting organizational agility in personnel management can contribute to creating more inclusive workplaces in which employees have a real influence on decisions, which translates into their greater engagement and job satisfaction.

Originality/value: The article brings a new perspective on the role of people management in the context of organizational agility, presenting a detailed analysis of the key determinants and their interdependencies.

Keywords: organizational agility, personnel management, enterprise, organizational, management model.

Category of the paper: research paper.

1. Introduction

Organizational agility in personnel management is becoming an increasingly important issue in the dynamically changing world of business. In the era of globalization, rapid technological development and growing competition, organizations must demonstrate the ability to flexibly adapt their structures and processes. Traditional, hierarchical management models often prove insufficient in the face of the challenges of modern markets. The need to quickly adapt to changes, both internal and external, requires organizations to implement agile practices that enable effective response to new situations and problems (Akkaya, 2021).

Personnel management plays a key role in the process of building organizational agility. It is employees, their commitment, skills and the way they cooperate that affect how effectively the organization is able to adapt to changes (Yang, Liu, 2012). Modern organizations are increasingly realizing that agility is not only a matter of structural flexibility, but also the ability to create an environment in which decisions can be made at various organizational levels, and relationships are based on equality and cooperation. Enabling employees to actively participate in decision-making processes and clearly defining roles and responsibilities are key to achieving agility (Nath, Agrawal, 2020).

Taking up this topic is important because organizational agility is becoming a key factor in determining the success of companies, especially in the face of rapidly changing market and technological conditions. Organizations that can flexibly manage their staff are better prepared for unexpected changes, which translates into their competitiveness and ability to innovate. Studying the determinants of organizational agility in personnel management allows for a better understanding of what factors influence success in this area and how they can be effectively implemented in various business contexts.

1.1. Organizational agility as a modern management model

Organizational agility is increasingly seen as a modern management model that allows organizations to respond more effectively to dynamic changes in the business environment. In contrast to traditional hierarchical structures, organizational agility is based on flexibility, decentralization of decisions and the ability to quickly adapt to new challenges and opportunities (Raschke, 2010). It is also characterized by a high degree of autonomy of employees and teams, which facilitates faster decision-making and response to changing market conditions. One of the key elements of organizational agility is the flexibility of the structure, which allows for smooth adjustment to market needs, technology and customer preferences. In such a model, organizations strive to minimize unnecessary layers of management, which not only speeds up the decision-making process but also strengthens cooperation between employees. Instead of a rigid division of roles and tasks, organizational agility promotes a more holistic approach, in which employees can take on a variety of tasks and adapt to current requirements (Doz, Kosonen, 2008).

Another feature of agile organizations is co-decision-making, which assumes broad employee involvement in decision-making processes (Womack, Jones, 2003). In agile management structures, decisions are not made exclusively at the highest levels of the hierarchy, but are largely the result of cooperation and consultation within teams (Porter, Kramer, 2006). Such a model promotes greater employee responsibility and involvement, which translates into higher motivation and efficiency of actions (Gao, Zhang, Gong, Li, 2020; Borowski, 2021). Organizational agility also assumes continuous improvement and learning of the organization as a whole. Processes in agile companies are constantly monitored and improved, and the organization focuses on a culture of openness to change. In this context, it is also important to promote innovation, which plays a key role in agile organizations. Employees are encouraged to share their ideas, test new solutions, and take risks, which promotes rapid development and adaptation (Chen, Li, 2021).

In agile management models, technologies that support communication and collaboration at every organizational level also play a key role. Modern digital tools enable rapid information transfer, which is crucial for agile organizations that must act quickly and effectively in conditions of market uncertainty. Thanks to new technologies, companies can better manage projects, streamline production processes, and adapt to customer expectations in real time (Nath, Agrawal, 2020; Skyrius, Valentukevič, 2020).

In summary, organizational agility is a modern approach to management that is characterized by flexibility, decentralization, co-decision-making, and continuous improvement. Thanks to such features, organizations gain a greater ability to react quickly to changes and to adapt to dynamic market conditions, which becomes crucial for their survival and success in the long term.

1.2. Factors influencing organizational agility

The factors that influence organizational agility include a number of aspects that determine the extent to which an organization is able to adapt to changing external and internal conditions. A key element in building organizational agility is an appropriate organizational culture that promotes openness to change, innovation, and collaboration (Jones, Adam, 2023). Organizations with an agile culture strive to create a work environment in which employees feel engaged, have space to express their ideas, and are ready for continuous learning. Such a culture is based on trust, in which hierarchical structures are minimized, and decisions are made at a team level (Munodawafa, Johl, 2019).

An important factor influencing agility is also the appropriate organizational structure. In agile organizations, the structure is not rigid, but dynamic and adaptive to needs (Seifollahi, Shirazian, 2021). Instead of traditional hierarchies, networks of teams are preferred, in which employees can freely cooperate and exchange information (Sherehiy, Karwowski, 2017). Such a structure promotes faster decision-making and facilitates the flow of information, which is crucial for the adaptability of the organization. In addition to the structure, it is also important

to clearly define roles and responsibilities, which allows for flexible taking over of tasks depending on current needs (García-Granero, Piedra-Muñoz, Galdeano-Gómez, 2020).

Technology also plays a key role in increasing organizational agility. Modern digital tools allow organizations to respond to market changes faster and more effectively, as well as better manage their resources. Technologies not only enable process automation, but also facilitate communication between employees and teams, which promotes greater transparency and cooperation. In addition, analytical tools allow organizations to monitor market trends and make more informed decisions on this basis (Rahimi, Mansouri, 2019).

Another factor that determines organizational agility is the way change is managed. Organizations that are able to quickly and effectively implement changes have a greater ability to adapt (Sajdak, 2021a). This ability depends on the ability to manage the change process, including preparing employees for new conditions, adapting operational processes, and continuously monitoring the effects of the introduced changes. It is also important to promote a proactive attitude, where organizations not only respond to changes, but also actively seek new market opportunities (Kurnia, Chien, 2020).

Another factor influencing organizational agility is the development of employee competencies. Agile organizations invest in the development of their employees, offering them opportunities to acquire new skills and professional development. Employee flexibility in taking on new challenges and their ability to quickly acquire knowledge becomes crucial in conditions of dynamic changes. Organizations that emphasize the development of competencies are able to respond better to the changing needs of customers and the market environment (Routledge, 2020).

An important aspect that supports agility is also the ability of the organization to manage risk. In a dynamically changing market environment, organizations must be prepared for various types of risks, both external and internal. Agile organizations have developed mechanisms that allow for quick identification of risks and taking corrective actions. Risk management in an integrated manner, involving different teams, allows not only to minimize losses, but also to use risk as an opportunity for development (Prieto, Talukder, 2023).

In summary, organizational agility depends on many factors, such as organizational culture, flexible structure, modern technologies, effective change management, development of employee competences and the ability to manage risk. These elements complement each other and create foundations on which the organization can build its ability to adapt in a dynamic business environment.

1.3. Key Aspects of Organizational Agility in Managing Organizational People

The key aspects of organizational agility in personnel management refer to a number of factors that directly affect the effectiveness and flexibility of an organization in the context of human resources management. The first important element is a flexible organizational structure that allows for quick adaptation to changing market conditions and internal needs of the

organization (Chen, Siau, 2020). The flexibility of the structure allows for a freer flow of information and better adaptation of employees to new challenges (Sajdak, 2021b). Organizations that implement a flexible approach to the structure abandon traditional, rigid hierarchies in favor of dynamic teams in which tasks and responsibilities can be easily changed depending on the situation. This type of approach promotes greater agility because it allows organizations to respond faster to external and internal changes (Rahimi, Mansouri, 2019).

Another key aspect of organizational agility is the lack of hierarchy in personnel management. In agile organizations, hierarchical structures are reduced, which promotes more partnership-based relationships between employees and managers. Such an arrangement allows for better communication, faster decision-making, and greater employee involvement in organizational processes (Attar, Almusharraf, Alfawaz, Hajli, 2022). Reducing excessive hierarchy reduces the distance between different organizational levels, which translates into greater transparency and more effective personnel management (Mrugalska, Ahmed, 2021).

The lack of decision-making supremacy is another important aspect that significantly affects organizational agility. In agile structures, decisions are not made only at the highest level, but the decision-making process is distributed across various organizational levels. Employees who have a greater influence on decisions regarding their work are more engaged and motivated to take the initiative (He, Harris, 2021). Thanks to this, the organization can react faster to changing conditions and carry out tasks more effectively. The dispersion of decision-making responsibility strengthens trust between employees and managers, which is conducive to building a culture of cooperation and collective responsibility (Luo, Ren, Cao, Hong, 2020).

Equality in mutual relations between employees is another aspect that is crucial for organizational agility. In an organizational culture based on equality, employees feel more engaged and responsible for their tasks, which leads to greater teamwork efficiency. Equality in relations also promotes better information exchange and mutual support in the team, which in turn increases flexibility in achieving organizational goals. In such organizations, partnership relations are promoted, and all decisions and actions are the result of collective work, which additionally strengthens the agility of the organization (Fiddler, 2017).

Knowing the tasks and assigned responsibilities also plays an important role in the context of organizational agility. Employees who are clear about their roles and responsibilities are able to respond faster to the changing needs of the organization and adapt better to new challenges (Joiner, 2019a). Clear definition of tasks promotes work efficiency because it minimizes the risk of misunderstandings and chaos. Agile organizations invest in appropriate training and tools that allow employees to better understand their tasks and goals, which translates into better implementation of activities (Sedej, Justinek, 2021).

Co-determination, or the active involvement of employees in decision-making processes, is another key aspect of organizational agility (Rosário, Raimundo, 2021). Organizations that promote co-determination give their employees the opportunity to influence key decisions regarding both operational and strategic activities of the company (Brown, Jones, 2018).

Such a model promotes greater employee identification with the organization, as well as stimulates creativity and innovation. Co-determination enables better understanding by employees of the organization's goals and greater commitment to their implementation, which translates into greater agility in action (Joiner, 2019b).

The real impact of employees on the development of the enterprise is an integral aspect of organizational agility. Employees who perceive that their actions and decisions have a real impact on the development of the organization are more motivated to engage in innovative projects and take the initiative (Awasthi, Awasthi, 2023). Such influence also promotes a greater sense of responsibility for the company's results, which in turn leads to faster and more effective responses to market changes. In organizations where employees have a real impact on development, decisions are made faster and the organization is better able to adapt to external challenges (Alshehhi, Nobanee, Khare, 2018).

1.4. Research Methodology

The aim of the research was to identify and assess the determinants of organizational agility in the management of the organization's personnel, with an emphasis on the aspects of decision-making, structure and relations between employees. The research hypothesis assumed that there are strong connections between the flexibility of the organizational structure, the lack of hierarchy, and the level of co-decision-making and the influence of employees on the development of the enterprise. The subject of the study was to check whether determinants such as the lack of decision-making superiority, equality in relations and knowledge of entrusted duties have a significant impact on organizational agility. The research questions concerned the extent to which individual determinants, such as flexibility of the structure, the lack of hierarchy, co-decision-making and the real influence of employees, affect the increase in organizational efficiency and agility.

The research was conducted using a survey method between April and June 2024 on a sample of 312 respondents. Respondents answered questions about their opinions on various aspects of personnel management, including the flexibility of the organizational structure, decision-making, hierarchy and mutual relations. Based on the obtained results, Pearson correlation was calculated to determine the strength and direction of relationships between individual determinants. This correlation allowed us to determine the extent to which selected factors are interconnected and how they can jointly affect organizational agility in the context of personnel management.

During the research, sociodemographic data were obtained on the surveyed enterprises. Among the dominant types of activity, the largest percentage, as much as 65.1%, were service enterprises, while 25.6% of companies were engaged in trade activities and only 9.3% were engaged in production activities. In terms of the number of employees, the largest group (23.1%) were enterprises employing from 0 to 9 people. Companies employing from 10 to 49 people accounted for 20.5%, while enterprises with the number of employees from 50 to

249 people accounted for 15.7%. Enterprises employing from 250 to 999 people accounted for 21.8%, and those employing 1000 or more people – 18.9%.

In terms of scope of operations, the largest percentage of companies, 36.2%, operated internationally. Domestic companies accounted for 30.4%, while 21.5% of companies operated locally. Regional scope covered 11.9% of surveyed companies. In terms of education level, 57.1% of respondents had a university degree, 9.3% had a higher vocational education, and 33.7% had completed secondary school. In terms of age, the largest group, 48.4%, were respondents aged 20 to 30. Those aged 31 to 40 accounted for 12.8%, and 21.2% were those aged 41 to 50. Those aged 51 to 60 accounted for 10.9% of respondents, and the oldest group, over 60, comprised 6.7% of respondents.

1.5. Presentation of Research Findings

The research aimed to investigate the determinants of organizational agility in the management of the organization's personnel by analyzing various aspects of the functioning of the organizational structure. The table presents the respondents' answers divided into five categories: "Definitely not", "I don't think so", "I have no opinion", "I guess so", "Definitely yes", regarding seven different determinants.

The first determinant was flexible structure, where 57 respondents answered "Definitely not", 46 stated "I don't think so", 115 expressed no opinion, 71 chose the option "I guess so", and 23 people strongly confirmed this feature. The lack of hierarchy was assessed as follows: 109 respondents disagreed with the statement, 69 expressed slight disapproval, 57 had no opinion, 54 stated "I guess so", and 23 people strongly supported this determinant. In the case of lack of decision-making supremacy, 59 people strongly disagreed, 65 had slight doubts, 67 people had no opinion, 91 chose the answer "I guess so", and 30 people strongly supported this aspect.

Equality in mutual relations was assessed as follows: 69 respondents expressed strong disagreement, 65 had slight reservations, 55 people had no opinion, 89 people agreed partially, and 34 strongly supported this determinant. Knowledge of tasks and assigned responsibilities was assessed by 58 people as "Definitely not", 79 respondents expressed slight doubts, 57 people had no opinion, 97 answered "I guess so", and 21 people expressed strong support. Co-decision-making received answers in the range of: 62 people strongly disagreed, 77 had doubts, 59 had no opinion, 84 chose the option "I guess so", and 30 respondents strongly supported this determinant.

The last determinant, i.e. the real influence of employees on the development of the enterprise, was met with the following responses: 63 people expressed strong disapproval, 73 had doubts, 50 respondents had no opinion, 83 people partially agreed, and 43 people strongly supported this feature.

Table 1.*Determinants of organizational agility in the area of personnel management*

	Definitely not	I don't think so	I have no opinion	I guess so	Definitely yes
Flexible structure (1)	57	46	115	71	23
No hierarchy (2)	109	69	57	54	23
Lack of decision-making superiority (3)	59	65	67	91	30
Equality in mutual relations (4)	69	65	55	89	34
Knowledge of tasks and assigned responsibilities (5)	58	79	57	97	21
Co-decision (6)	62	77	59	84	30
The real impact of employees on the development of the enterprise (7)	63	73	50	83	43

Source: Own study based on research.

Table 2 presents the correlations between the seven determinants of organizational agility in HR management, which are presented in Table 1. The correlation values indicate the strength of the relationships between individual variables, which can help in understanding the interrelationships between the determinants. A correlation value close to 1 indicates a strong relationship, while a value close to 0 suggests no significant relationship.

Table 2.*Correlation Table*

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
1	1						
2	0.19	1					
3	0.58	0.32	1				
4	0.31	0.50	0.92	1			
5	0.35	0.36	0.95	0.93	1		
6	0.36	0.45	0.92	0.92	0.99	1	
7	0.05	0.37	0.83	0.92	0.94	0.93	1

Source: Own study based on research.

In the correlation analysis, it can be seen that the lack of decision-making superiority (variable 3) is strongly related to other determinants, especially equality in mutual relations (variable 4), knowledge of tasks and assigned responsibilities (variable 5), co-decision-making (variable 6) and the real influence of employees on the development of the enterprise (variable 7). The correlations in these cases range from 0.83 to 0.99, which indicates that these aspects may be strongly interdependent. Equality in mutual relations (variable 4) and knowledge of tasks and responsibilities (variable 5) are also strongly related (0.93), which suggests that greater equality in relations may be associated with better knowledge of the assigned tasks. Co-decision-making (variable 6) also shows a very high correlation with these determinants, which indicates a strong relationship between these elements.

Flexible structure (variable 1) seems to be less related to other determinants, except for the lack of decision-making supremacy, where the correlation is .58. The lack of hierarchy (variable 2) has the strongest associations with equality in relationships (.50) and co-decision-making (.45), but is generally less correlated with other variables than the determinants related to decision-making and relationships. The correlation between the determinants presented in

Table 2 indicates significant links between different aspects of organizational agility, especially in the areas of decision-making, cooperation and equality in employee relations.

2. Discussion

The conducted research indicates significant relationships between various determinants of organizational agility in personnel management, which allows for a better understanding of how these factors can jointly affect the effectiveness of the organization. Particular attention is drawn to the strong correlation between the lack of decision-making supremacy and other aspects, such as equality in mutual relations, knowledge of tasks and assigned responsibilities, co-decision-making and the real impact of employees on the development of the enterprise. These relationships suggest that in organizations where decision-making supremacy is limited, greater emphasis is placed on employee participation, which in turn can lead to more harmonious relationships in the team and higher awareness of tasks and responsibilities.

Equality in relationships and knowledge of tasks also show a strong correlation, suggesting that where relationships between employees are based on greater equality, understanding of individual roles and responsibilities in the organization increases. Co-determination, as an element of organizational agility, seems to be crucial for creating conditions in which employees can express their opinions and influence decisions, which increases the sense of responsibility for the development of the organization.

Flexibility of organizational structure, although indicated in the research as an important determinant, does not seem to be so strongly related to other factors, which may suggest that structural flexibility alone is not enough to build an agile organization if it is not accompanied by an appropriate level of co-decision-making and balance in relationships. The lack of hierarchy, although important in the context of decision-making, seems to be of less importance for organizational agility than other determinants, especially those related to relationships and cooperation.

Research shows that organizational agility is not the result of individual factors, but rather the synergy of many elements that interact with each other. The key factors seem to be the relationships between employees, their participation in decision-making processes and the transparency of tasks and responsibilities. Organizations that want to develop their agility should pay special attention to these aspects, striving to limit decision-making superiority, promote co-decision-making and build equal relationships among employees. These factors complement and support each other, which can lead to increased efficiency and flexibility of the organization in the face of dynamic market changes.

In conclusion, the research results indicate that organizational agility is strongly related to an organizational culture in which there is a balance in relationships, clearly defined tasks and

employee involvement in decision-making processes. These correlations emphasize how important it is to take into account all these aspects when striving to improve the agility of the organization.

Based on the research results, it is possible to recommend that companies take several key actions to increase organizational agility. First of all, it is worth striving to limit decision-making superiority, which can strengthen employee involvement in decision-making processes and improve their sense of responsibility for the development of the organization. Co-decision-making and greater employee influence on strategic decisions should become the foundation of organizational culture, which will contribute to more balanced relationships in teams.

It is equally important to build equality in employee relations. Supporting open communication and partnerships between employees at different levels of the organization not only promotes a harmonious work environment, but also increases efficiency through better understanding of roles and tasks. Transparency in the scope of tasks and responsibilities, as well as shared goals, can lead to greater motivation and better management of human resources. Flexibility of the organizational structure should be supported, but not as the only factor increasing the agility of the organization. The introduction of flexible frameworks of activities must go hand in hand with improving co-decision processes and strengthening relationships between employees. Without appropriate mechanisms for engaging the team, structural flexibility alone may not bring the expected results.

Organizational culture should be built on the principle of synergy of these elements that complement each other: equality, participation, clear structure of tasks and responsibilities. Companies should also regularly analyze relations between employees and their involvement in decision-making processes in order to constantly adjust management strategies to the needs of the organization in the face of dynamic changes on the market. Such a model will allow companies to be more flexible, effective and better prepared for changing external conditions.

Based on these considerations, an original model of personnel management practices in an agile organization was constructed (see Fig. 1). Based on these considerations, an original model of personnel management practices in an agile organization was constructed. This model includes several key elements that are intended to increase the flexibility and effectiveness of the organization. Limiting decision-making supremacy as the first element allows for increased employee involvement in decision-making processes. Another aspect is co-decision-making, which assumes a greater influence of employees on strategic decisions and is the foundation of organizational culture.

Balanced relationships in teams are key to building trust and partnerships between employees at different levels of the organization. Another important factor is the transparency of tasks and responsibilities, which supports open communication and clarity of roles. A flexible organizational structure should be supported by co-decision processes and strengthening relationships between employees, which promotes the synergy of equality, participation and a clear structure of tasks and responsibilities. Regular analysis of employee

relations and involvement in decision-making processes allows the organization to continuously adapt management strategies to changing market conditions, increasing flexibility and efficiency.

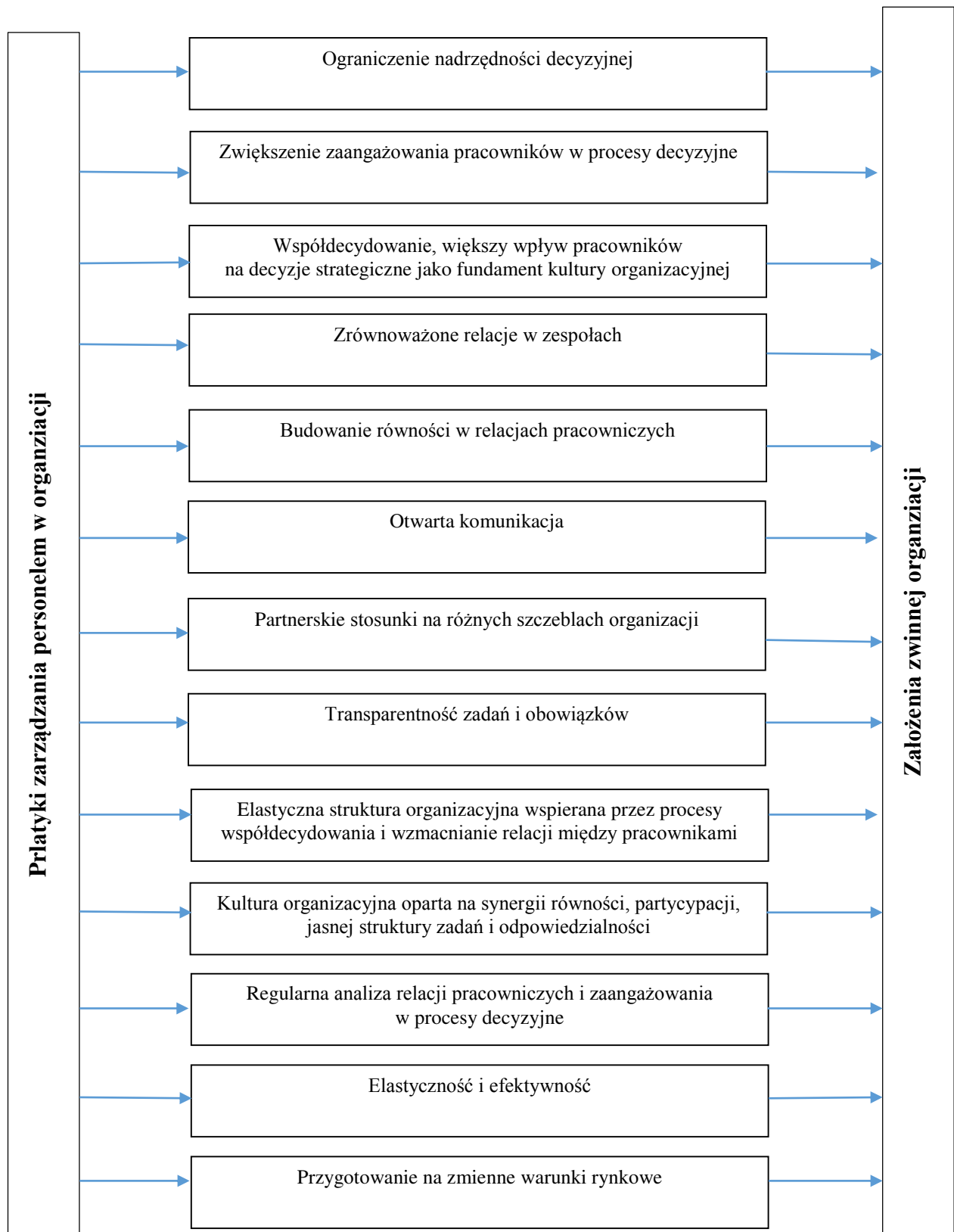


Figure 1. Personnel management practices in an agile organization.
Source: Own study.

The utilitarian value of the proposed model lies in its ability to increase the effectiveness of the organization by introducing more flexible and sustainable personnel management practices. This model enables better employee involvement in decision-making processes, which not only increases their motivation and sense of responsibility, but also leads to more accurate and innovative decisions. Thanks to transparency and partnership relations between employees at different organizational levels, it is possible to create an environment conducive to open communication, which translates into higher operational efficiency. Additionally, a flexible organizational structure supported by co-decision-making allows for faster adaptation to changing market conditions, which increases the company's competitiveness. Regular analysis of employee relations and their involvement in decisions ensures that the organization can dynamically respond to internal and external changes, which promotes its long-term development and stability. This model is therefore a practical tool that can be implemented in various types of organizations, adapting them to contemporary market requirements and strengthening their ability to adapt and innovate.

3. Conclusions

The research results presented in the article can be compared with the results of other authors dealing with the topic of organizational agility. In the study of the authors of this article, it was identified that the key determinants of organizational agility are flexibility of the structure, lack of hierarchy and employee co-decision. These results are consistent with the analyses conducted by Gao, Zhang, Gong and Li (2020), who found that technical IT capabilities have a significant impact on increasing organizational agility, especially in the context of decentralization of decision-making processes, which affects the better adaptation of the organization to changes. Similar conclusions can be found in the research of Chen and Siau (2020), where it was emphasized that IT infrastructure, combined with business analysis, supports organizational agility, facilitating decision-making at various levels of the organizational structure.

The research results on the impact of co-decision-making on organizational effectiveness are confirmed by Joiner's research (2019), which indicates that leadership agility, including broad employee involvement in decision-making processes, is crucial for achieving success in dynamic market conditions. The authors of this article emphasize that co-decision-making and equality in employee relations promote greater organizational flexibility, which is also reflected in the works of He and Harris (2021), who indicate the positive impact of organizational agility on crisis management and financial results of enterprises.

At the same time, it is worth noting that research on organizational agility conducted by Mrugalska and Ahmed (2021) also confirms the importance of modern technologies in increasing agility. The article indicates a correlation between reducing hierarchy and organizational effectiveness, which is consistent with the results of Fiddler's (2017) research, who emphasized that smaller hierarchical structures facilitate faster information flow and decision-making.

Based on these comparisons, it can be stated that the research results of the authors of the article are consistent with the findings of other researchers, which strengthens the thesis that organizational agility based on a flexible structure, equality in relations and employee co-decision-making plays a key role in effective organizational management.

Future research directions may focus on deepening the analysis of individual determinants of organizational agility, especially in the context of different industries and sectors. It is worth examining how these determinants function in organizations with different structures, sizes, or forms of ownership, which can provide a broader picture and allow for better adjustment of recommendations to specific conditions. Research can also cover the long-term effects of introducing agile HR strategies to assess their lasting impact on the efficiency, innovation, and adaptability of companies. Another interesting area may be the analysis of the impact of digitalization and new technologies on organizational agility, especially in the context of managing remote or hybrid employees. Examining how new communication tools and management systems affect co-decision-making, structural flexibility, and relationships in the organization can provide valuable information for companies that want to remain agile in an increasingly digital work environment.

Another direction could be the analysis of cross-cultural differences in organizational agility. Research could focus on comparing how different organizational cultures affect the implementation of agile practices, especially in international corporations. Finally, it is also worth considering research on the impact of external factors, such as economic changes or market crises, on organizational agility to better understand how organizations can adapt to dynamically changing conditions.

The limitations of the research result primarily from the nature of the research method used and the specificity of the research sample. The survey, although it provided valuable data, was based on the subjective opinions of respondents, which may result in some ambiguity of the results. The survey was conducted among 312 respondents, which is a representative sample, but the limited number of surveyed companies may not reflect the full picture of the functioning of organizations in various sectors of the economy. The study also included specific types of activities, such as service, trade and manufacturing companies, which may limit the possibility of generalizing the results to other sectors, especially those with more complex structures.

Another limitation is the time of the research, which was conducted in a relatively short period (April-June 2024). This time limitation could have affected variability of results, especially in the context of dynamic changes in the market and organizations. The research could provide a broader picture if it were conducted over a longer period, which would allow for a better understanding of long-term trends.

Moreover, focusing mainly on correlations between selected determinants of organizational agility does not allow for a full examination of the causal relationships between them. Correlations only show the strength of the relationships, not providing clear answers as to how individual determinants influence each other. Further research should consider more complex analyses, such as causal models, which could provide a more complete picture of the interactions between determinants of organizational agility.

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EMPLOYEE ENGAGEMENT IN DECISION-MAKING PROCESSES IN AN AGILE ORGANIZATION

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Purpose: The purpose of this article is to analyze employee engagement in decision-making processes in agile organizations and to examine how this engagement affects organizational effectiveness and building competitive advantage. The focus is on identifying key elements of agile employee engagement in various sectors of the economy.

Design/methodology/approach: The research was conducted in the form of a survey on a sample of 303 respondents who assessed various aspects of employee engagement in decision-making processes. The collected data was subjected to quantitative analysis, including correlation analysis, to examine the links between individual elements of engagement and organizational agility.

Findings: Research has confirmed that a high level of employee engagement in decision-making processes significantly affects organizational effectiveness and the ability to adapt in a changing market environment. Key aspects such as consulting strategic changes and supporting employee initiatives are of significant importance for building organizational agility.

Research limitations/implications: The study is limited by its geographical scope and the industry specificity of the respondents, which may affect the generality of the results. In addition, the self-assessment method may introduce subjective distortions in the responses.

Practical implications: The study results can be used by managers to create strategies that increase employee involvement in decision-making processes, which contributes to improving the efficiency and flexibility of the organization.

Social implications: Employee involvement in organizational decisions can improve their job satisfaction, increase motivation and loyalty, which translates into a positive impact on work culture and relationships within the organization.

Originality/value: The article adds value by providing an in-depth analysis of key aspects of organizational agility and employee engagement, providing managers with practical guidance on how to implement agile management strategies to achieve competitive advantage.

Keywords: agile organization, decision-making processes, employees, enterprise, competitive advantage.

Category of the paper: research paper.

1. Introduction

Modern organizations operate in a dynamically changing environment that requires constant adaptation to new market, technological and social conditions. The ability to respond quickly to changes and effectively manage resources has become a key factor determining the success of an organization. In this context, organizational agility, the essence of which is flexibility and the ability to adapt to unpredictable challenges, is playing an increasingly important role (Prieto, Talukder, 2023). Contemporary research indicates that one of the key elements of organizational agility is the active involvement of employees in decision-making processes. Employees who have an impact on decisions regarding strategy, operations and innovation contribute to increasing the effectiveness of the organization and its ability to adapt (Kt, Sivasubramanian, 2023).

The issue of employee engagement in decision-making processes in the context of organizational agility is becoming increasingly important, especially in the face of growing competition and rapidly changing technologies. Despite the growing interest in this topic, there is still a need for in-depth analysis of how different forms of employee engagement affect the functioning of the organization. Examining these relationships can provide valuable tips for managers on how to effectively engage employees and use their potential to build a competitive advantage.

Undertaking to investigate this problem is justified also from a theoretical point of view, because the literature lacks comprehensive analyses that link organizational agility with employee engagement in decision-making processes. Therefore, the article aims to fill this gap by analyzing how employee engagement affects organizational agility and which elements of this engagement are most important for the operational and adaptive effectiveness of enterprises.

2. Literature Review

2.1. Principles and foundations of organizational agility

Organizational agility is based on flexibility, speed of adaptation and the ability of the organization to effectively respond to changes in the environment. Modern organizations, in order to cope with dynamic market conditions, must integrate these features in their structures and processes. Agility does not only mean speed of action, but also the ability to introduce changes in a thoughtful way, with minimal impact on organizational stability (Awasthi, Awasthi, 2023).

The foundation of agility is the ability of an organization to quickly identify and respond to changing market needs, customer preferences, and technological innovations. Open communication channels play a key role here, enabling rapid information transfer and decision-making based on current data. In an agile organization, decision-making is decentralized, allowing teams to operate independently and efficiently without the need for lengthy approval processes (Yang, Liu, 2012). Another important element of agility is the ability to learn and continuously improve. Organizations must be open to testing new solutions, implementing innovations, and quickly modifying strategies when the business environment changes. The learning process is based on the analysis of both successes and failures, which allows for continuous improvement of processes and adaptation to new challenges (Sajdak, 2021).

Organizational agility also assumes the flexibility of internal structures. Traditional hierarchical structures often turn out to be too rigid to effectively respond to changing conditions (Routledge, 2020). Agile organizations are dominated by flat structures that facilitate rapid communication and shorten the distance between employees and management. Teams are autonomous and interdisciplinary, which allows for efficient problem solving and project implementation in a short time (Kurnia, Chien, 2020).

Ultimately, organizational agility also requires an appropriate organizational culture based on openness to change, trust, and cooperation (Kocot, Kwasek, 2022). Employees must be prepared to work in conditions of constant change and uncertainty, which requires a supportive work environment in which employee innovation and initiatives are appreciated. The organizational culture should support knowledge sharing and openness to ideas that can contribute to improving the company's operations (Skyrius, Valentukevič, 2020).

These elements create a coherent whole in which organizational agility becomes not only a set of management techniques, but also a philosophy of operation, enabling organizations to function effectively in a changing and unpredictable market environment.

2.2. The Role of Employee Engagement in Creating Competitive Advantage

Employee engagement plays a key role in creating an organization's competitive advantage, as employees are the main driver of innovation, service quality, and operational efficiency. Organizations that can effectively engage their employees benefit from their knowledge, skills, and creativity, which translates into better market results (Chen, Siau, 2020). Employee engagement helps build a stronger organizational culture in which individuals feel responsible for the success of the entire company, which in turn leads to increased loyalty and motivation to work towards common goals (Rut, Meyer, Andrzejczyk, 2022).

A key element of competitive advantage resulting from employee engagement is their ability to respond quickly to changes in the market environment. Employees who feel part of the organization and have a real impact on decision-making processes are more likely to take initiatives that can improve operational efficiency or introduce new, innovative solutions

(Mycka, 2023). As a result, organizations become more flexible and able to adapt to changing market conditions, which gives them an advantage over competitors who operate in a more static and rigid way (Luo, Ren, Cao, Hong, 2020).

Employee engagement also increases the quality of services and products offered by the organization. Employees who are appropriately motivated and identified with the values of the organization attach greater importance to the quality of the work performed, which translates into better customer service and higher quality of final products. High quality of services and products is often a factor determining competitive advantage, especially in markets where customers have a wide range of offers to choose from (Bukowska, 2023). Organizations that are able to build and maintain employee engagement gain the ability to constantly provide added value to their customers, which allows them to stand out from the competition (Rahimi, Mansouri, 2019).

Another aspect of competitive advantage resulting from employee engagement is the ability to innovate internally. Engaged employees who feel valued and see meaning in their work are more open to introducing new ideas, testing new solutions, and taking risks that can lead to breakthrough innovations (Erdil, 2014). Organizations that support such attitudes gain access to the constantly evolving knowledge and ideas of their employees, which can be a significant competitive advantage, especially in industries where the pace of innovation determines the survival of the company (Ramadhana, 2021).

Employee engagement also contributes to increased organizational effectiveness. When employees are actively involved in decision-making processes and share responsibility for the company's results, they become more focused on achieving organizational goals and efficiently using resources (Alshehhi, Nobanee, Khare, 2018). As a result, organizations can better optimize their processes, reduce operating costs, and increase productivity (Adamik, 2019). High operational efficiency, which is the result of employee engagement, gives companies a competitive advantage in the form of a better profit margin and the ability to complete projects faster (Kordecki, 2023).

Finally, employee engagement influences the building of long-term relationships with customers (Cappelli, Tavis, 2018). Employees who are strongly attached to the organization become its brand ambassadors, which affects the positive image of the company on the market (Fiddler, 2017). Better communication with customers, attention to their needs, and willingness to take additional actions on their behalf lead to increased customer trust and loyalty (Attar, Almusharraf, Alfawaz, Hajli, 2022). Organizations that are able to engage their employees at the operational and emotional level gain a stronger market position because they are able to build more lasting and beneficial relationships with customers, which in the long term translates into a competitive advantage (He, Harris, 2021).

In conclusion, employee engagement is one of the most important factors influencing the competitive advantage of an organization. The ability of an organization to build engagement at various operational levels translates into better efficiency, higher quality products and services, greater innovation and better relationships with customers. As a result, organizations that effectively engage their employees are more competitive on the market and have a better chance of long-term success.

2.3. Employee engagement in decision-making processes as a key element of an agile organization

Employee involvement in decision-making processes is a fundamental element of an agile organization, as it promotes the culture of open communication, cooperation, and adaptation to dynamically changing market conditions. An agile organization cannot function effectively without the active participation of its employees in making key decisions. Therefore, the role of employees in shaping decisions at various organizational levels becomes an indispensable element of the effective operation of agile structures (Jurczak, Konecka, Łupicka-Fietz, Pawlicka, 2024).

Consulting strategic changes with employees strengthens their commitment, giving them a sense of shared responsibility for the development of the organization. Regular communication about the company's strategy allows employees to better understand long-term goals and influences their motivation to act in a manner consistent with these goals (Ciszewski, 2023). When an organization engages employees in strategic decisions, it increases their sense of belonging to the company, which naturally translates into their loyalty and a higher level of involvement in everyday tasks. Such a model of operation of an agile organization allows for quick response to changing market conditions, as well as better adaptation to new challenges (Joiner, 2019).

An equally important element is encouraging employees to share ideas for improving processes (Chen, Li, 2021). Employees who feel that their opinions and ideas are valuable are more likely to actively participate in the life of the organization. In agile organizations, it is particularly valuable to create a space where every employee can submit their ideas, which leads to increased innovation and efficiency. An open culture of communication favors the generation of new solutions that can bring the organization a competitive advantage (Brown, Jones, 2018). The greater the involvement of employees in the creation and optimization of processes, the more the organization gains in flexibility and adaptability (Seifollahi, Shirazian, 2021).

The ability of employees to influence decisions concerning their teams is crucial for the operational effectiveness of agile organizations. Decentralization of the decision-making process, which is typical of agile structures, enables faster decision-making at the operational level (Bray et al., 2019). Thanks to this, employees can adapt the activities of the teams to changing market conditions, which increases their effectiveness. Autonomy in decision-making

also promotes greater engagement, because employees feel that their opinions are taken into account and have a real impact on the way they work. This leads to greater motivation and responsibility for the results of the teams, which in turn improves the effectiveness of the entire organization (Sedej, Justinek, 2021).

Regular feedback meetings are an important element of the decision-making process in agile organizations. The exchange of feedback allows employees to monitor progress on an ongoing basis, identify areas for improvement, and adapt activities to new conditions (Jones, Adam, 2023). Feedback meetings also promote transparency in decision-making, which builds trust between employees and management. In agile organizations, regular meetings of this type not only help to coordinate activities, but also stimulate a culture of continuous improvement. Employees who regularly receive feedback on their work are more engaged in the process of improving their own skills and in the development of the organization (Felipe, Leander, Roldan, Leal-Rodriguez, 2020).

The last but not least element is the provision of tools and support for employee initiatives by the organization. Agile organizations that invest in the development of their employees not only increase their efficiency, but also enable them to implement their own initiatives (Borowski, 2021). Employees who have access to the right tools and support are able to implement their ideas more effectively and implement innovations that can contribute to the development of the company. Supporting employee initiatives also helps build a culture of innovation, in which employees are motivated to take actions that go beyond their daily duties (Sherehiy, Karwowski, 2017).

In summary, employee engagement in decision-making processes is a key element of an agile organization. Employees who are actively involved in shaping decisions at various levels of the organization contribute to its greater flexibility, innovation, and efficiency. By decentralizing the decision-making process and creating an open environment conducive to sharing ideas, agile organizations are better able to adapt to changing market conditions, which is a significant competitive advantage.

2.4. Research Methodology

The aim of the article was to assess employee engagement in decision-making processes in an agile organization and to examine the extent to which this engagement affects organizational effectiveness and building competitive advantage. The focus was on analyzing various aspects of this engagement, such as consulting strategic changes, encouraging the sharing of ideas, the possibility of employees to influence decisions in their teams, organizing regular feedback meetings, and providing tools and support for employee initiatives.

The research hypothesis was that organizations that engage employees more in decision-making processes achieve higher levels of agility and better market performance. Therefore, the research question was whether there is a clear correlation between the level of employee engagement and the organization's performance in terms of efficiency and

adaptability. Other research questions concerned which aspects of engagement have the greatest impact on organizational agility and how differences in engagement can affect employees' perceptions of strategic changes.

The study was conducted quantitatively, using a survey addressed to 303 respondents. The survey was conducted in April and May 2023, and its purpose was to collect data on various aspects of employee engagement in decision-making processes in agile organizations. The responses were assessed on a five-point Likert scale, which allowed for an accurate estimation of the degree of employee engagement in individual decision-making areas and for an analysis of the relationship between this engagement and the effectiveness of the organization.

During the study, sociodemographic data were obtained. During the study, sociodemographic data were collected. The study participants were dominated by men, who made up 58.7 % of the respondents, while women made up 41.3% of the study group. The largest age group was respondents under 25 (47.2%), while people aged 26-35 made up 30.4%, and 19.5% of the participants were in the age group of 36-45. People over 45 made up only 3% of the respondents.

In terms of position held, employees predominated (57.4 %), followed by middle managers (25.2%). This was followed by low-level managers (11.1 %) and top management (6.4%). In terms of seniority, 47.7% of respondents declared professional experience of up to 5 years, 33.4% had seniority of 6 to 10 years, and the rest of the group had more professional experience. The respondents came from companies of various sizes and with various seniority on the market, with a predominance of small enterprises (37.5 %) and microenterprises (26.4%).

The majority of survey participants came from the retail sector (54.8 %), with smaller groups representing other industries such as education and automotive. The companies in which respondents worked operated mainly at regional and national levels.

2.5. Presentation of Research Findings

The research was aimed at assessing employee engagement in decision-making processes in an agile organization. The study involved 303 respondents who answered questions about various aspects of engagement in decision-making processes (Table 1). The research provided a detailed picture of the perception of various aspects of employee engagement in decision-making processes in an agile organization, while also showing differences in opinions on individual organizational activities.

The first question concerned regular consultations between the organization and employees on strategic changes. 92 respondents answered "YES" strongly, and 119 rather agreed with this statement. On the other hand, 56 people had no opinion on this subject, while 29 answered "Rather NO" and 7 "Definitely NO". This indicates a relatively high level of involvement of the organization in strategic consultations with employees, although a certain group of people remains undecided or dissatisfied with these activities.

The next question was about encouraging employees to share ideas for improving processes. Here, 114 respondents answered "Definitely YES" and 113 "Somewhat YES", suggesting strong support for such an initiative from the organization. A smaller group, 44 people, had no opinion, and 22 respondents thought that the organization does not encourage sharing ideas. Only 10 people answered that the organization does not definitely support such activities.

The third question concerned the influence of employees on decisions concerning their teams. The answer "Definitely YES" was selected by 103 respondents, and "Rather YES" by 122, which suggests that most employees feel they have an influence on team decisions. However, 41 people had no opinion and 31 thought they did not have such an influence. A small group, 6 people, answered "Definitely NO".

The fourth question concerned the organization's regular feedback meetings. To this question, 109 people answered "Definitely YES" and 110 "Rather YES", which indicates a generally positive perception of these meetings. However, 52 people were undecided, 24 considered that such meetings are rather not organized, and 8 people answered "Definitely NO".

The last question concerned the organization's provision of tools and support for employee initiatives. 102 respondents responded strongly positively, and 117 rather agreed with this statement. 48 people had no opinion, while 27 believed that the organization rather does not provide appropriate tools and support. Only 9 respondents were definitely "NO".

Table 1.

Employee involvement in decision-making processes in an agile organization, N = 303

	Definitely NOT	Rather not	I don't have an opinion	Rather YES	Definitely YES
The organization regularly consults with employees on strategic changes (1)	7	29	56	119	92
Organization encourages sharing of ideas for process improvement (2)	10	22	44	113	114
Employees have a say in decision-making for their teams (3)	6	31	41	122	103
The organization organizes regular feedback meetings (4)	8	24	52	110	109
Organization provides tools and support for employee initiatives (5)	9	27	48	117	102

Source: Own study based on research.

Table 2 presents a correlation matrix between the variables described in Table 1 related to employee engagement in decision-making processes in an agile organization. The correlations are very high, suggesting strong links between the different aspects of engagement.

The correlation value between all variables ranges from 0.96 to 0.99, which indicates almost perfect correlations. For example, the correlation between encouraging the sharing of ideas for improving processes (variable 2) and organizing regular feedback meetings (variable 4) is 0.99. This means that organizations that organize feedback meetings frequently also tend to strongly encourage employees to share ideas for improvement. Similarly, the high correlation

of 0.99 between the variables related to providing tools and support for employee initiatives (variable 5) and the other variables indicates that organizations that offer support are also more likely to involve employees in other areas of decision-making.

The strongest correlation, 0.99, is between variable 5 and the other variables, suggesting that providing tools and support for employee initiatives is closely linked to other aspects of employee engagement. A high correlation between all variables may suggest that the organization's employee engagement efforts are consistent and complementary.

Table 2.

Correlations table, N = 303

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1	1				
2	0.96	1			
3	0.98	0.98	1		
4	0.97	0.99	0.98	1	
5	0.99	0.99	0.99	0.99	1

Source: Own study based on research.

The analysis of the correlation table in the context of the employee engagement table indicates that organizations that engage employees more in decision-making processes also perform better in other activities that support organizational agility. High correlations between these variables may suggest that improving one aspect of engagement can lead to strengthening other areas, which in turn can contribute to building an organization's competitive advantage.

3. Discussion

The presented research allows us to formulate several important conclusions regarding employee engagement in decision-making processes in an agile organization and the interrelationships between various aspects of this engagement.

First, the high level of agreement among respondents in Table 1 suggests that most employees positively evaluate the organization's involvement in decision-making processes, such as regular consultations on strategic changes, encouraging the sharing of ideas, as well as organizing feedback meetings and providing tools for employee initiatives. A significant number of respondents agreed that organizations undertake these activities, which indicates their role in building an environment conducive to collaboration and innovation.

Second, the analysis of correlations between individual variables, as shown in Table 2, indicates strong links between different aspects of employee engagement. Very high correlation values (from 0.96 to 0.99) suggest that the individual organizational engagement activities are closely related. For example, organizations that regularly consult with employees on strategic changes are also likely to encourage the sharing of ideas and organize regular feedback meetings.

Third, the .99 correlation between the variable on providing tools and support for employee initiatives and the other variables suggests that providing appropriate resources is a key element in supporting organizational agility. This means that organizations that invest in tools and support are more likely to effectively engage employees in other aspects of decision-making processes, which can lead to higher efficiency and better adaptation to market changes.

Finally, it can be concluded that high coherence of organizational actions in the field of employee engagement is conducive to building an organizational culture based on trust, cooperation and innovation. Since the correlations between all variables are close to one, this indicates a synergistic effect of these actions, where improving one aspect can strengthen others. In practice, this means that organizations that consistently engage employees in decision-making processes create conditions conducive to agility, which can be a significant competitive advantage in a dynamically changing market.

In summary, research clearly shows that agile organizations that comprehensively engage their employees can adapt to change more effectively and better respond to market needs, which can lead to sustainable business success in the long run.

Based on the research conducted, several key conclusions and recommendations can be formulated for agile organizations that want to effectively engage their employees in decision-making processes and build a sustainable competitive advantage. First, agile organizations should regularly consult strategic changes with employees. Research indicates that such activities are highly valued by employees and can significantly affect their commitment and loyalty to the organization. Regular consultations also help build trust and a sense of shared responsibility for the development of the company.

Second, it is crucial to encourage employees to share ideas for improving processes. Organizations that actively promote a culture of open communication and innovation can count on higher levels of creativity and engagement. Employees who feel that their ideas are valued and implemented are more likely to engage in the development of the company.

Third, organizations should enable employees to have a real say in decisions about their teams. The high correlation between this variable and other dimensions of engagement suggests that employees who have the opportunity to influence decisions are more motivated and committed to the organization. Creating space for independent decision-making can also promote faster adaptation to changing market conditions.

Fourth, organizing regular feedback meetings is a key element of an agile organization. Such meetings not only allow for ongoing monitoring of progress, but also provide a platform for open communication and exchange of ideas. Regular feedback is essential for continuous improvement of processes and building strong relationships within teams.

Ultimately, agile organizations must provide tools and support for employee initiatives. Research shows that access to the right resources is closely linked to other aspects of engagement. Organizations that invest in the development of their employees and provide them

with the necessary tools create an environment conducive to innovation and adaptation, which is crucial to achieving success in a rapidly changing market.

In summary, agile organizations should strive for comprehensive employee engagement at all levels. Integration of the above recommendations can lead to higher operational efficiency, better adaptation to market changes, and a stronger competitive position. Employees who feel engaged and supported by the organization are more motivated to act, which in turn translates into the success of the entire company. Based on the considerations below, a model of agile decision-making engagement is proposed (see Figure 1).

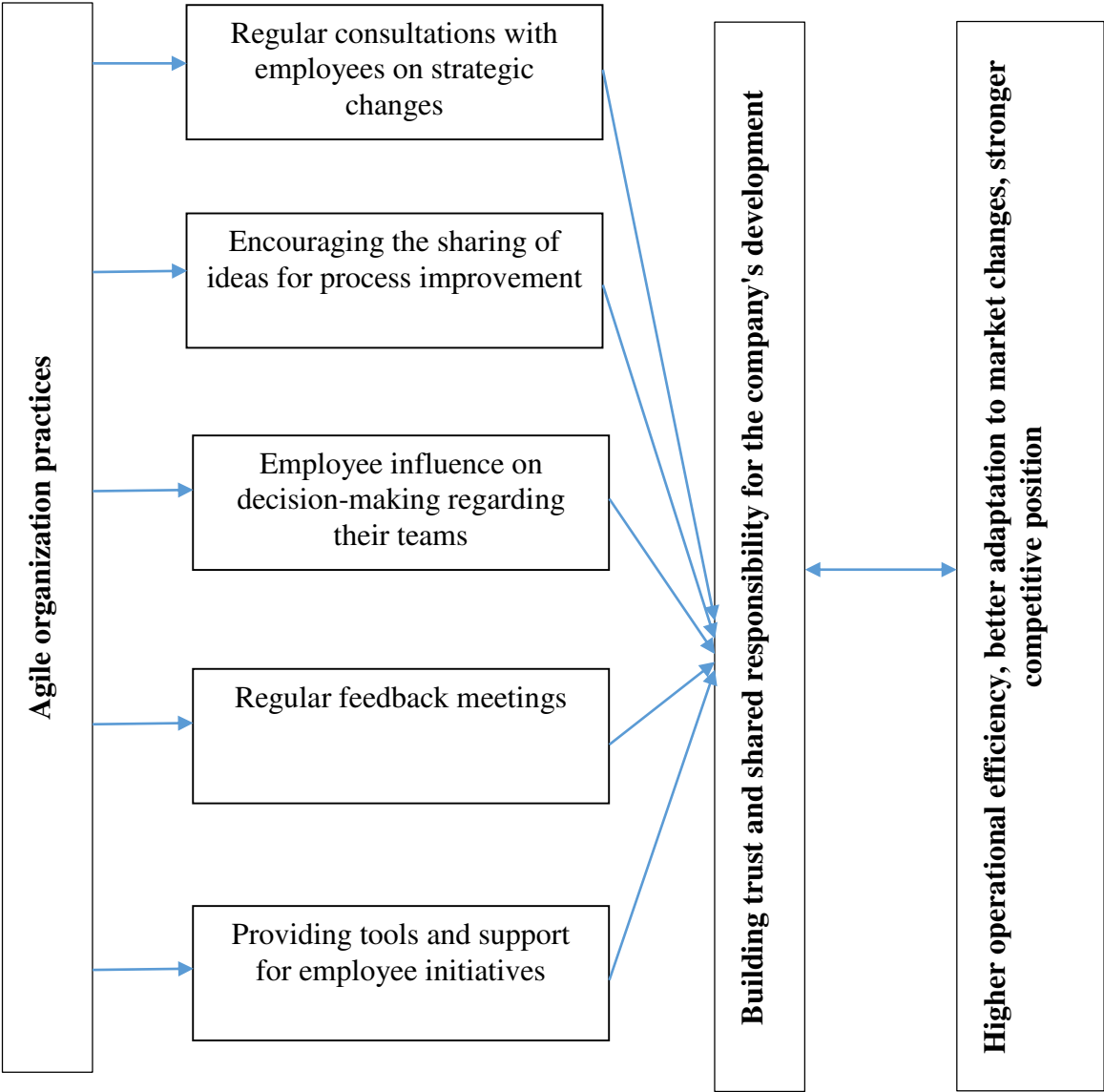


Figure 1. Agile decision-making engagement model.

Source: Own study.

It shows how individual elements work together to support the agility of the organization, while at the same time influencing the development of competitive advantage. The model illustrates that the key to an agile organization are: regular consultation of strategic changes with employees, encouraging the sharing of ideas for improving processes, the influence of

employees on making team decisions, organizing feedback meetings and providing tools and support for employee initiatives. These elements create a coherent system in which a high level of employee engagement contributes to greater flexibility and adaptability of the organization, which in the long term allows it to function more effectively in a dynamically changing market. The model also visualizes the interconnections between the individual components of employee engagement, which allows for a better understanding of the mechanisms that lead to achieving organizational agility and improving operational efficiency.

It is worth mentioning that the conducted research encountered certain limitations. They result from several key factors. First of all, the research was conducted on a sample of 303 respondents, which may not fully reflect the diversity in the approach to employee involvement in decision-making processes across industries and regions. It is worth noting that the dominance of respondents from the retail sector may have influenced the results, which are not necessarily representative of other sectors of the economy, such as industry or public services.

Another limitation of the study is its geographical scope. The respondents came mainly from companies operating at the regional and national level, which may limit conclusions about global organizations or companies operating in international markets. The specificity of local markets may affect the results, so they may not be fully applicable to organizations operating in more diverse cultural and economic contexts. Another limitation is the research method, which was based on a survey and employee self-assessment. This type of research is prone to subjective respondents, which may lead to some distortions or inaccuracies of the results. Employee self-assessments may not always reflect the actual decision-making processes in organizations, which limits the objectivity and precision of the conclusions.

In addition, the research was cross-sectional, meaning that data was collected at one point in time—in April and May 2023. This type of study does not allow for the analysis of the long-term effects of employee engagement in decision-making processes or for understanding the changes that may occur in organizations as a result of dynamic market conditions. Another limitation may be the focus on specific aspects of engagement, such as consulting on strategic changes or organizing feedback meetings, which may ignore other important factors influencing employee engagement, such as leadership style or organizational culture. Further research could consider a broader range of factors that affect employee engagement in decision-making processes.

4. Conclusions

The presented studies have shown a strong correlation between employee engagement in decision-making processes and the operational effectiveness of the organization. Agile organizations that regularly engage employees achieve higher levels of flexibility and innovation. These results are consistent with the research of Bray et al. (2019), who also emphasize that organizations characterized by a high level of adaptability and employee engagement cope better with dynamic market changes.

This research also highlights that organizations that support employee initiatives through appropriate tools and support achieve higher levels of competitiveness. Similar findings were presented by Chen and Li (2021), who found that organizations that demonstrate agility are better prepared to respond to challenges such as the COVID-19 pandemic. This shows that the ability to quickly adapt to changing market conditions is a key factor for success.

Additionally, smaller studies have shown that decentralization of the decision-making process promotes faster response to changes and building competitive advantage. These results are consistent with the findings of Sajdak (2021), who described strategic agility as a key factor supporting the development of enterprises, especially in dynamic market conditions.

Future directions of research on employee engagement in decision-making processes in agile organizations may focus on several key areas that require further analysis. One important direction is to deepen research on the various factors influencing the degree of employee engagement in different sectors of the economy. Previous research indicates the importance of engagement in the context of agile organizations, but there is still a need for a more detailed understanding of how the specifics of different industries affect the dynamics of engagement and which strategies are most effective in each sector. Examining differences between industries, such as information technology, manufacturing, or services, could provide valuable information on the specific mechanisms of employee engagement and their impact on organizational agility.

Another area of research that requires in-depth analysis is the influence of cultural and regional factors on employee engagement in decision-making processes. Organizational agility operates in different cultural contexts, and research could focus on how cultural differences affect employee openness to engaging in decision-making processes. Comparing organizations operating in different regions of the world could provide interesting conclusions on how different approaches to HR management and local social norms shape the degree of employee engagement.

An interesting direction of research may also be to examine the long-term effects of employee involvement in decision-making processes. Although the literature emphasizes the benefits of including employees in the decision-making process, few studies analyze the long-term implications of such activities for organizations. It is worth conducting long-term studies

that will allow for the assessment of how employee involvement contributes to organizational stability, innovation, and sustainable competitive advantage. Such studies can focus on analyzing how employee involvement affects their loyalty, motivation, and development of competencies over many years.

Another interesting area of research is the impact of technology on the employee engagement process in agile organizations. In the era of increasing digitalization and automation, the role of technology in decision-making processes is becoming increasingly important. Research could focus on how modern technologies, such as artificial intelligence or internal communication platforms, can support or hinder employee engagement. Examining the impact of technology on the transparency of decision-making processes and the availability of information for employees could provide valuable tips for managers looking for tools supporting the agility of the organization.

Another potential area of research is the analysis of the impact of different leadership styles on employee engagement in decision-making processes. Research could focus on how different leadership approaches – from authoritarian to democratic – affect employees' willingness to actively participate in decision-making. Understanding how organizational leaders can support the engagement process by providing inspiration and tools is crucial to shaping agile organizations. This research could also address how changes in leadership affect the level of organizational agility and employees' willingness to adapt.

The last but not least direction of research is to investigate the relationship between employee engagement and psychophysical health. Modern organizations require employees to be flexible and constantly adapt to changes, which can lead to excessive stress and burnout. Research can focus on analyzing how organizations can maintain a balance between engagement and employee well-being. Examining the role of mental support programs and mechanisms for preventing burnout can provide valuable guidance for organizations that want to build sustainable and effective work environments.

In summary, future research directions on employee engagement in decision-making processes in agile organizations offer ample opportunities to explore different aspects of this issue. Analysis of industry specificity, cultural context, long-term effects, the role of technology, leadership styles, and employee well-being can provide new, valuable information on how to effectively engage employees in decision-making processes and how this engagement can contribute to building a sustainable competitive advantage.

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FACTORS SUPPORTING THE DEVELOPMENT OF AN AGILE ORGANIZATION

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Purpose: The aim of the article is to identify key factors supporting the development of agile organizations, with particular emphasis on investments in modern technologies, process innovations and employee development opportunities.

Design/methodology/approach: The research is based on literature analysis and a survey conducted on a sample of 312 respondents. The data collected in the study were subjected to statistical analysis, including the calculation of correlations between key factors, which allowed for the identification of mutual dependencies.

Findings: The research results showed that investing in modern technologies and process innovations have the strongest impact on the agility of the organization. A significant correlation was also identified between the development opportunities of employees and the operational flexibility of the organization, which emphasizes the importance of investing in the development of team competences.

Research limitations/implications: The article provides practical guidance for managers and decision-makers, showing which areas of investment and action can significantly contribute to the growth of the organization's flexibility and effectiveness. The results can serve as a basis for making decisions on resource allocation in organizations striving for agility.

Social implications: The development of agile organizations improves working conditions, increases employee engagement and supports their competence development. An agile approach promotes open communication and cooperation, which positively affects job satisfaction and adaptation to changing market conditions.

Originality/value: The article contributes to the literature on agile organizations by combining theoretical considerations with empirical results that reveal specific relationships between key factors supporting agility.

Keywords: agile organization, modern technologies, innovations, employees, organization.

Category of the paper: research paper.

1. Introduction

Modern organizations operate in a dynamically changing environment that requires them to constantly improve and be flexible. In these conditions, agility becomes one of the key elements ensuring effectiveness and competitiveness on the market (Abdmouleh, Alammari, Gastli, 2015). Organizations must not only respond to changes in the environment, but also actively adapt their structures, processes, and resources to meet new challenges. The development of agile organizations is therefore becoming an important research topic, because it is agility that allows organizations to quickly adapt to changing market conditions, as well as introduce innovations that become a key element of competitive advantage (Jones, Adam, 2023).

Taking up this topic is also justified by the growing importance of modern technologies, which directly affect the formation of an organization's agility. Investments in information technologies and innovative management processes play a significant role in improving the efficiency of an organization's operations and in building operational flexibility (Akkaya, 2021). It is also important to understand how these factors interpenetrate and how they can jointly support the development of organizational agility (Felipe, Leander, Roldan, Leal-Rodriguez, 2020).

Organizational agility is therefore becoming a necessary element of survival and development of organizations in today's highly competitive business environment. Research on which factors have a key impact on the development of agile organizations allows for a better understanding of how organizations can transform to better respond to market needs and develop dynamically.

2. Literature Review

2.1. The essence and functioning of an agile organization

An agile organization is characterized by its ability to quickly adapt to changing market conditions and customer requirements, which allows it to achieve better results in a dynamic environment. A key feature of such an organization is flexibility, which is reflected in the organizational structure, decision-making processes, and the way teams are managed. Instead of a rigid hierarchy, flat structures are preferred here, which enable quick decision-making and streamline the flow of information. In this way, unnecessary bureaucratic barriers are eliminated, which in traditional organizations can delay reactions to change (Luthra, Kumar, Kharb, Ansari, Shimmi, 2015).

Organizational agility is based on the principles of self-organization of teams that operate autonomously and are strongly goal-oriented (Borowski, 2021). This work model allows for more effective problem-solving because employees, being closer to specific tasks and projects, demonstrate a better understanding of challenges and can make decisions on an ongoing basis (Bukowska, 2023). These teams work in short cycles, which allows for regular delivery of value to the customer and quick implementation of corrections based on the feedback received. The iterative nature of work allows for continuous improvement of products and services, which is crucial in agile organizations (McNamee, Schoch, Oelschlaeger, Huskey, 2012).

Another important element of an agile organization is the culture of open communication and collaboration (Kurnia, Chien, 2020). It promotes an approach in which all team members have the opportunity to contribute their ideas and suggestions, which increases their engagement and motivation (Erdil, 2014). Another important aspect is the willingness to experiment and take risks, which allows the organization to quickly test new solutions and technologies without fear of failure (Bray et al., 2019). Therefore, agile organizations often use the "fail fast" approach, which allows for the quick detection of possible errors and their immediate correction (Harraf, Wanasika, Tate, Talbott, 2015).

The ability to learn organizationally is also important. Agile organizations attach great importance to the continuous improvement of employee competences and the introduction of innovations in processes (Doz, Kosonen, 2008). This creates a culture of development in which employees are constantly encouraged to improve their skills and share knowledge. Thanks to this, these organizations are able to quickly respond to new challenges, while maintaining a high level of competitiveness on the market (Joiner, 2019).

An agile organization also focuses on delivering value to the customer. This means that all activities and processes are designed to best meet the needs of customers (Brown, Jones, 2018). The customer is the focal point, and their satisfaction is the main measure of the organization's success. Regularly collecting customer feedback and taking it into account in decision-making processes allows for faster adjustment of the offer to their expectations (Rut, Meyer, Andrzejczyk, 2022).

In conclusion, the functioning of an agile organization is based on flexibility, decentralization of decision-making processes, self-organization of teams and continuous improvement and innovation. The key element is customer orientation, quick response to changes and continuous improvement of internal processes and employee competences. Such an organization, thanks to its agility, is able to effectively compete in a rapidly changing business environment.

2.2. Investments in modern information technologies as a determinant of an agile organization

Investments in modern information technologies play a key role in shaping the agility of an organization, becoming one of the main determinants of its success in a dynamically

changing market environment. Modern organizations that strive for agility increasingly focus on implementing advanced IT tools, because they enable not only the optimization of processes, but also the acceleration of decision-making and increased efficiency of operations (Luo, Ren, Cao, Hong, 2020).

Modern IT technologies, such as ERP systems, CRM, project management platforms, and cloud solutions, allow organizations to better control and manage resources and monitor key performance indicators in real time (He, Harris, 2021). The use of such tools allows for a quick response to market changes, which is crucial for maintaining a competitive advantage. Organizations that invest in innovative technologies gain the ability to analyze data more precisely, which allows for better prediction of market trends and making better business decisions (Sherehiy, Karwowski, 2017).

These technologies also support collaboration between teams, enabling the integration of different departments of the organization and improving the flow of information. Teamwork platforms, such as internal and remote communication tools, allow for ongoing contact between team members regardless of their location (Cappelli, Tavis, 2018). Thanks to this, agile organizations can function effectively even in hybrid or completely remote models, which significantly increases their flexibility. Additionally, modern systems support the automation of many operational processes, eliminating manual and time-consuming tasks, which allows teams to focus on more strategic activities (Sedej, Justinek, 2021).

It is also worth noting that investments in IT technologies contribute to improving knowledge management in an organization. Data and documentation management systems enable effective collection, storage, and sharing of knowledge, which is particularly important in agile organizations that must quickly respond to changing conditions and develop new competencies (Capgemini, 2024). Thanks to such tools, organizations gain easy access to key information, which speeds up the decision-making process and increases the ability to quickly introduce innovations (Seifollahi, Shirazian, 2021).

One of the most important aspects of IT investments is also their impact on increasing operational flexibility. Technologies such as cloud computing, artificial intelligence (AI) or business process automation (RPA) allow organizations to quickly scale their operations depending on market needs. Instead of investing in expensive infrastructure, agile organizations can dynamically adjust their resources in response to growing or decreasing demand. An example of this is cloud solutions that enable flexible use of computing power and disk space depending on current needs, which reduces costs and increases efficiency (Rahimi, Mansouri, 2019).

Investing in modern IT technologies not only improves the operational efficiency of an organization, but also supports innovation. Organizations that implement advanced technologies have greater opportunities to experiment with new solutions and test prototypes or new products faster. These technologies also enable the collection and analysis of customer and market data, which allows for the creation of more personalized and tailored offers, as well as better response to changes in consumer behavior.

2.3. Factors determining the development of an agile organization

The development of an agile organization depends on many interconnected factors that support flexibility and the ability to quickly adapt to a changing business environment. Investments in modern technologies, process innovations, as well as opportunities to develop and improve employee competences are of key importance here. These elements, when combined, create a complex network of activities that directly affect the organization's ability to function effectively and respond to changing market conditions (Seifollahi, Shirazian, 2021).

One of the most important factors supporting the development of an agile organization is investing in modern technologies. They enable the organization not only to streamline current processes, but also to introduce new, innovative solutions that can contribute to improving operational efficiency (Fiddler, 2017). Modern technologies support process automation, data analysis and improve communication, which has a direct impact on the organization's speed of response to changing conditions. The use of technology allows for better integration of processes and resources, which in turn enables more effective change management (Prieto, Talukder, 2023).

Another important factor determining the agility of an organization is the innovativeness of implemented processes. The introduction of innovative methods of work, project management or organizing teams allows for a faster response to market needs and a better adjustment of the offer to customer expectations (Liu, 2024). Organizations that effectively introduce process innovations are able to maintain competitiveness and increase their ability to create value. Organizational agility requires continuous improvement of processes and searching for new solutions that can accelerate the achievement of business goals (Munodawafa, Johl, 2019).

Tools based on modern technologies are another important element influencing the development of an agile organization (Alshehhi, Nobanee, Khare, 2018). The use of advanced technological solutions, such as artificial intelligence, analytical systems or platforms supporting team collaboration, allows organizations to make decisions faster and better coordinate activities. Thanks to these tools, it is also possible to better use resources and optimize operational processes, which directly affects the increase in the efficiency and flexibility of the organization (Masoud, Basahel, 2023).

Development opportunities offered to employees are another key factor determining an organization's agility. Employees who have the opportunity to develop and improve their skills are more engaged and better prepared to face new challenges (Mycka, 2023). Agile organizations attach great importance to building cultures that support professional development, which translates into the ability to better adapt to change. Providing employees with access to training, mentoring, or development programs allows them to increase their competences, which in turn affects the increase in the organization's innovation and effectiveness (Lambri, Sironi, Teti, 2024).

An equally important factor is the ability of employees to improve their skills (Attar, Almusharraf, Alfawaz, Hajli, 2022). Organizations that enable systematic improvement of their teams' skills gain greater flexibility in response to new market challenges. Continuous improvement of skills allows for better use of new technologies and process innovations, which in turn contributes to increasing the organization's ability to adapt and develop (Adan, Fuerst, 2016). As a result, employees are better prepared to cope with dynamic changes in the environment and perform tasks that support the long-term development of the organization faster and more effectively (Deloitte, 2024).

Certainly, investments in technology, process innovations, the use of modern tools, development opportunities and improving competences – create the foundation on which organizational agility is based. Their synergistic impact allows organizations to better adapt to changes, increase operational efficiency and achieve their business goals faster.

2.4. Research Methodology

The aim of the conducted research was to determine which factors have a key impact on the development of an agile organization. The study aimed to identify which elements, such as investing in modern technologies, process innovations, the use of tools based on modern technologies, development opportunities and the possibility of improving competences, play the most important role in building organizational flexibility. The research hypothesis assumed that the development of an agile organization is directly dependent on the synergy of these key factors. It was examined to what extent these factors are interconnected and how their mutual relations can support the flexibility and effectiveness of the organization.

The research method used in this project was a survey conducted between April and June 2024 on a sample of 312 respondents. This study allowed for collecting opinions on the perception of the impact of individual factors on the development of the organization. Based on the obtained data, correlation coefficients were calculated to determine the strength of the relationships between individual factors. The calculation of correlations was aimed at identifying which of these factors support each other and how their synergistic effect can contribute to increasing the agility of the organization. These correlations also helped to analyze whether some of the aspects studied are more crucial than others and how strongly they interact with each other, creating a system supporting the development of an agile organization.

During the research, sociodemographic data were obtained on the surveyed enterprises. Among the dominant types of activity, the largest percentage, as much as 65.1%, were service enterprises, while 25.6% of companies conducted commercial activities, and only 9.3% were engaged in production. In terms of the number of employees, the largest group (23.1%) were enterprises employing from 0 to 9 people. Companies employing from 10 to 49 employees constituted 20.5%, while companies employing from 50 to 249 people constituted 15.7%. Enterprises with the number of employees from 250 to 999 people comprised 21.8%, and companies employing more than 1000 people constituted 18.9%.

In terms of scope of operations, the largest number of companies, 36.2%, operated internationally. 30.4% of companies operated nationally, while 21.5% of companies operated locally. Regional scope covered 11.9% of surveyed companies. In terms of education level, 57.1% of respondents had a higher education, 9.3% had a higher vocational education, and 33.7% had a secondary education. In terms of age, the largest group of respondents, 48.4%, were between 20 and 30 years old. 12.8% of survey participants were between 31 and 40 years old, while 21.2% were between 41 and 50 years old. Respondents aged 51 to 60 made up 10.9%, and the oldest group, over 60, numbered 6.7%.

2.5. Presentation of Research Findings

The research aimed to determine what factors influence the development of an agile organization by analyzing five key areas, the results of which are presented in Figure 1. The first of these areas is investing in modern technologies. In this category, 23 people stated that it definitely does not influence on the development of the organization, 32 people rather disagreed with this, and 41 respondents had no opinion. In turn, 137 people believed that investing in modern technologies rather favors development, and 79 people expressed strong support for this factor.

The next factor examined was the innovation of implemented processes. The results showed that 17 respondents definitely did not consider it a key element, 34 people rather disagreed, and 46 people remained indifferent. In this category, 130 respondents considered that process innovations rather support the development of the organization, while 85 people strongly confirmed it. The third analyzed category was the use of tools based on modern technologies. In this group, 17 people expressed a strong negative position, 40 people rather disagreed, and 38 people had no opinion. In turn, 116 respondents considered that such tools rather support development, and 101 people were definitely in favor of this.

Development opportunities in the organization were the fourth aspect examined. The results showed that 28 respondents definitely did not see this factor as having a significant impact on development, 33 people rather disagreed, and 38 people had no opinion. On the other hand, 95 respondents considered that development opportunities rather support the development of the organization, and 118 people were definitely convinced of their positive impact.

The last factor analyzed was the possibility of improving competences. In this category, 28 people expressed a strong negative position, 43 people rather disagreed, and 31 people had no opinion. In turn, 105 respondents considered that the possibility of improving competences rather favors the development of the organization, and the same number of people, i.e. 105, expressed strong support for this factor.

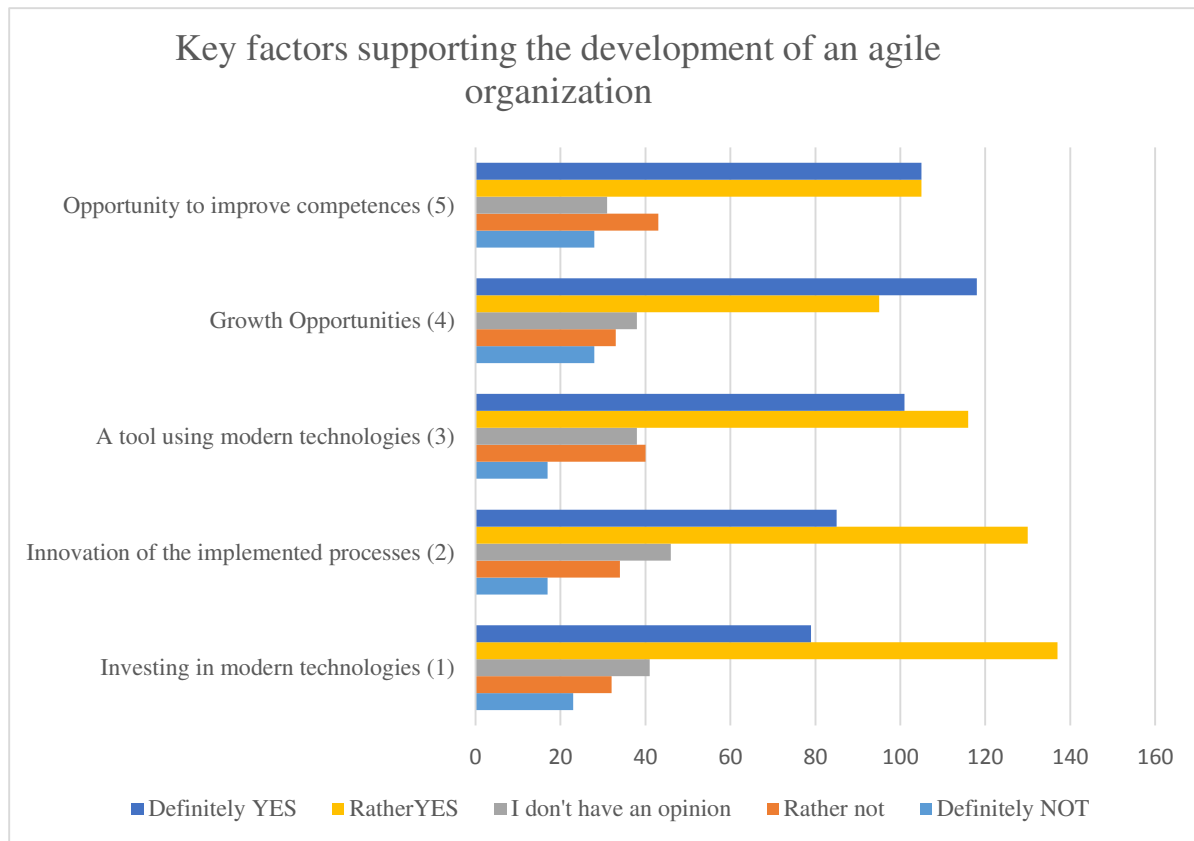


Figure 1. Key factors supporting the development of an agile organization.

Source: Own study based on research.

Table 2 presents a matrix of correlations between key factors supporting the development of an agile organization, which are presented in Figure 1. Each of the five factors: investment in modern technologies, process innovations, tools using modern technologies, development opportunities and the opportunity to improve competences, was compared in terms of correlation with the others. The highest correlation (0.99) can be seen between process innovations (2) and investment in modern technologies (1), which suggests that these two factors are closely related - organizations that invest in modern technologies often introduce innovations in their processes at the same time. This correlation may also mean that respondents perceive these two aspects as mutually supporting each other in the development of an agile organization.

An equally high correlation (0.98) was observed between the possibility of improving competences (5) and tools using modern technologies (3). This means that the ability of an organization to support the development of employee competences may be closely linked to the introduction of modern technologies in everyday work, which in turn has an impact on increasing the efficiency and flexibility of the organization. High correlations (above 0.9) are also visible between process innovations (2) and tools based on modern technologies (3) and the possibility of improving competences (5). This indicates that these three factors are strongly related and jointly affect the agility of the organization.

Slightly lower, but still strong correlations (from 0.79 to 0.96) were observed for the relationship between development opportunities (4) and the remaining factors. This may indicate that, although development opportunities are an important factor, they are less dependent on other technological and innovation aspects.

Table 2.
Correlation Table

	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
1	1				
2	0.99	1			
3	0.93	0.96	1		
4	0.79	0.83	0.93	1	
5	0.88	0.90	0.98	0.96	1

Source: Own study based on research.

Figure 2 shows that all factors show strong correlations between each other, suggesting that organizational agility is the result of a comprehensive approach that combines both technological and developmental aspects. It is worth noting, however, that these correlations are not perfect (they are not 1), indicating that each factor also has its specific role and they are not completely interchangeable.

3. Discussion

Based on the conducted research, a number of conclusions can be drawn that shed light on key factors influencing the development of an agile organization. The results clearly indicate that investing in modern technologies plays a significant role in building the flexibility of an organization. It is precisely technologies that largely support process innovations that are the foundation that allows companies to quickly adapt to changing market conditions and growing customer requirements. Organizations that decide to implement modern technologies demonstrate a greater ability to introduce innovations in their processes, which in turn increases their competitiveness and operational efficiency.

The second important factor is process innovation, which not only affects the development itself, but also supports other aspects of the organization's functioning. Enterprises that introduce changes to their processes are more open to adopting modern technological solutions, which allows them to better manage resources and increase efficiency. The introduction of process innovations becomes crucial in the context of the organization's agility, as it allows for faster adaptation to the dynamically changing market environment.

An important element influencing the development of an agile organization is also the use of tools based on modern technologies. These tools are perceived as significant support in everyday operational activities, as well as a factor increasing the organization's ability to

respond quickly to changes. These tools support employees in performing their duties more effectively, which translates into the overall flexibility of the organization. In addition, their use promotes better use of human potential, enabling the improvement of competences and professional development. Development opportunities within the organization have been identified as an important factor supporting its agility. Enterprises that provide employees with opportunities for development, including the improvement of their qualifications, are able to adapt to changes more effectively, which leads to an increase in their flexibility. In turn, the development of employee competences promotes better adaptation to modern technological tools and process innovations, which synergistically supports the development of the entire organization.

Correlations between individual factors indicate the existence of strong links between technological, process and development aspects of the organization's activity. This means that the development of an agile organization is not the result of the isolated action of one factor, but the effect of an integrated approach that includes both investments in modern technologies and the development of employee competences and process innovations. Each of these factors reinforces the action of the others, creating a complex mechanism that supports the flexibility of the organization and allows for a quick response to changing market conditions. Nevertheless, despite strong correlations between the areas studied, each of these factors has its own specific role and cannot be treated as completely interchangeable. This means that success in building an agile organization depends on a balanced approach, in which each element - technological, process and human - must be properly developed and integrated with the others. Otherwise, the organization may encounter difficulties in maintaining its agility, which may lead to a decrease in efficiency and competitiveness.

In summary, research confirms that a key factor in building organizational agility is a comprehensive approach encompassing investments in modern technologies, introducing process innovations, and providing employees with development opportunities. The strong links between these elements indicate the need for an integrated development strategy that allows organizations not only to operate effectively, but also to adapt to dynamic changes in the market environment.

Based on the research and conclusions, several important recommendations can be formulated for companies striving to increase their agility. First of all, it is crucial to regularly invest in modern technologies. These technologies not only support process innovations, but also enable faster adaptation to changing market conditions. Investing in technology should be considered not as a one-time action, but as a permanent element of the development strategy, integrating with other processes in the organization.

It is also worth putting a lot of emphasis on innovation in processes. Introducing changes in the way a company operates, improving procedures and eliminating outdated methods of operation allows organizations to optimize work and be more flexible in the face of challenges. These innovations should be part of the organizational culture, supported by appropriate technological tools and employees' openness to change.

One of the priorities should also be the constant improvement of employee competences. Companies should actively support the development of their teams through training programs, workshops and access to modern technological tools that will facilitate everyday work. The development of competences is closely related to the introduction of modern technologies - employees should have the opportunity to acquire new skills in areas related to technological innovations, which increases their efficiency and allows for better use of available tools.

Organizations must also create an environment that supports employees' continuous development, offering clear career paths and opportunities to improve their skills. This is not only beneficial for the employees themselves, but also for the company, because employees who develop their skills are more engaged and better prepared to support the agility of the organization.

An integrated approach that combines all these elements into a coherent strategy is extremely important. The company should strive to harmoniously combine process, technological and development innovations to create a strong foundation for its agility. Only through coordinated actions can long-term effects be achieved that will allow the company to better respond to changing market requirements and maintain its competitiveness.

Focusing on the cooperation of technology, process innovation and employee competence development creates a competitive advantage, which is crucial in a dynamically changing business environment. In order to fully use the potential resulting from these activities, it is necessary to regularly monitor their effectiveness and flexibly adapt the strategy to new challenges and opportunities. The mutual interactions between factors supporting the development of an agile organization and achieving market success are presented in Figure 2.

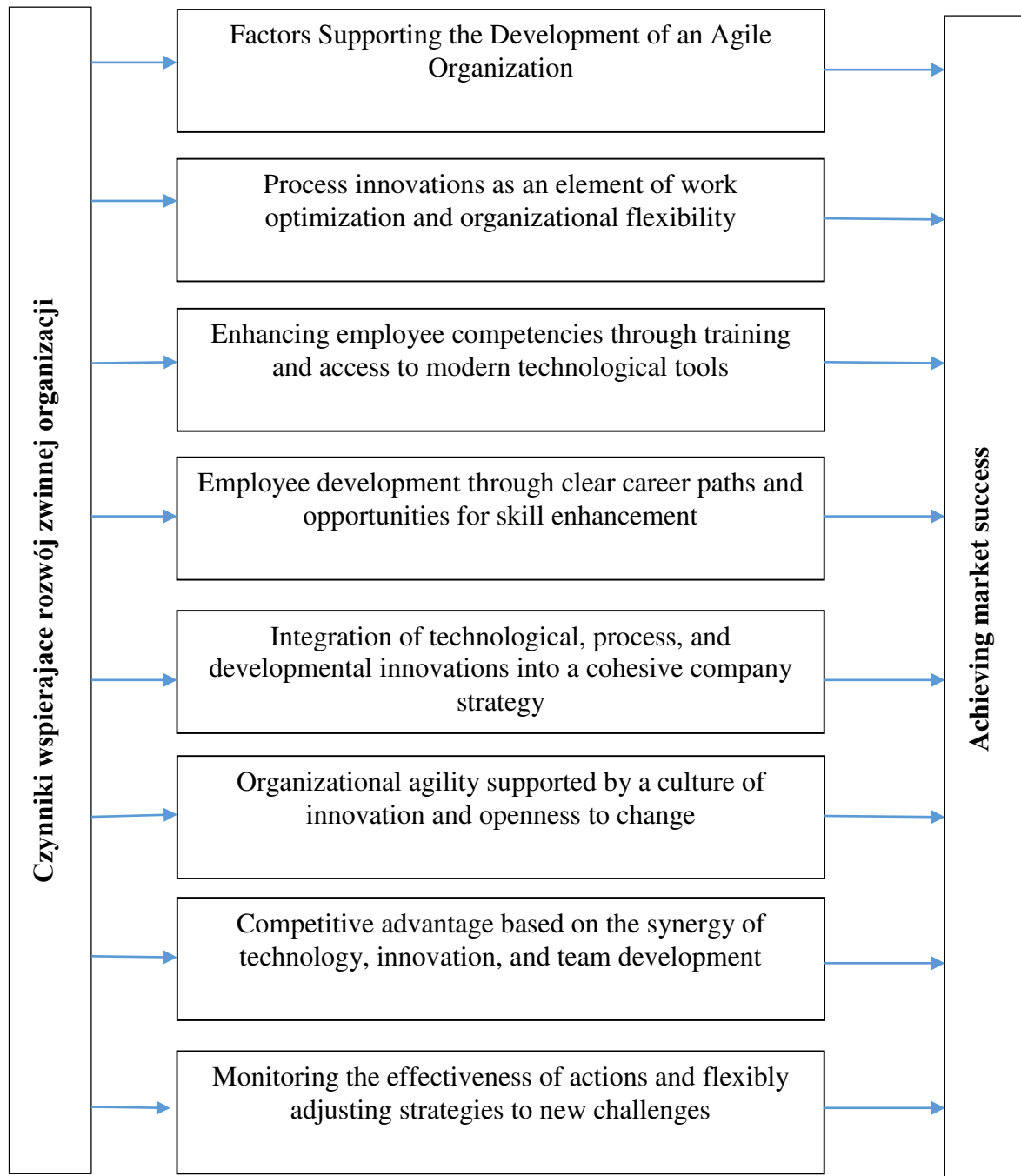


Figure 2. Model of interaction between factors supporting the development of an agile organization and achieving market success.

Source: Own study.

4. Conclusions

It is worth comparing the research results presented in this article with the research results of other researchers. The presented studies indicate that investments in modern technologies have a strong impact on the agility of the organization, which is also confirmed by the works of Sherehiy and Karwowski (2017), who emphasize that technologies such as ERP or CRM systems increase operational flexibility through process optimization. Similarly to this article, Sherehiy and Karwowski show that these technologies support better data and resource management.

In turn, process innovations, which according to the studies discussed in this article are of significant importance for organizational agility, have been widely discussed by Luthra et al. (2015), who point to the elimination of bureaucratic barriers and decentralization of decision-making processes as key aspects influencing organizational agility. Both studies agree on the role of team self-organization in the process of increasing organizational agility.

The development of employees and their competencies, which in this study correlates with the operational flexibility of the organization, is also an important factor according to the research of Felipe et al. (2020). Both works showed that investing in the development of team competencies allows organizations to adapt faster to market changes.

The presented research results also indicate the importance of synergy between technologies, process innovations and employee development, which confirms the high correlations between these factors. Similar conclusions appear in the literature on the subject (Akkaya, 2021), where it is emphasized that the success of agile organizations results from the integration of technologies and the development of competencies.

Future research directions could focus on deeper analysis of the impact of specific technologies on organizational agility, especially in the context of new digital tools such as artificial intelligence, big data, or process automation. Research could also include sector analysis to understand how industry specifics affect the implementation of innovations and technologies, and whether different sectors require different approaches to developing organizational agility.

Another important direction would be to examine how organizational culture and management style can support or limit agility. Research could focus on the role of leadership, employee motivation, and internal communication mechanisms, which are crucial for the effective implementation of innovations and technologies. It is also worth expanding research to include a global perspective, examining how different international markets, cultural differences, and legal regulations affect organizational agility. This would allow for a better understanding of the challenges faced by companies operating in different parts of the world and what strategies may be most effective in different geographical and cultural contexts. Additionally, an interesting direction could be to examine the long-term effects of

implementing organizational agility to determine how companies cope with challenges in the long term. This research could also include an analysis of the costs and benefits associated with implementing modern technologies and process innovations, which would allow for a more precise determination of which activities bring the greatest return on investment.

Another potential area of research could be understanding how changes in organizational structure, such as decentralization or greater team autonomy, can affect agility. It is also worth considering research on how the pandemic and other global crises have affected the acceleration of agility processes and what lessons from these experiences may be useful in the future.

The limitations of the study were related to several important aspects. First, the research sample included only 312 respondents, which may affect the generality of the conclusions and their representativeness in relation to the wider market. Although this number is sufficient for the analysis, a larger sample could have provided more detailed results and a better reflection of the diversity of opinions among the surveyed companies. Another limitation was the specificity of the survey, which focused on the respondents' self-assessment of the key factors supporting the development of an agile organization. Such an approach, although it allows for obtaining valuable information, may introduce subjective interpretations and limit the objectivity of the results. Respondents may have had different understandings of individual concepts, which could have influenced their answers.

Another limitation of the study was that it focused on five selected factors that, according to initial assumptions, were supposed to influence the development of an agile organization. It is possible that other, unexamined factors, such as cultural, geopolitical or economic aspects, also have a significant impact on the agility of the organization, but were not included in this study. The study covered companies operating in specific industries, which limits the possibility of generalizing the results to other sectors of the economy, which may be characterized by different challenges and needs in the development of organizational agility. Additionally, the data was collected in a specific time period (April-June 2024), which means that dynamic changes in the market or new technologies that appeared after this period may not have been included in the study, which could affect the validity of some conclusions.

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AUTOMATIC DEPLOYMENT OF A REPOSITORY OF DIGITAL DIDACTIC DOCUMENTS AT UNIVERSITIES

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Purpose: This work aims to establish a template containing a skeletal version of the existing Repository of Didactic Processes Data (RDPD) along with its environment and, by utilizing this system, to develop universal installation scripts enabling the implementation of the repository at any university in Poland. These scripts are used for cloning, meaning the template replication. They are intended to enable the implementation of Repository as a Service (RaaS) launched on demand by the service recipient.

Design/methodology/approach: The RDPD skeletal version is developed as a system offering repository functionality for managing data from didactic processes. It does not contain visual identification elements and data. To operate, the skeletal version needs an environment that requires creating a VM on Proxmox and installing the OS and applications needed for RDPD: PostgreSQL, Apache, Tomcat, Solr, and Angular. The RDPD skeletal version and its environment create a template which is cloned by Ansible scripts running sequentially. Ansible scripts also configure the created clone. The university then only needs to customize the system and feed the repository with data.

Findings: The university (client) provides identification parameters to generate a virtual machine (VM), ultimately containing the repository. In response, the RDPD system is automatically replicated and configured on a clone of the template in line with the parameters provided.

Practical implications: A solution was proposed allowing for the automatic implementation of the RDPD repository at any Polish university. Hence, the provision of a service to generate a ready-to-use version of the RDPD system is significantly convenient for universities.

Originality/value: The developed RDPD system, dedicated strictly to storing and managing data generated by a university, can be automatically implemented and configured per request. There are no such solutions, which is the original element of this work.

Keywords: repository as a service, data management, automatic replication and configuration, batch loading data, DSpace.

Category of the paper: Conceptual paper, Case study.

1. Introduction

Data generated during the educational processes at a university include didactic materials, curricula, test reports, theses, authorities' orders, reports for accreditation bodies, study plans, etc. Some of those are prepared in paper form while others are prepared electronically; some are stored, and others, having fulfilled their function, are disposed. All of them however provide information which can be used to organize work and manage the university in terms of educational needs. Hence, they should be collected in a single institutional repository with a logical and intuitive structure.

The authors have developed such a repository as the Repository of Didactic Processes Data (RDPD) DSpace-based system for the management of data generated in didactic processes for Kielce University of Technology (KUT), Poland (Koczubiej et al., 2022). It is the outcome of a larger project titled “National Data Storage (NDS). Universal infrastructure for sharing, storage and effective processing of large data volumes in HPC, Big Data and Artificial Intelligence models” (National Data Storage..., 2024), Intelligent Development Operational Program, Agreement: POIR.04.02.00-00-D010/20-00. Work on the Repository of Didactic Processes Data system commenced in April 2021. However, the system is structured in a way which allows other universities to use it.

The RDPD repository consists of a set of services (e.g., database, backend and frontend) which need to be properly installed, configured and linked together. Therefore, the RDPD implementation requires expertise in various areas of IT and competence in data management. Hence, it would be a significant convenience for universities wishing to use such a system to provide a service that generates a ready-to-use version of RDPD. Following this idea, the authors have implemented an advanced solution for the automatic deployment of RDPD.

It is particularly difficult to find publications covering issues similar to those presented in this work. Related literature was sought out (2024/06/12) in the three largest bibliographic databases: Scopus (www.scopus.com), Web of Science (www.webofscience.com), and Dimensions (app.dimensions.ai/discover/publication) using the following keywords: *repository replication, repository as a service, repository automatic deployment*. A single work was found that presents the concept of automatic generation of a Repository as a Service (RaaS) system: “Digital repository as a service: automatic deployment of an Invenio-based repository using TOSCA orchestration and Apache Mesos” by Antonacci et al. (2019). The authors used containerization for this automation and employed an orchestrator to configure and manage distributed cloud resources. They developed a demonstrator for the Arts and Humanities Research domain. In contrast, in this work, the automatization of the RDPD implementation was prepared with the use of virtualization. In practical terms, the developed RDPD is a working system which can serve any university.

2. RDPD implementation process

The RDPD implementation process is presented in Figure 1. The RDPD skeletal version is created at the outset, serving as a source for the RDPD template – this is a one-time action. Any university can request the deployment of RDPD by completing the order form. Following positive verification, the replication of the RDPD system (its clone) is automatically generated based on the RDPD template, with the use of a set of Ansible scripts (Ansible Documentation, 2024). In the next step, the university adapts the clone to its specific requirements. Finally, the system can be fed with data. Once the implementation is complete, the repository endpoint is provided to the users. They can browse, search, upload and download data from the didactic processes contained in the repository via the dashboard.

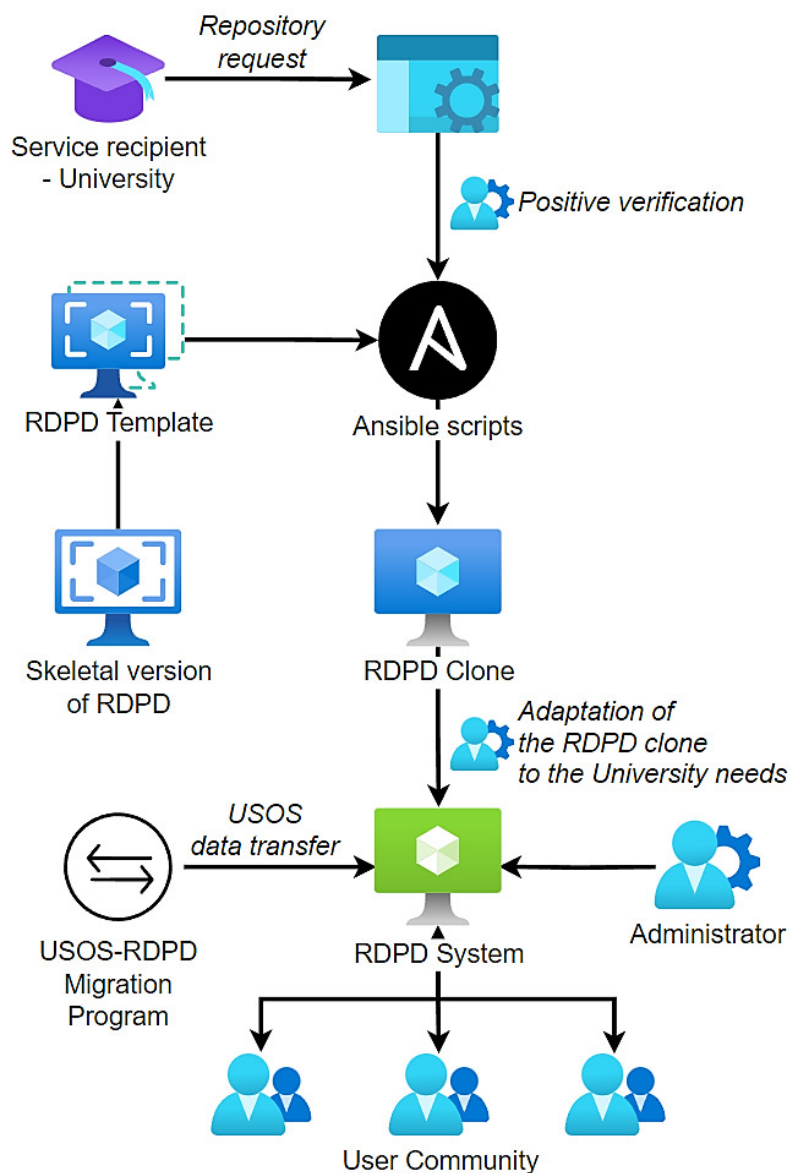


Figure 1. The RDPD system implementation workflow.

Source: authors' elaboration.

3. Skeletal version of the RDPD system

3.1. System specification

The skeletal version of RDPD was developed based on the existing open-source repository system DSpace (DSpace 7.x Documentation, 2024; DSpace, 2024). Logical metadata layers were developed, followed by implementation, adopting a customized solution in line with the requirements of the authors' metadata schema. RDPD reflects the typology of documents from the university's didactic processes and not its organizational structure (departments, chairs, institutes). Six communities are at the top of the hierarchy structure: *Students' academic performance*, *Fields of study*, *Orders of the university authorities*, *Teaching activity organization*, *Students' accomplishments*, and *Various others*. Communities contain collections, which are groups of thematically related content; for example, the *Students' academic performance* community contains the collections: *Thesis* and *Course credit protocols*. Each collection consists of items which constitute the basic archive components of the Repository. For instance, the *Theses* collection covers engineering, bachelor's and master's theses of all university students. User groups are also created in RDPD. The groups have permissions defined according to their function in the didactic processes:

- *Anonymous* refers to any Internet user, in particular a student.
- *Academic teachers*, refers to all teachers at the university.
- *University authorities* refer to the rector, vice-rectors, deans, deputy deans, and other heads of teaching units.
- *Administrator* refers to those responsible for managing the system.

The RDPD system has Polish and English localizations, with the English localization being part of the main DSpace distribution, while the Polish localization was implemented according to the authors' concepts.

3.2. Polish localization

3.2.1. Back-end language support

Activating the Polish-language version of the RDPD system required configuring two parameters in the file `[dspace-source]/dspace/config/local.cfg`:

- `default.locale`, the value for RDPD: `default.locale = pl`
- `webui.supported.locales`, the value for RDPD: `webui.supported.locales = en, pl`

The language settings in the `local.cfg` file overwrite the settings defined in the `config.cfg` file. The `default.locale` parameter defines the default language for communicating with the users when the system is opened (loaded). The `webui.supported.locales` parameter lists the language codes and allows for:

- user's selection of preferred language as part of their profile,
- switching the session language,

- sending e-mails by the system in the language selected for the session,
- editing the file containing messages in the language selected for the session (*dspace-admin Edit News* command).

Depending on the languages to be supported, all language version files must be obligatorily prepared according to i18n (W3C. Internationalization (i18n) Activity, 2024). In the case of RDPD, this applies to Polish and English.

Preparations of back-end resources to support the language include the following elements:

- List of messages. The list of messages in English is part of the main DSpace distribution. It is stored in the file:

[dspace-source]/dspace-api/src/main/resources/Messages.properties

A list of Polish equivalents of these messages should be prepared in the *Messages_pl.properties* file, which must be saved in the folder:

[dspace-source]/dspace/modules/server/src/main/resources/

Setting the parameter *default.locale* determines which file with a list of messages is used.

- Contents of e-mails. The contents of the e-mails sent automatically by the DSpace system are stored in files located in the folder *[dspace]/config/emails/*. Each file has a unique name providing information about its content (e.g., the *welcome* file contains feedback about the successful registration of the user to the repository). For the RDPD system, the authors created a set of such files with appropriate content in Polish, with the file names extended by adding the *_pl* ending (e.g., the equivalent of the *welcome* file is the *welcome_pl* file).
- Metadata language. In RDPD (according to the DSpace concept), the user can connect each metadata field value with a language code at the stage of defining this field.
- Submission forms. Due to the variety of metadata structures in the RDPD system, the authors developed a separate submission form in English and Polish for each of its collections. The definitions of the English version of the forms are stored in the *submission-forms.xml* file, while the definitions of the Polish version are stored in the *submission-forms_pl.xml* file. Both files must be saved in the folder */opt/dspace/config*. For each different language version, a new file must be created, in the name of which, instead of *pl*, the code of the corresponding language must be specified in accordance with the ISO 639-1 list (ISO 639 - Language codes, 2022).

3.2.2. Front-end language support

By default, DSpace checks the language of the user's browser. If a file with interface translations in that specific language is available in the system, the page content is rendered accordingly. Otherwise, English or another language configured in DSpace is used by default. Language package files contain texts displayed in widgets (components) of the application interface, such as button descriptions, messages, and menu items.

English language package file *en.json5* is part of the main DSpace distribution. An additional, authors' file of the Polish language package *pl.json5* was defined for RDPD. Both files must be saved in the folder */src/assets/i18n/*. In the *config.yml* file, in the */opt/dspace/ui/config* folder, one can configure the default language, and the languages supported in the user interface. The default language of the RDPD system is Polish, and the supported languages are Polish and English.

4. Creation of the RDPD template for cloning

A template is a resource that enables the generation of a ready-to-use version of RDPD at the user's request. This is a significantly convenient function for the university, as it does not require specialist knowledge in various IT areas or competences in data management.

The template is created following the steps described below.

- Creation of Virtual Machine (VM) on Proxmox. Proxmox VM is a virtualization environment for managing servers running Windows and Linux operating systems (Proxmox VM, 2024). It supports dynamic scaling of compute infrastructure and storage as the data center needs to grow. Proxmox VM uses the QEMU emulator (QEMU (Quick Emulator), 2024), which, in combination with the KVM (Kernel-based Virtual Machine), 2024) hypervisor integrated with the Linux kernel, offers hardware-assisted virtualization with performance close to a real computer system.
- Completing the template resources on the virtual machine. This step includes the following actions:
 - installing and configuring the operating system,
 - installing applications required for DSpace: PostgreSQL (PostgreSQL, 2024), Apache (Apache, 2024), Tomcat (Tomcat, 2024), Solr (Solr, 2024), Angular (Angular, 2024),
 - installing the RDPD skeletal version,
 - configuring the connection to the Ansible server using an SSH key,
 - disabling the administrator password for later use of Ansible scripts; this is an operation required to automatically execute the scripts (without the administrator intervention),
 - stopping VM.
- Converting (transforming) the template resources into a form ready for cloning. This form defines the template.

5. RDPD cloning

A portal for servicing the *pracelab* projects (Cooperation in Advanced Computing in Europe – *pracelab*, 2024) and the NDS project (NDS – National Data Storage, 2024) is available. Universities can place orders for the RDPD system through the portal. The form with the necessary data has to be filled out, as shown in Figure 2. The *Mail user* and *Password* in the *Mail server data for the RDPD system* panel are used for automatic e-mail communication with the system users.

Figure 2. RDPD skeletal system order form - English equivalent.

Source: authors' elaboration.

After placing the order and verifying the data, a copy (clone) is automatically created from the prepared template. Next, the clone is configured. These operations are performed by running an original shell script, containing calls to Ansible scripts (also the original ones) in a specific order (the names of the authors' scripts are provided in parentheses):

- Script 1 (*automate.yml*) creates (clones) a new VM with RDPD and the associated software from the template. The script uses information from the *hosts* file: the IP of the server where the clone is created and the data used to generate *hosts* files for subsequent Ansible scripts.
- Script 2 (*reconfigip.yml*) configures the clone's network settings: in the *netplan* configuration file, changes the IP address of the master server to the IP address of the clone server, creates an authenticated connection between the clone and the Ansible server using an SSH key, and triggers a re-read of the *netplan* configuration file.
- Script 3 (*configrdpd.yml*) configures the network parameters of internal communication of RDPD modules: sets the IP for the database server, front-end, and back-end using the same IP address, configures the mail account for e-mail correspondence sent by the RDPD system. At the end of the entire cloning operation, the script revokes the user's rights to execute shell commands on the clone server as *sudo* without entering a password (see Section 2).

Both the template and the clones are stored on the hardware resources of the Kielce University of Technology IT infrastructure created as part of the NDS project (service servers, CEPH servers, network infrastructure).

6. Adaptation of the RDPD system to the needs of a university

The administrator can customize the RDPD system to suit the needs of their respective institution in terms of:

- visual identification of the university,
- drop-down lists in the submission forms,
- federated logins.

These operations require modifications of specific configuration files of the DSpace, Tomcat and Apache systems, which may result in the necessity to recompile and restart the services.

6.1. Visual identification of the university

The university's visual identification includes the editing and arrangement of the resources as follows (see Figure 3):

- terms of service provided in the file */opt/dspace-ui/src/app/info/end-user-agreement/end-user-agreement-content/end-user-agreement-content.component.html*
- privacy policy provided in the file */opt/dspace-ui/src/app/info/privacy/privacy-content/privacy-content.component.html*
- university-approved typeface and color scheme configured in the Sass (Syntactically Awesome Style Sheets) cascading style sheet format (the file: */opt/dspace-ui/src/themes/rdpd/styles/_theme_sass_variable_overrides.scss*)
- header logo configured in the file */opt/dspace-ui/src/themes/rdpd/app/header/header.component.html*
- menu logo configured in the file */opt/dspace-ui/src/themes/rdpd/app/navbar/navbar.component.html*
- background and text on the homepage configured in the file */opt/dspace-ui/src/themes/rdpd/app/home-page/home-news/home-news.component.html*
- favicon image files along with the manifest stored in the directory */opt/dspace-ui/src/themes/rdpd/assets/favicons*

Logo and background graphic files are located in the application's resources directory */opt/dspace-ui/src/themes/rdpd/assets/images/*.

The screenshot shows the homepage of the Repository of Didactic Process Data (RDPD) at Kielce University of Technology. The header includes a logo and navigation links. The main banner features a university building image with the title 'Repozytorium Danych Procesu Dydaktycznego' and the university name. Below the banner is a search bar and a list of community categories. The 'Ostatnie zgłoszenie' section displays several announcements with thumbnails and dates. A footer contains copyright information and links to privacy and terms of service.

Callout boxes highlight the following elements:

- Logo in the header and menu**: Points to the university logo in the top left corner.
- Background and text on homepage**: Points to the main banner image and text.
- University-approved typeface and color scheme**: Points to the list of community categories.
- Terms of service and privacy policy**: Points to the footer links.

Figure 3. RDPD visual identification for Kielce University of Technology.

Source: authors' elaboration.

6.2. Drop-down lists in submission forms

Submission forms (Polish and English versions) embedded in the template contain drop-down lists for the following metadata fields – see the work by Koczubiej et al. (2022):

- *rdpd.dyscyplinyNau* – discipline of science (e.g., computer science, mathematics, management and quality studies),
- *rdpd.formaZaj* – a form of teaching (e.g., lecture, laboratory, project),
- *rdpd.klasyfikacja* – students’ accomplishment classification (scientific, sports, artistic, other),
- *rdpd.poziomKsz* – education cycle (e.g., first-cycle studies, second-cycle studies),
- *rdpd.rodzaj* – type of action to promote the university (e.g., workshop, lecture, interview),
- *rdpd.rokAka* – academic year (e.g., 2023/2024, 2024/2025),
- *rdpd.semestr.nazwa* – semester name (summer, winter),
- *rdpd.semestr.numer* – semester number (e.g., 1, 2, 3, 4),
- *rdpd.studia.profil* – study profile (practical, general academic),
- *rdpd.studia.tryb* – study mode (full-time, part-time),
- *rdpd.wydzial* – faculty name and its Polish acronym (e.g., Faculty of Management and Computer Modelling – WZiMK, Faculty of Mechatronics and Mechanical Engineering, – WMiBM).

The drop-down lists can be customized for a particular university by modifying the contents of the files (DSpace 7.x Documentation): *submission-forms.xml* and *submission-forms_pl.xml*.

6.3. Federated logins

Regardless of the standard one, it is possible to log in to the RDPD system in a federated mode, without the need for explicit registration. Such a solution is made possible due to the fact that the DSpace system cooperates with Shibboleth. Shibboleth is a distributed system for secure user authentication and transfer of user attributes from one or more identity providers (Shaping the future of Shibboleth Software, 2024). To use the Shibboleth system, an external identity provider (IdP) is required that supports Shibboleth technology – a university system. DSpace will then act as a Service Provider (SP), which receives authentication information and then provides the service to the user based on it. In this case, DSpace requires that the Apache server has the appropriate Shibboleth module installed to act as a proxy for all HTTP requests to the application container (Tomcat). DSpace receives user authentication information from this module via HTTP headers.

After logging into the RDPD via the Shibboleth system, the user is automatically assigned to the *Academics* group representing all the university’s teachers. If he had a previously registered account in the RDPD system, the user’s rights will be the sum of the rights of the groups they are assigned to and the *Academics* group.

7. Batch data transfer to RDPD

Apart from uploading data into the system via screen forms, RDPD enables batch data loading using the DSpace Simple Archive Format. This is the functionality of DSpace, which is particularly useful for loading data from other university systems. The process can be automated by creating a dedicated computer program. Such applications were developed for the RDPD system at Kielce University of Technology and support the following collections: *Thesis*, *Course credit protocols*, and *Full-time study timetables*. An example diagram of the process of transferring data from university systems to the *Thesis* collection using these programs is shown in Figure 4. The Polish abbreviations USOS and APD stand for: University Study Service System and Diploma Theses Archive, respectively.

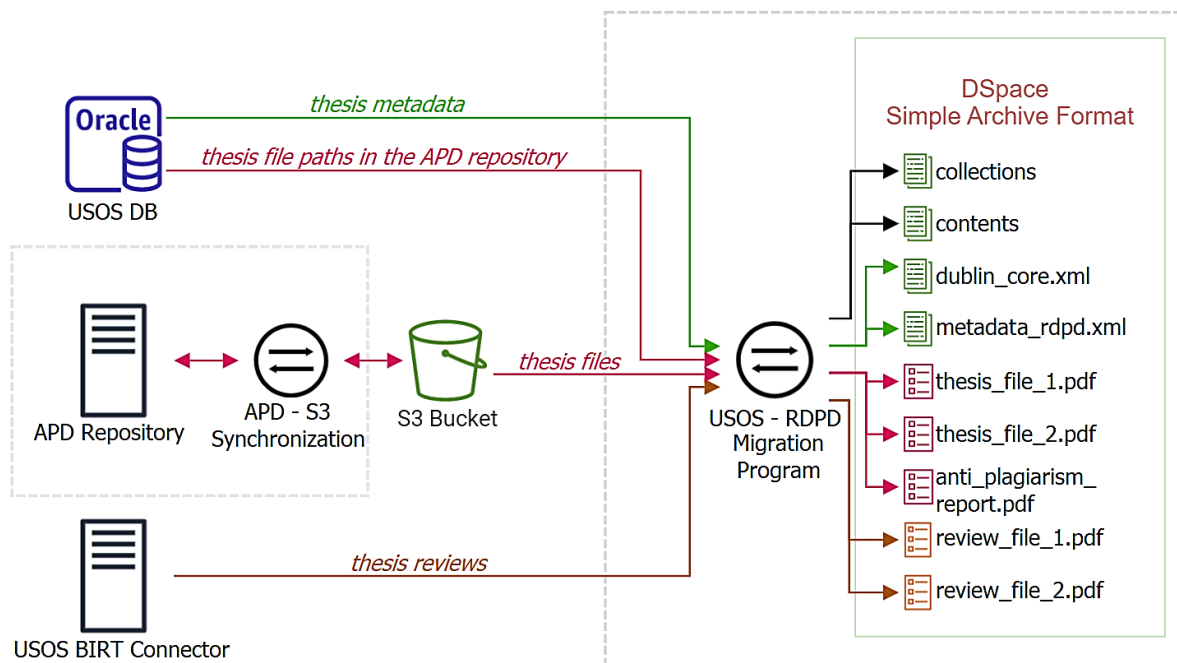


Figure 4. Diagram of data transfer from university systems to RDPD.

Source: authors' elaboration.

8. Summary and conclusions

The RDPD system was prepared for Kielce University of Technology, Poland, within the project titled “National Data Storage (NDS). Universal infrastructure for sharing, storage and effective processing of large data volumes in HPC, Big Data and Artificial Intelligence models”, Intelligent Development Operational Program, Agreement: POIR.04.02.00-00-D010/20-00. The system is a production version for a specific university.

The experience gained while working on the RDPD production version allowed for the development of a skeletal version in a manner which allows to implement it in other universities. This version is universal without elements of visual identity and federated login.

The skeletal version serves as the basis of the RaaS – Repository as a Service. For the service to work, an automatic installation process was developed at the request of a university customer. This required the use of advanced information technology including the creation of the RDPD template and the cloning of the template. Cloning is defined in the form of a list of operations to be performed to obtain a ready-to-use RDPD system. Thus, the system is made available to other universities in Poland. The university can customize the system. End users can access the repository, designed to store and manage data generated by the university's didactic processes, enter their metadata and data or download data.

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THE ANALYSIS OF NO-COST SOLUTIONS FOR TOXIC WASTE REDUCTION AT THE COMMERCIAL CHEMISTRY PLANT

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Purpose: The aim of the research was to implement innovative technologies and management practices that would allow the chemical company to reduce the amount and harmfulness of toxic waste generated.

Design/methodology/approach: The research took a quantitative approach, based on a detailed analysis of production processes and waste management. Techniques were used to monitor waste at each stage of the production cycle, allowing a precise assessment of the effectiveness of the solutions implemented. A production process analysis and waste balancing method were used. The study included detailed measurements of the consumption of toxic substances and the identification of opportunities to return them to the production cycle, with both economic and environmental benefits.

Findings: The implementation of new technologies and the optimization of resource management enabled the company to significantly reduce emissions of hazardous substances and reduce costs associated with waste management and potential environmental penalties.

Practical implications: The results of the project indicate that other companies in the chemical industry can use similar solutions to achieve a reduction in toxic waste and increase the efficiency of production processes, while reducing operating costs.

Social implications: The project to reduce the production of hazardous substances emitted into the environment described in the article has produced the desired environmental results. The environmental impact of the company has been reduced thanks to the solutions applied.

Originality/value: An important aspect of the article was to describe the innovations introduced in an operational innovative line with a closed production cycle.

Keywords: toxic waste, production line, pipe cleaner, no-cost innovation.

Category of the paper: Technical paper.

1. Introduction

In light of escalating environmental and public health challenges, the reduction of toxic waste in industrial processes has emerged as a critical concern not only for environmental protection but also for economic efficiency (Alloway, Ayers, 1999). These substances, which may possess poisonous, corrosive, flammable, explosive, or other hazardous properties, pose significant risks. Toxic waste can take various forms, including chemical, biological, radioactive, and other hazardous materials (Kuczyńska, 2000; Wardasz, 2003). By comprehensively understanding these two key dimensions, we can evaluate the benefits for the environment, public health, and the operational efficiency of industrial enterprises (Bilitewski, Härdtle, Marek, 2006; Rosik-Dulewska, 2008).

With the growing imposition of regulatory requirements and environmental standards, industries are increasingly compelled to minimize the generation of hazardous waste (Dyrektywa Rady EWG, 1991; Dz.U. RP, 2023). Poor management of such waste can result in severe threats to ecosystems, contamination of groundwater and surface water, air pollution, and ultimately, adverse health effects on both human and animal populations. Therefore, there is an urgent need to implement advanced technologies and waste management strategies that not only comply with but also surpass existing regulations. Such measures will optimize the reduction of environmental harm (Pyssa, 2014; Nemerow, 2007).

Investment in cutting-edge technologies and innovative waste management practices is pivotal for the sustainable development of industry. It also serves as the foundation for fostering a more responsible and environmentally conscious society. By adopting modern methods of recycling, raw material recovery, and emission control, the industrial sector can significantly mitigate its environmental footprint. Additionally, this approach enhances public awareness regarding the issue of environmental pollution and promotes sustainable production and consumption practices. Educating the public about the consequences of toxic pollution and encouraging changes in consumer behavior are essential for achieving long-term environmental sustainability (Rostek, Wiśniewski, 2021; Feld, 2018; Wodecki, 2013).

2. No-cost solutions applied within the company

By their very nature, no-cost solutions represent the most commonly adopted initial actions within the industry. These typically involve aspects related to organizational practices, standards, and training. Matters of industrial automation, particularly those related to software optimization, operations, or sequencing, are also considered within the organizational

framework—provided that such changes do not necessitate alterations to the mechanical infrastructure of the production line (Nawrot, 2016).

An American company specializing in household chemicals initiated a zero-waste project at one of its manufacturing facilities. The primary objective of this project was to reduce the costs associated with toxic waste, which had risen significantly between 2021 and 2023. The project focused on a production line dedicated to mass-producing bottles of pipe cleaner for the consumer market, consuming 4 million liters of toxic substances per month. This line is a fully integrated production unit, managing the entire process from raw material intake to the finished product, including all necessary steps of manufacturing, processing, assembly, testing, and packaging (Nogała, 2024).

The products manufactured are 0.5-liters and 1-liter bottles of pipe unblocking agent. This agent contains hazardous substances, specifically 15% sodium hypochlorite (NaCl) and 8% sodium hydroxide (NaOH) (Figure 1). The residual mixture is a carefully formulated concentrate, the specification of which is proprietary. The bottles are made from high-density polyethylene (HDPE) and are sealed with safety caps equipped with a special mechanism designed to prevent children from easily opening the packaging.



Figure 1. 0.5 l and 1 l bottles of pipe unblocking agent.

Source: Nogała, 2024.

The production line was comprised of eight segments, each employing different technological processes. Its capacity was measured by a filling rate of 150 liters per minute.

The line included a SKID system – an assembly of dosing units, mixers, pumps, and tanks. This system enables the precise combination of eight different raw materials, which are dosed into buffer tanks according to a specific formulation (proprietary know-how), producing the semi-finished concentrate of the final product. Each of these raw materials is classified as a hazardous substance, with the most toxic being caustic soda (NaOH) at a concentration of 50% (Figure 2).



Figure 2. SKID infrastructure.

Source: Nogała, 2024.

Surge Tank – the final tank where the completed formulation is created. This tank, with a capacity of 2 m³, receives the previously prepared concentrate, ultra-pure CIP water with a conductivity level not exceeding 7 μS/cm, and sodium hypochlorite (NaOCl) with an active chlorine concentration of 14-16% (Figure 3).



Figure 3. Surge-Tank.

Source: Nogała, 2024.

Pouring Machine with Capper – a machine that dispenses the prepared formula into the final packaging, consisting of 0.5-liters and 1-liter bottles made of high-density polyethylene (HDPE) with high chemical resistance (Figure 4). This machine maintained a pouring accuracy of ±2 ml, verified each time a bottle was filled. The capper was equipped with a system that evaluated the cap tightening force by monitoring the current loads on the servo drive, allowing the cap tightening torque to be precisely adjusted within a tolerance range of 1.2-1.4 Nm.



Figure 4. Pouring and capping machine.

Source: Nogała, 2024.

Plasma Machine – a device responsible for reducing the electrostatic charge that accumulates on bottles during transport, particularly due to friction against plastic components such as guide rails or transport wheels (Figure 5).



Figure 5. Plasma machine.

Source: Nogała, 2024.

Labelling Machine – a device responsible for applying wax labels to the bottles using water-based adhesive (Figure 6).



Figure 6. Bottle labelling machine.

Source: Nogała, 2024.

Carton Folding Machine – a machine responsible for unfolding pre-prepared cartons supplied by the manufacturer and shaping them to accommodate the finished products (Figure 7).



Figure 7. Carton folding machine.

Source: Nogała, 2024.

Manual Packaging Zone – a network of conveyors featuring eight open stations where the finished bottles are removed and manually packed into cartons (Figure 8).

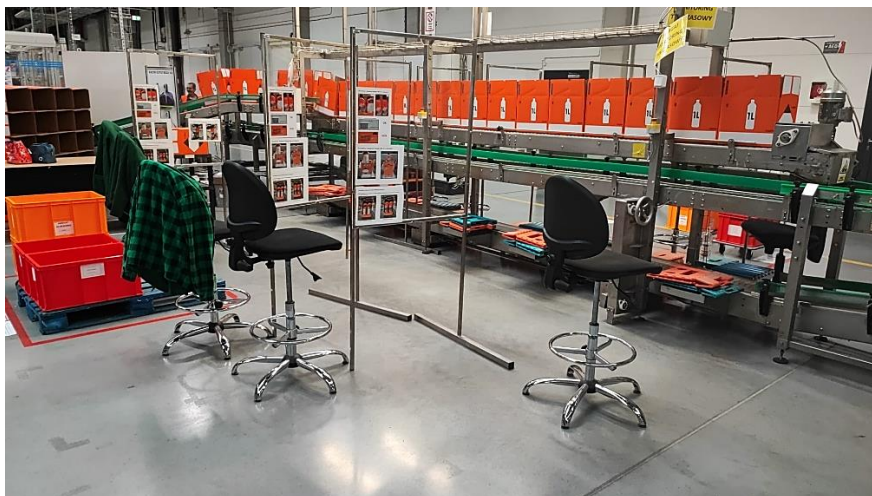


Figure 8. Manual bottle packing zone.

Source: Nogała, 2024.

Palletizing Machine – equipped with a carton closing and sealing module, a weighing system that verifies the quantity of packed products per the specified recipe, a robotic arm for palletizing the cartons, and a stretch wrapping system for securing the pallets (Figure 9).

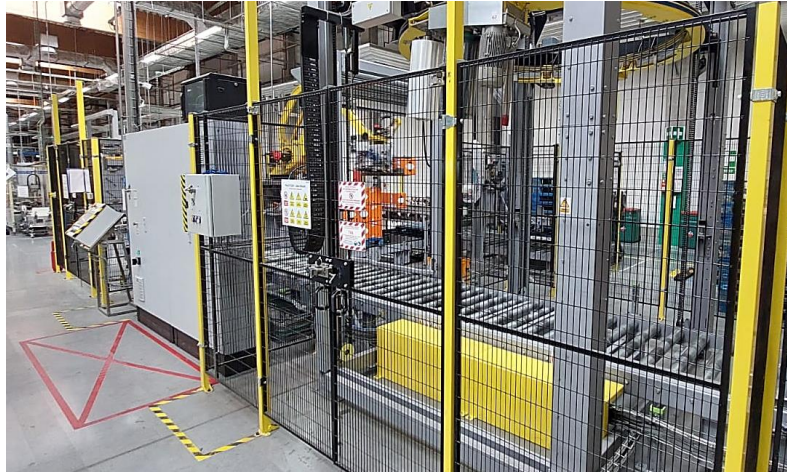


Figure 9. Palletizing machine with stretch film wrapping system.

Source: Nogala, 2024.

The complexity of this production line, with its numerous processes – each generating waste in the form of bottles containing hazardous substances – presents a significant design challenge for implementing a zero-waste policy.

3. Identification of Types and Quantities of Toxic Waste Generated by the Selected Production Line

In the production line depicted, there is a risk of generating waste at each stage of the process. Waste can be categorized into controlled and uncontrolled types. Controlled waste refers to waste produced as a result of quality testing, including liquid waste or waste contained in packaging. Uncontrolled waste, on the other hand, arises from the inadequate performance of machinery and equipment, leading to the production of non-compliant products of various kinds.

3.1. Controlled waste

At the start of the line in the 'SKID' module, controlled waste includes samples of concentrates sent to the laboratory for quality testing, amounting to 0.5 kg per sample. Before sampling, any remaining concentrate is discharged into a 15 kg bucket to drain the system. This discharge is stored as waste in external Intermediate Bulk Containers (IBCs). With a maximum line capacity, sampling occurs 7 times per day, resulting in 108.5 kg of waste.

Quality sampling of raw materials before processing also contributes to additional waste. There are 8 raw materials used in production, each tested at different frequencies and volumes:

- **Raw Materials 1, 2, 3, 4, and 5:** These additives are each tested once per day at 0.5 kg per sample. After testing, the samples are disposed of, resulting in a total of 2.5 kg of waste daily.
- **Raw Materials 6 and 7:** These additives are tested once per day and once per delivery. Each sample is 0.5 kg, and with two deliveries per day, this results in 4 kg of waste.
- **Raw Material 8:** This additive is sampled three times per day at 0.5 kg per sample, resulting in 1.5 kg of waste.

In total, controlled waste from the sampling process amounts to 116.5 kg per day.

The Surge Tank module, where the final product is created, generates 93 kg of waste. This includes sampling for testing six times per day at 0.5 kg per sample and a 15 kg drainage discharge.

The Bottle Filler with Capper module produces the largest amount of controlled waste due to quality checks. Daily, the twist-off torque of eight bottles is measured. Because this test affects the thread design and prevents reuse, each test results in waste. With sampling every 15 minutes in batch production, this module generates between 384 kg and 768 kg of waste per day, depending on the bottle format (0.5 l and 1 l).

In the plasma machine process, surface tension tests on bottles, using markers with special liquid density, result in 3 kg to 6 kg of waste per day, depending on the bottle format.

The labelling machine performs validation tests for label position and use-by date printing, requiring nine bottles per day. This results in 4.5 kg to 9 kg of waste, depending on bottle size.

The carton assembly, packing area, and palletizing area do not generate process-controlled waste through quality control measures.

A summary of the waste generated by the production line over a 24-hour period is presented in Table 1.

Table 1.

Summary of Controlled Waste [kg] Generated by the Production Line During 24 Hours of Operation

Bottle format	Process module							Total	
	SKID	Surge-Tank	Pouring/ cooling machine	Plasma machine	Labelling machine	Case folding machine Packing zone Palletizing machine			
	Controlled waste, kg								
Bottle 0.5 l	116,5	93	384	3	4,5	0	0	0	601
Bottle 1 l			768	6	9	0	0	0	992,5

Source: own elaboration based on Nogała, 2024.

3.2. Uncontrolled waste

Uncontrolled waste results from process or human errors. To identify such waste, it is essential to monitor the process and conduct analyses to validate the data and draw appropriate conclusions.

Assessing the scale of uncontrolled waste involves documenting all activities and operations performed on the equipment. A comprehensive analysis of the entire machine infrastructure—including component performance and operational activities carried out by personnel—was conducted across all modules.

The SKID system comprises tanks, metering sections, pumps, and valves. Due to the presence of strong acids (part of the additives) and strong bases such as 50% NaOH, the system requires a closed infrastructure. This includes tanks and piping made from type 316 steel. Most pumps are pneumatically powered diaphragm pumps, chosen for their ability to handle the viscosity of raw materials. To prevent component degradation, electric pumps are equipped with polypropylene impellers. Pneumatic valves feature stems made from acid-resistant steel. This infrastructure supports the preparation of the concentrate for the final product and its transfer to the Surge Tank.

The concentrate is produced up to seven times daily, with a volume of 2500 liters per batch. The production process takes approximately two hours, while consumption of the concentrate takes around 3.5 hours. During production, raw materials are delivered to the tank in the correct sequence and quantity.

An identified process error occurred with the closing valve during the addition of the fourth raw material when the concentrate volume was 1500 kg. The valve jammed during closure, resulting in an overdose of the fourth raw material. This caused the concentrate to deviate from quality specifications. Consequently, the affected concentrate was disposed of by pumping it to external IBC tanks.

Another process error observed was excessive aeration of the concentrates, negatively affecting key parameters such as viscosity and density. An analysis of the raw material delivery process revealed that the eighth raw material, which was pumped into a 50-liters intermediate tank, was dosed from the top through a spigot. The high fill level caused the agent to hit the surface of the liquid, leading to aeration. Given that this component constitutes 20% of the concentrate, it adversely impacted the final product specifications.

The Surge Tank module, where the final product is prepared, also experienced issues with aeration. Quality control results showed deviations in viscosity and density specifications. Analysis revealed that the spigot delivering the final mixture to the tank was positioned at the top. The filling control automation allowed the formula to be dispensed at low levels, causing the agent to create air bubbles upon hitting the liquid surface. With a product density of 1123 kg/m³ and a high consumption rate, outgassing of the formula in the tank was problematic.

The Pouring/Bottle Cap machine underwent two separate analyses for the pouring and capping modules. In the pouring module, common issues included overfilling bottles beyond the set tolerance, leading to waste and production downtime for machine cleaning. Another problem was the formation of drips on the outer walls of the bottles due to splashing from the filling nozzles, which was a critical defect affecting user safety. In the capping module, issues included caps being screwed on at an angle, damaging bottle threads and causing loss of tightness. Additionally, excessive torque during capping could break the child-proof safety mechanism, rendering the bottle unusable.

The plasma machine did not generate uncontrolled waste. Its simple design, comprising a conveyor and plasma heads applying a charge to the bottle surfaces, proved effective without creating additional waste.

The labelling machine, responsible for applying front and back labels and printing expiration dates, also contributed to waste. Strict tolerances for label positioning and adhesion resulted in significant waste from poorly applied or missing labels. The printing of expiry dates, using an industrial inkjet printer, was a critical stage monitored by a vision system. Inefficiencies in the print head service led to deteriorating print quality, with bottles featuring illegible prints set aside as waste.

The carton erecting machine, packing zone, and palletizing zone were mostly free from defects causing toxic waste. Analysis confirmed that manual packing was the only area with potential for physical damage to bottles due to human error. While this did not require major intervention, awareness and training were recommended for the crew. Quality defects identified in the packaging area were typically linked to errors from previous stages, such as improperly labelled bottles or bottles with defective caps.

4. Solving the problems of toxic waste generation

In the SKID line area, addressing the current issues related to toxic waste generation led to the proposal of updating the concentrate production program. The analysis focused on the delivery of the second raw material, which is 1.8 kg with a tolerance of $\pm 10\%$. The system involved using a bulk flow meter upstream of the concentrate tank and incorporating a 'timer' for the bucket rotor pumps. This timer set a predetermined running time for the pumps in the program.

The flow meter collected data correlating with the pump settings based on the preset start-up and shut-down times. If the flow meter reading approached the preset quantity too closely and the pump shutdown was delayed, it resulted in an overdose of the raw material. Consequently, this would lead to a concentrate with a concentration of the second raw material that fell outside the specified tolerance, resulting in waste. By analyzing the durations of pump

start-up, valve opening, and raw material delivery, the delivery efficiency was improved, achieving a dose deviation of $\pm 2\%$, which is within the specification tolerance. Following confirmation of the optimized program's efficiency, a new Management of Change (MOC) procedure was prepared to implement the revised program after testing.

Another no-cost improvement involved testing methods to remove labels from bottles deemed waste due to poor label positioning outside quality tolerances (Figure 10). Water tanks, with temperatures not exceeding 30°C , were used for this purpose. Twenty bottles were placed upright in the tanks, with the water level not surpassing the height of the bottle necks. After conditioning the bottles in the water for 20 minutes, a cotton cleaner was used to dry the bottles and remove the labels. The warm water caused the glue to lose its viscosity, allowing the labels to peel off more easily.



Figure 10. Example of a badly labelled bottle.

Source: Nogała, 2024.

Another initiative aimed at waste reduction involved removing incorrectly printed production dates from 1-liter bottles (Figure 11). To achieve this, a specialized chemical designed for printer head cleaning was used. This dust-free cleaner, when applied, enabled the removal of the erroneous use-by date from the bottle's surface. Subsequently, the date could be re-printed correctly.

The implementation of this cleaning process, along with the label removal process, necessitated the development of detailed procedures and instructions. Additionally, staff training was provided to ensure proper execution of these measures.



Figure 11. Example of a photograph with a bad expiry date printed on it.

Source: Nogała, 2024.

Three main cost-free measures were implemented in two production processes:

1. **Optimizing the Supply of Raw Material No. 2 in the Concentrate Stage**

The first measure focused on optimizing the concentrate blending process through program enhancements for the delivery of raw material number 2. This material, required in an amount of 1.8 kg, is added in the second step of concentrate formation, following the dosing of CIP water. Prior to introducing the second raw material, a 50 kg water flush was performed to clear the system.

The process involved:

- **Initial Pump Operation:** A signal was sent to the pump for raw material no. 2 to operate for 1.2 seconds, raising the pressure before the pneumatic valve.
- **Valve Operation:** The valve was then signaled to open. During its opening, the pump received a second signal to operate for 2.4 seconds.
- **Blending Mode:** The pump entered a blanking mode for 0.8 seconds, synchronized with a signal to the closing valve to move it to a closed position.

Volumetric flow analysis ensured that the set quantity of raw material was delivered. If the total run time of the pump and valve deviated from the program, causing flow to fall outside the $\pm 10\%$ tolerance, the program entered a problem/failure mode and halted further mixture creation.

Key to this process was the efficiency of the valve, which was confirmed to fully move within 0.95 seconds. Consequently, the signal controlling the pump's run time was adjusted from 2.4 seconds to 2.25 seconds, and the quench time was extended to 0.95 seconds, aligning with the valve's closing time. This adjustment significantly reduced pressure fluctuations at the end of raw material delivery and improved precision to within a constant tolerance of $\pm 2\%$. The improvement minimized the risk of mixtures falling outside quality specification tolerances, thereby reducing hazardous substance waste to approximately 500-1000 kg per month.

2. Implementing a Procedure for Removing Labels from Bottles

The implementation of the label washing procedure in the labelling production process required establishing a clear set of operational standards (Figure 12). This involved preparing specialized water tanks equipped with compartments for the bottles, a thermometer for monitoring water temperature, and a stopwatch to time the conditioning of the bottles. Dedicated areas were set up for bottles to be washed and for those to be relabelled. Additionally, a specific cleaner was selected to assist in drying the bottles after washing. A tracking form was created to document the types of unsaleable bottles based on labelling quality. This form, combined with a defect chart, allowed for trend visualization, guiding appropriate actions to improve labelling quality. Finally, these procedures and standards were documented in a comprehensive set of procedures and work instructions to ensure consistency and effectiveness in the process.



Figure 12. Bottle label washing zone and production date imprint.

Source: Nogala, 2024.

3. Implementing a Procedure for Removing Production Dates from Bottles

The activation of the procedure for washing off the production date on the packaging was a critical action due to legal requirements. Products requiring an update to their overprint for quality reasons were first identified by an automated vision system, which separated them from the serial production line. The operator then transferred these products to a designated table, where the need for reprinting was confirmed, and the bottles were directed to the washing process to remove the old code. At this stage, a double-check procedure was implemented: a third party verified that the bottles could not return to the serial production line and documented the need for repair. The bottles were then moved to a designated area, where they were prepared for reprinting with a detailed description specifying the period, model, and date required. This process was confirmed with a signature to ensure accuracy and compliance.

Investing in optimizing production processes and reducing toxic waste emissions not only benefits the environment but also enhances a company's operational efficiency and competitiveness. By leveraging modern technology, adopting sustainable production practices, and collaborating with business partners, companies can achieve both economic and environmental objectives.

A prerequisite for initiating the project to reintroduce non-conforming finished products into production was to establish a procedure ensuring that the formula could be returned to production within 24 hours of manufacture. Consequently, a workshop was organized to prepare the material management areas from an organizational standpoint. A specific area was designated across the production line for storing bottles that were non-repairable. Each bottle had to be registered on a form and labeled with the date and time of manufacture. To minimize the time between production and reintroduction, it was mandated that each shift close the area with a status of zero bottles by the end of its shift. Additionally, a position was created to oversee and record the quantities of returned products once they overflowed. A location next to the Surge-Tank was chosen for the formula turnaround station, and another site was designated for hazardous waste storage. All planned activities were documented in a procedure and incorporated into job instructions for employee training.

The volume of hazardous waste generated was substantial, and its associated costs significantly impacted product expenses. Implementing corrective measures to reduce waste generation provided both economic and environmental benefits. To fully assess the effectiveness of the proposed solutions, a comparison was made between the period before the zero-waste project and the results after implementing the measures. Over a six-month observation period, the effectiveness of the zero-waste measures was confirmed. The measures resulted in a significant economic and environmental success, saving over PLN 350,000 and reducing waste emissions by 71 tonnes.

The recurring quantity of waste was evaluated six months after the project's implementation, which was carried out in two phases. During peak operation, the line produced approximately 3,456,000 1-liter bottles and 864,000 0.5-liter bottles per month, resulting in the generation of 4,366,224 kg of hazardous substances. Over this period, the line produced non-conforming products amounting to 64 tonnes of waste. Although the waste-to-product ratio was approximately 1.5%, the monthly cost associated with this waste was PLN 325,000. Prior to the project's implementation, the toxic waste stockpile was 11.8 tonnes, comprising waste from poor bottle labeling and off-specification concentrate (Table 2).

Table 2.*Volume of waste generated per month for the no-cost stage*

Type of waste generated	Monthly waste, kg	Monthly cost, PLN
NOK bottles (label quality) 0.5 l	2 400	12 000
NOK bottles (label quality) 1 l	8 400	42 000
Off-spec concentrate	1 000	5 000
Total	11 800	59 000

Source: own study.

With the introduction of the label-washing procedure and improvements in the raw material supply program, which effectively enhanced product specifications, the risk of producing out-of-specification waste was completely eliminated. Bottles with washed labels were successfully reintroduced into the production process. As a result, the effectiveness of the measures was confirmed to be 100%. After six months of operation following the project's initiation, no waste from these categories was recorded.

Operating at full capacity, the line generated up to 62 tonnes of waste per month. The disposal costs alone, not including other factors such as production time and raw material consumption, amounted to PLN 310,000. To address this, no-cost measures were implemented, and their effectiveness was confirmed six months later. These measures successfully reduced hazardous waste production from 12 tonnes to zero, resulting in monthly savings of approximately PLN 60,000. This achievement was notable, especially since it required no financial investment but only changes in work organization and minor program adjustments.

Protecting the environment by reducing hazardous substance emissions is crucial for human health, biodiversity, water and soil quality, and climate stability. Such actions are essential for ensuring societal sustainability and maintaining ecological balance. Reducing emissions of harmful substances benefits ecosystems, protects flora and fauna, and improves human living conditions by lowering the risk of pollution-related diseases.

5. Summary

The project aimed at reintroducing the formula into the production process yielded significant environmental and economic benefits. By optimizing technological processes and adopting more efficient resource management methods, the company achieved notable reductions in hazardous substance emissions. These measures not only decreased the company's environmental impact but also led to substantial cost savings related to waste management and pollution penalties.

In summary, the initiative to minimize hazardous substance emissions achieved its environmental goals while delivering tangible economic advantages. The project enhanced the company's market competitiveness, earned recognition from customers and business partners, and contributed to both local and global environmental protection. This demonstrates that investing in ecological and sustainable practices is both an ethical and financially sound strategy.

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CUSTOMER SERVICE PROCESS AND THE FINANCIAL CONDITION OF THE ENTERPRISE – CASE STUDY OF A COURIER COMPANY

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Purpose: The aim of the article is to analyze the impact of the quality of the customer service process on the financial condition of a company providing courier services in the era of digital transformation based on a case study.

Design/methodology/approach: The article uses a critical analysis of literature in the field of quality management, customer service process and digitalization, an examination of documents concerning the company, a diagnostic survey method conducted among customers of a courier company and statistical research.

Findings: The survey results showed that customers assess the quality of customer service and services in the analyzed company at a good level. Considering the lack of precision of this general statement, statistical analyses confirmed the advantage of the competition in the aspect of determinants related to the dimensions of certainty, reliability and materiality. In addition, a more in-depth analysis of the relationship between digitalization and quality showed that the development of digital technologies and the quality of digital services of the analyzed operator negatively affects the use of its offer and increases the advantage of competitors, who are assessed as a better choice. The respondents' answers are influenced to a statistically significant extent by their age and education. Older customers are more likely to choose the surveyed operator, while more educated customers appreciate the quality of service and the digital offer of competitors. In view of the information presented, it can be concluded that digitalization affects the quality of the customer service process in companies providing courier services. The assessment of quality depends on the age and education of the customer. It is necessary to provide support and education in the aspect of digital services for older customers and increase the attractiveness of digital services for younger customers. The impact of digitalization on the quality of the customer service process also affects the financial condition of the company, and the decreasing revenues from courier shipments have already been identified for reasons, the removal of which can improve the financial efficiency of the company.

Research limitations/implications: The presented work may constitute the basis for further research in the field of the courier/postal services market, the impact of digitalization on selected markets and the analysis of changes in consumer preferences in terms of management and marketing. In addition, it may constitute a guide for managers responsible for the effective functioning of courier companies.

Practical implications: The article provides information for both courier service companies and companies that are significantly affected by changes due to digitalization, in which customer service is one of the most important processes. Focusing on ensuring high quality of

the customer service process within quality management, with particular emphasis on digital changes taking place in the company and on the market, can bring tangible effects in the form of improving the economic situation of the company, which has a significant impact on its functioning on the market.

Originality/value: This article fills the identified literature gap. It has been shown that there is a wide range of theoretical studies and research in the field of quality management, customer service process and analysis of the courier services market and the impact of digitalization on business activities. The conducted research indicated that there is a lack of analysis of the connections between the quality of the customer service process and digitalization and the impact of these variables on the financial condition of a company providing courier services. The selection of the type of company is particularly important due to the impact of digitalization on the activities of courier companies and their importance in the modern economy.

Keywords: corporate finances, digitalization, quality management.

Category of the paper: research paper.

1. Introduction

The activity of courier companies, not only in Poland, are undergoing a transformation strongly related to technical progress and digitization. The change in consumer preferences regarding both services and the form, time and method of using them affects the entire activity of this type of organizations, defining their management, marketing and logistics in order to be able to stay on the market in the era of high international competition. A factor of fundamental importance for every type of activity, especially services, is quality. Quality is not only a fundamental aspect that must be provided to the customer, but also a tool for competitive struggle. Different industries are characterized by varying importance of customer service and different impact of digitalization on their business. A modern approach to quality management allows for the adoption of customer service as a process. In service companies, due to the specificity of services, interaction with the customer is of key importance. This means that the customer service process, apart from its extensive scope, can be referred to as a basic process, and therefore its quality is a key factor in their functioning. For the CEP (Courier, Express and Parcels) market, the quality of the customer service process is therefore of strategic importance. This market has also been undergoing intensive technological changes for a dozen or so years, and the digitalization of the operations of these companies determines their survival. Does the economic condition of the company therefore depend on the level of quality of the customer service process in the digital area? The aim of the article is to analyze the impact of the quality of the customer service process on the financial condition of a company providing courier services in the era of digital transformation based on a case study.

This goal contributed to posing the following research questions: Is the quality of the customer service process in this company appropriate from the customers' point of view? Can the quality of the customer service process be related to the financial condition of the

company? Does digitalization impact the quality of the customer service process in a courier company? In the paper there is used a critical review of literature, document examination, a diagnostic survey method among customers and consumers of a selected courier company and statistical research. The novelty of the work is the analysis of the relationship between the quality of the customer service process and the financial result in the era of digitalization of courier services market, carried out on the example of the case study. The work provides important information for managers and courier companies, as well as scientists analyzing quality in industries heavily influenced by digital transformation.

2. Literature review

Tables, figures and formulas – continuous numbering in the text. The services sector has been of constant interest to researchers in the field of economics for years, as its share in economic proportions has been steadily growing, but also in management, as in highly developed countries statistical data indicate that employees predominate in the services sector (Kawa, 2010). The reasons that argue for the growing importance of the service sector in the economy include digitalization, globalization, technical progress and innovation, the importance of human capital, the wealth of societies, and changes in lifestyle and the improvement of the quality of life of the population (Jamry, 2019; Dominiak, Kosowski, 2023). The literature also includes repeated phrases such as "service-based economy" (Service Economy), which confirms the importance of research on the sector (Solberg Søylen, 2021).

Services are a diversified part of the economy, which includes numerous branches, industries and types fulfilling various functions. It should be assumed that competition in the services sector is high and development prospects include its further growth. Competition depends on a number of factors, including: market size, number of enterprises providing services, service differentiation, entry barriers and methods of competition. Methods of competing in the modern market, apart from the most popular, traditional price competition, also include non-price competition including, among others, quality (Czapla, 2021; Szowacka-Mokrzycka, 2017).

The assumptions of the functioning of enterprises from the 1990s and early 21st century, according to which quality is not a source of strategic benefits, but a basic requirement for functioning on the market, are still relevant today. After 2010, enterprises perceived their own level of quality in a deceptive way and did not approach its assurance honestly, which resulted in undertaking intensive competitive struggle at other levels. These activities contributed to the reconsideration of quality, the importance of which was also intensified by changes in the economy and society, including, among others: the growing popularity of the process approach focused on improving quality, the emphasis on flexibility, efficiency and improvement,

the increase in the exchange of information between the enterprise and the customer, the growing importance of customer opinions, the ease of establishing business contacts, the pressure to produce/provide services efficiently and in a modern way, and access to information via online channels (Georgiev, Ohtaki, 2016; Sumardi, Fernandes, 2020).

In the literature related to competitiveness and quality, two main strategies of operation of modern enterprises are distinguished: internally oriented quality - thanks to ingenuity, innovation and cooperation, employees are involved in the process of creating a quality offer, and externally oriented quality - creating an offer with a quality level that, in the opinion of customers, exceeds the quality level of the competition (Gillies, 2015). The possibility of gaining a competitive advantage thanks to quality-related activities if possible when: the quality level of a given enterprise's services is higher than that of the competition, customers evaluate the quality level of a given enterprise's services better than that of the competition and improving the quality level is combined with the possibility of setting a higher price for services (Kaur, Kaushik, 2022).

Quality is a concept that is difficult to characterize unequivocally and universally for two main reasons. The first is the changes resulting from the development of humanity (social, technological, etc.) and the changes in quality (products, services, life, etc. - all "objects" of quality) and the perception of quality that they force. The second reason is the subjectivity of quality and the multitude of its determinants (Bielawa, 2011). While in the case of products, a significant part of the quality assessment may be quantitatively measurable features (e.g. product parameters; although many studies on quality management also emphasize the importance of non-measurable features in the case of products), the quality of services is mainly shaped by non-measurable aspects assessed by people with different opinions. This assessment is based on selected quality determinants and this selection also derives from a huge number of features. Quality is sometimes considered an intuitively understandable and undefinable term due to the lack of acceptance of a single, universal definition, which contributes to terminological chaos and the emergence of derivative issues (Mroczo, 2012; Tetteh, Ammoako-Gyampah, 2021). There are a number of features that characterize service quality. These include: difficulty in measurement, diversity and difficulty in selecting (lack of universal) evaluation criteria, customer satisfaction as a function of met expectations, quality dependence mainly on the service provider, (in many cases) the need for cooperation between the service provider and the service recipient, limited nature of quality control, difficulties in defining standards and customer requirements, lack of tolerance for errors, difficulties in planning, difficult assessment of compliance and non-compliance (Singh, 2016).

In the economy, the customer is referred to as the "driving engine" that determines the survival of contemporary enterprises on the market. Literature on quality based on the ISO standard in the principles of quality management shows that an enterprise is dependent on customers (Gołębiowski, 2015). In the past, customer service was only an inseparable activity supporting the functioning of the enterprise, necessary to finalize the transaction.

Currently, however, the customer plays a key role in manufacturing and service enterprises. This is due to the increasing competition, which causes the differences between individual enterprises to become smaller and smaller. The basis of customer service theory and inspiration for contemporary considerations, customer service can be seen as: all activities necessary to meet customer needs, providing the customer with goods and services at the time and place expected by them, and in a specific way, a series of activities undertaken by various areas of the company's activity to achieve established goals (Kowalik, Bagińska, 2023). From the customer's point of view, service is all elements of using the offer of a given company with which they come into contact. Therefore, it is not only direct interaction during the sale of a product or service, but also all forms of contact with the company, including, among others, material evidence and events taking place before and after the sale/service provision. Individual elements differ depending on the type of goods or services, industry, company size, organizational culture and trends (Zhang, Zhou, 2022). Customer service in the so-called broad sense is the adoption and combination of all three approaches in business practice. It then becomes the mission of the company, to which its functioning is subordinated. In this understanding, the company is oriented towards the customer, whose needs and expectations are the starting point of planning aimed at meeting their needs and expectations based on controlled standards and continuous improvement. Customer service is seen as a philosophy by market leaders who implement the most modern management concepts in order to maintain their position on the market (Fraś, Scholz, Olsztyńska, 2015). To sum up, customer service is an issue that has been presented in scientific literature for a long time, and over time it has begun to occupy a higher place as a subject of interest for researchers. This is mainly related to economic changes, largely caused by the development of technology. These factors have brought the role of the customer in shaping the possibilities of functioning of enterprises on the modern market to the forefront, which has translated into appreciating its importance and perceiving the essence of customer service for economic entities.

3. Methodology

The study was conducted using the diagnostic survey method. This method uses the survey's questionnaire technique. As part of the inductive research path, it consists in obtaining answers to a set of questions important for solving the research problem from precisely defined people (respondents characterized by a set of selected features) (Niemczyk, 2015). Among the advantages of the analyzed research method are the ease of implementation, simplicity and low cost of obtaining a large amount of data (Matejun, 2016). For the purposes of the work, survey questionnaire was developed for customers using the services of this and other courier

companies. The collected data were processed in a descriptive form and using statistical tests. Spearman correlation coefficients were used in the paper.

The study involved 953 customers of the analyzed company providing courier services in Poland and internationally (table 1).

Table 1.
Characteristics of respondents

Customers									
Gender [%]		Age [%]				Education [%]			
Male	Female	18-24	25-39	40-59	60<	primary	vocational	secondary	higher
49,74	50,26	14,17	31,27	38,51	16,05	0,84	16,68	52,15	30,33
Total: 100		Total: 100				Total:100			

Source: Author's calculations.

In addition to the metrics, the survey questionnaire included a set of statements assessed on a Likert scale of 1-5. The questions concerned both selected quality factors of the customer service process in a courier company (selected according to the Servqual methodology and five dimensions of quality) and the impact of digitalization on quality.

The analyzed company is an experienced operator. The financial documents provided indicate a slight increase in net sales revenues (by 0.98%) in the last fiscal year compared to the previous year, with a simultaneous gross loss on sales (an increase of 91.82%) and a loss on operating activities. This means that the analyzed company is in an unfavorable financial situation that is getting worse every year.

However, it operates among the ten main postal operators, which together have over 99% of the volume share. It operates in a highly competitive market - the postal services market is referred to as a market of dynamic changes. Domestic trends coincide with the trends of global postal markets. In recent years, the number of traditionally sent letter items has been regularly decreasing, with a simultaneous increase in the number of parcels. In addition, there is an increase in the importance of courier items in postal services (which are the most popular postal service, accounting for over 70% of the volume of postal services - in 2023, over a billion of them were sent) and an increase in the number of parcels sent abroad.

After a period of stagnation observed in the years 2010-2016, since 2017 there has been an increase in the value of the Polish postal market (currently, year on year by over 13%). The increase in revenues from postal services is mainly due to the increase in the value of parcels and courier shipments from e-commerce. In Poland, the e-commerce market, currently estimated at around PLN 100 billion, is considered a market with great potential for further growth (UKE Reports, 2018-2024).

In view of the information presented, the following research questions were asked: Is the quality of the customer service process in this company appropriate from the customers' point of view? Can the quality of the customer service process be related to the financial condition of the company? Does digitalization impact the quality of the customer service process in a courier company? Can digitization impact the financial condition of the company?

4. Research Results and Discussion

In the first part of the questionnaire, respondents from the customer group assessed the quality of selected features of the customer service process. Due to the high average ratings, the relationship between the frequency of using services and the assessment of the determinant was examined using statistical methods (table 2).

Table 2.

Values of correlation coefficients between the use of courier shipment/receipt in company and the assessment of the status of individual quality features of the customer service process

Pair of variables:	Rs frequency of services' use
modernity of equipment	0,014
professional presentation of employees	-0,003
availability of materials	0,007
punctuality	-0,005
faultlessness	0,034
help with problems	-0,134
compliance with the offer	0,002
competence	0,044
courtesy	-0,089
building trust	-0,045
feeling of safety	-0,102
speed and efficiency of service	-0,114
providing information	-0,003
response to requests	0,017
individual treatment	-0,095
paying attention	-0,017
understanding needs	-0,030

Source: Author's calculations.

Respondents using the services of the analyzed company mostly highly evaluate their quality. In contrast to these evaluations, there are five negative correlations between the frequency of using courier services and the evaluation of the quality of services, including receiving help with problems (Rs = -0.134), politeness of staff (Rs = -0.089), sense of safety (Rs = -0.102), efficiency and speed of service (Rs = -0.114) and individual treatment (Rs = -0.095; $p = 0.003$).

Due to the multitude of assessed statements and the research conducted for the analyzed operator and its competitors, the quality determinants were grouped into five standard dimensions for the purpose of comparison (table 3).

The courier company subjected to the study is significantly better assessed by customers in terms of quality factors included in the responsiveness group. Moreover, respondents significantly lower assess the material aspects of service. In the opinion of customers, the competition is characterized by statistically significantly higher assessments of the quality of the materiality, reliability and reliability dimension factors, which seems to be closely related not so much to the customer service process, but to the logistical aspect of providing services.

Table 3.

Values of correlation coefficients between the frequency of using courier services and the assessment of the quality dimensions of the analyzed operator and competition

Quality dimension	Rs analyzed operator	Rs other operators
empathy	0,042	-0,060
tangibility	-0,119	0,186
reliability	0,033	0,111
assurance	-0,004	0,104
responsiveness	0,071	0,123

Source: Author's calculations.

Next, respondents from the customer group were asked how digitalization affects their use of the offers of this and other operators (table 4).

Table 4.

The values of the correlation coefficients between the use of the company's services and the assessment of the impact of the development of digital services on them

Pair of variables: the impact of digitalization	Rs total	Rs age	Rs education
sending/receiving more parcels	0,178	-0,262	0,152
sending/receiving less parcels	-0,074	0,199	-0,146
using this operator more often	-0,245	0,051	0,023
using this operator less often	0,229	-0,092	0,079
using other operators more often	0,091	-0,257	0,211
using other operators less often	-0,052	0,234	-0,081

Source: Author's calculations.

The data in the table confirms literature research, which indicates an increasing frequency of using courier services. A statistically significant relationship was demonstrated between the assessment of the impact of digitalization and the frequency of using parcels ($R_s = 0,178$). In addition, a significant statistical relationship was identified between the impact of digitalization and the frequency of using this and other operators. Respondents who perceive a large impact of digitalization on courier shipments choose the services of the analyzed company significantly less often, and the services of other operators significantly more often. Moreover, with the increase in the age of respondents, the frequency of using parcels decreases, contrary to the influence of education - more educated respondents send more parcels. It was also noticed that older respondents significantly more often choose the analyzed company and significantly less often its competitors. In addition, more educated respondents declare more frequent choice of competitors.

The next question in the questionnaire concerned the general assessment of the quality of traditional and digital services of the analyzed company and its competitors (table 5).

Table 5.

The values of the correlation coefficients between the age and education of the respondents and the overall assessment of the quality of services provided by the analyzed company and its competitors

Pair of variables: the impact of digitalization	Rs age	Rs education
Quality of traditional courier services of this operator	<u>0,227</u>	<u>-0,102</u>
Quality of digital services of this operator	-0,010	-0,030
Quality of traditional courier services of other operators	<u>-0,146</u>	0,039
Quality of digital services of other operators	<u>-0,344</u>	<u>0,195</u>
Digitization contributes to improving the quality of services of this operator	<u>-0,102</u>	0,037
Digitization contributes to improving the quality of services of other operators	<u>-0,262</u>	<u>0,160</u>

Source: Author's calculations.

The quality of traditional courier services in the analyzed company is assessed higher and higher with the increasing age of the respondents from the customer group, contrary to the relationship related to the increase in education - the more educated the customer, the lower he or she assesses the traditional services of this company. Age also affects the perception of the quality of digital courier services, regardless of the operator. As age increases, the assessment of the importance of digitalization as a factor improving the quality of courier services, regardless of the company, also decreases. In addition, the higher the education, the better customers assess the impact of digitalization on the quality of competitors' services.

Respondents from the customer group also assessed their compliance with a set of statements the impact of digitalization on selected aspects of customer service (table 6).

Table 6.

Values of correlation coefficients between the use of courier services and the assessment of the impact of digitalization on customer service in company X

Pair of variables:	Rs frequency of services' use
facilitating the use of services	<u>0,201</u>
extending the range of services	<u>0,079</u>
reducing the waiting time for service	<u>0,177</u>
reducing the service time	<u>0,127</u>
improving the accuracy of service	<u>0,179</u>
increasing staff knowledge	<u>0,263</u>
increasing convenience	<u>0,129</u>
increasing trust to the operator	<u>0,173</u>

Source: Author's calculations.

With the increase in the frequency of using the courier services of the analyzed company, customers significantly more often notice the impact of digitization on improving the quality of all selected aspects presented in the table.

It was also checked whether there were any relationships between the age and education of the respondents from the customer group and the assessment of the impact of digitization on selected aspects of service in the analyzed company (table 7).

Table 7.

Values of correlation coefficients between the frequency of using courier services and the reasons for choosing the offer of other operators

Pair of variables: the impact of digitalization	Rs age	Rs education
making it easier to use services	-0,168	0,076
expanding the range of services	-0,188	0,169
shortening the waiting time for service	-0,078	0,088
shortening the service time	-0,184	0,136
improving the accuracy of service	-0,092	0,056
increasing staff knowledge	0,047	0,026
increasing the convenience of using services	-0,197	0,138
increasing trust	-0,030	0,094

Source: Author's calculations.

As the age of respondents increases, the value of perceived advantages caused by digitalization in the service and services of the company decreases significantly. This results, among other things, in a decrease in trust in the company. Moreover, as the education of the surveyed people increases, they significantly better assess the quality of individual aspects and the impact of technological progress on them. No statistically significant correlation was identified regarding the increase in staff knowledge.

Due to the lack of differentiation in the results, respondents also indicated reasons for using the services of other courier operators (table 8).

Table 8.

Values of correlation coefficients between the frequency of using courier services, age and education of respondents and the reasons for choosing the offer of other operators

Pair of variables:	Rs frequency of services' use	Rs age	Rs education
greater convenience	0,123	-0,434	0,300
better availability	0,100	-0,394	0,313
lower prices	0,106	-0,419	0,272
different range of services	-0,081	-0,376	0,270
better adaptation to needs	0,091	-0,377	0,291
necessity - lack of choice	0,049	-0,095	0,203

Source: Author's calculations.

In the opinion of respondents, courier services of other operators (including their digital aspects) are characterized by statistically significant greater convenience (Rs = 0,123), availability (Rs = 0,100), lower price (Rs = 0,106) and better adaptation to needs (Rs = 0,091). Compared to other operators, the analyzed company is better assessed in terms of the scope of services. No statistically significant relationship was found in the need to use the services of a given operator (e.g. in terms of professional or geographical). As age increases, respondents significantly less often choose other operators due to the indicated advantages. The examined relationships concern all the aspects examined. Education has a completely opposite effect on customer choice. As education increases, all the advantages of other operators causing a change in the choice of a courier company are statistically significantly more often noticed.

5. Conclusions, Proposals, Recommendations

In the first part of To sum up, the conducted literature research, document examination and the use of the survey method enable the achievement of the aim of the work and the answer to the formulated research questions and contribute to the formulation of additional conclusions. Literature research has shown a transformation of the postal and courier services market, the causes of which include changes in consumer preferences, lifestyle, modern economy and digitalization. Digitalization has a direct impact on it (the emergence of an increasingly wide range of digital services) and indirectly (the increase in the attractiveness of the courier services sector due to, for example, the increasingly popular e-commerce, which increases revenues in the sector). The analyzed postal services market is a market with further growth potential, which is significantly affected by the digitalization of postal services. The surveyed company, despite the market prospects, is in a difficult financial situation. The conducted survey indicated a good assessment of the quality of traditional courier services, but at the same time, the advantage of the competition in quality dimensions such as materiality, certainty and reliability, which are closely related to the logistical aspect of providing courier services.

The research results also allow us to conclude that digitalization affects the quality of the customer service process in companies providing courier services. In addition, the opinions of respondents regarding its impact and influence on the quality and quality of selected aspects of the customer service process, as well as the comparison of the quality level of the analyzed company with the competition, are influenced by the metric characteristics of the respondents, such as age and education. Older customers appreciate the quality of the analyzed operator's services and use their digital aspects significantly less often. More educated customers prefer the services of competitors, assess their quality higher and significantly more appreciate the impact of digitization on quality and notice the higher quality of competing companies. The conducted research allows for the formulation of the following answers: the quality of the customer service process in the analyzed company providing courier services is at a satisfactory level from the point of view of customers. The quality of the customer service process may be related to the financial condition of the company, especially if it is strongly influenced by a selected factor in this case digitization. This means that digitization is a factor influencing the financial condition of the company providing courier services.

The presented work may constitute the basis for further research in the field of the courier/postal services market, the impact of digitalization on selected markets and the analysis of changes in consumer preferences in terms of management and marketing. In addition, it may constitute a guide for managers responsible for the effective functioning of courier companies.

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ANALYSIS OF SOCIAL MEDIA USER SEGMENTS AS PART OF CONTENT MARKETING IN SPORT

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Purpose: The main aim of the article will be to accurately characterise the user groups of social networks in order to tailor information messages to them through these media. It is assumed that there are significant differences between the audiences of the same content depending on the qualitative criteria adopted.

Methodology: As part of the methodology to achieve the intended goal, i.e. the non-interventional observation of the activity of three user groups of the most popular social networks (Meta, Instagram and TikTok) on 25 June 2024. This day is the last performance of the Polish national team at the European Football Championship in Germany. A qualitative method using covert observation was applied here. 250 observational data from each medium were collected. These were then analysed in terms of the content posted. The language of communication, discussion activity, emotional engagement, use of emoticons and content culture were examined.

The data will be analysed qualitatively and quantitatively. The data was analysed qualitatively and quantitatively. The choice of subject was dictated by the European Championships 2024 and the related interest in the Polish national football team.

Findings: The result of the study is the identification of target segments among users (fans) of social networking sites and an attempt to determine the possibility of using the diversity of these segments in social media content marketing.

The main limitations of the study are the variety of forms of expression and the potential difficulty in indicating differences between groups.

Practical implications: The practical application of the study may concern social media communication units. Awareness of different categories of users will allow them to manage content appropriately, modify their own messages, and treat specific groups of users.

Social implications: This article aims to show the natural behavior in public spaces under the influence of sports emotions. It can influence self-reflection on what is posted on the Internet and that there can be moral consequences for any activity.

Originality/value: The novelty of the article is to present an assessment of natural social behaviour on the Internet. The applied method of observation using a covert technique and qualitative analysis allows for a real and not declarative assessment of human behaviour on social media.

Keywords: marketing in sport; social media; segmentation.

Category of the paper: Research paper.

1. Introduction

The development of modern information and communication technologies, and the consequent significant increase in their importance in the lives of modern consumers, means that they play an increasing role in marketing activities. One of the informational and real-world processes carried out in and through the enterprise, in its market environment, is marketing communication, which is an important integral instrument of the marketing strategy and practical implementation of the enterprise's market objectives (Wiktor, 2001).

Marketing communication can be defined as a set of signals emitted from various sources to the marketing environment and a set of signals collected by the company from this environment (Mruk, 2001). Thus, marketing communication should be treated as activities by means of which the enterprise transmits information, of varied form and content, about itself and its market offer to different groups of addressees, and as activities aimed at registering and providing feedback, which is an expression of the recipients' reaction to the actions taken (Pilarczyk, Wańkowski, 2010).

They enable companies to interact multichannel with current and potential buyers. Therefore, more and more companies are using them in the sphere of creating, delivering and communicating value to customers (Kieźel, Wiechoczek, 2020). In the modern economy, it is impossible to imagine a company functioning without communicating with market environment actors. In the literature, it is possible to encounter opinions that an enterprise exists through the transmission of information and communication, and that its nature is expressed in the processes of communication with entities of the environment (Bajdak, 2013).

There is a division of communication tools into classic and modern ones. Examples of classic communication tools include: billboards, TV spots, radio, newsletters, newsletters, etc. Modern tools include: blogs, emails, text messages and social media channels.

Marketing communication is defined in the literature as the process of information exchange between an enterprise and its environment for the implementation of a specific marketing strategy by an enterprise (Czarnecki, 2003).

Unlike promotion, where the stream of information flows mainly from the enterprise to the buyer, marketing communication implies a free flow of information in both directions, and is therefore a broader concept than promotion in its classical formulation. In recent years, the marketing communication environment has experienced two main changes:

1. The fragmentation of traditional media (the emergence of satellite TV, digital, thematic channels targeting a narrow audience).
2. The emergence of new modes of communication (e.g. product placement, interactive electronic media).

Marketing communication should be an interactive dialogue between a company or institution and its external internal environment (Lachiewicz, Mateyun, 2009). More and more companies are engaging in a variety of communication projects to encourage consumers to contact the company directly and, in the process, show that the brand is active and strives to connect with customers. This is being done, among other things, through online exchange platforms (e.g. launched as part of the companies' own websites and/or fanpages on social networks), which allow for multi-channel interactions with customers and often between consumers themselves. Through these so-called company profiles, forums or social networks, they are invited to express (e.g. in the form of posts, photos, videos) their opinions about the company and its offerings, their experiences and experiences with the products or to make suggestions.

Companies that use marketing communication are also sports organisations (primarily sports clubs). They are in the business of creating conditions for and supporting sport. It is through them that fans can watch sporting events and discuss them, and sponsors can use sporting events for promotional purposes. It should be noted that none of the actors mentioned in the model can do without communicating with other market players. Each uses different tools and methods to do so and does so with varying frequency (Smith, 2008).

Sports organisations need to build their image and encourage fans to use the service offer they have prepared, as well as to purchase material goods that represent an extended level of the sports product. Activities of an informational or strictly promotional nature are an inseparable part of the management system of these organisations and should take the form of a continuum. The communication activities of sports organisations are carried out in two areas (B2C and B2B) and must therefore select a different set of tools and forms for this purpose.

In recent years, integrated communication tools based on CRM solutions have become increasingly popular for developing relationships with fans and creating loyalty attitudes among them. The Internet and mobile telephony are primarily used for this purpose (Wańkowski, 2008). Social media play a special role here.

On the one hand, athletes, clubs, federations and sports brands, especially in the high performance area, have positively embraced the emergence of social media since its inception, using it as a way to develop their personal brand (Geurin, Burch, 2017). On the other hand, fans can now show and share their emotions and feelings through these new channels (Chang, 2019) instantly and in front of a wide audience, democratising the structures of sports consumption (Watanabe et al., 2017).

Over the past decade, the presence of social media has grown tremendously, changing the way we behave and communicate with others (Abeza et al., 2019; López-Carril et al., 2019). These tools are constantly accompanying us, both personally and professionally, through various technologies and devices such as tablets, smartphones or laptops that facilitate their use (Alalwan et al., 2017; Kolokytha et al., 2015).

Social media has also modified the way they offer a sports product, fostering fan engagement (Vale, Fernandes, 2018). Thanks to the development of social media, fans can now play a more active role in content creation (Armstrong et al., 2016), before, during or after a sporting event, across multiple platforms and markets (Billings et al., 2019; Li et al., 2019).

Given the popularity and importance of social media in both society and the sports industry, sports science research is already addressing the topic of social media. Studies here explore the use of social media and opportunities in the context of sport (López-Carril et al., 2019). Studies focusing on social media platforms include: Facebook (Osokin 2019; Achen et al., 2018), Twitter (Anagnostopoulos et al., 2017; Delia, Armstrong, 2015; Hasaan, 2019), Instagram (Anagnostopoulos et al., 2018; Siguencia et al., 2017), or Pinterest (Conlin et al., 2014; Hambrick, Kang, 2015) show the great potential and importance of these tools for sports organisations. In addition to this, it is important to emphasise the enormous potential and value that social media offers to sports science researchers by enabling them to access in an accessible way the large amount of data that is produced on these platforms (Chang, 2019).

Social media is an active part of the current dynamics of society, where an ever-increasing amount of information is available and easier to access. Both researchers and practitioners of a particular research discipline or research topic may find themselves in a situation where a vast amount of scholarly literature on the topic is available (van Nunen et al., 2018).

Given the importance of social media in management, it is also important to find methods to segment this volatile market (Naraine et al., 2019), which is also the aim of this article.

In scientific research on social media, the most important behavioral approach. In the world users' motivations are mainly examined, without quantitative analysis (Mochla et al., 2023; Abeza, 2023). Similarly, in research in Poland, the authors focus on the analysis of Internet users' behavior (Gąsior, 2016; Noga, 2023).

An additional important issue in the aspect of social media management is determining the segments of sports users. The segmentation process in sports focused mainly on spectators. In Poland, there are no such studies, because marketing in sports is still a scientifically neglected field. However, in the world you can find, for example, analyzes by spectators (Aleksandrisand Tsotsu, 2012; Hyatt et al., 2018). Scientists also undertook tasks related to the analysis of participants communicating via social media (Behrens, Uhrich, 2019; Hamilton et al., 2016). The combination of social media, the language of communication, sports and segmentation is practically unheard of, and this article is an attempt to distinguish individual forms of social media and their subsequent application in the marketing management process.

2. Methods

Research on social media user segments can be conducted differently. They can also concern different entities. The aim of this study is to determine the characteristics of active social media users on the basis of content left as a reaction to a sports organisation's post.

It should be emphasized that the method used in this article in relation to social media in sports has not been used in Poland. Similarly, around the world, mainly aspects of the division of sports fans were dealt with, without including them in social media. In this respect, the presented research is intended to be an innovative attempt to find differences in the behavior of users of particular forms of social media.

The hypothesis of the article assumes that there are significant differences among the recipients of the same content provided by a sports organization, which are determined by the adopted quality indicators. These indicators include the length of comments, the frequency of use of emoticons, the level of culture of expression and the intensity of interaction with other users. The above-mentioned qualitative indicators can serve as criteria for the segmentation of users engaged in activities in social media.

The method of non-interventional observation of the activity of three groups of users of the most popular social networking sites (Meta, Instagram and TikTok) on June 25, 2024 was used here. This day is the last performance of the Polish national team at the European Championships. A qualitative method was used here. 250 observational data each were collected. These were then analysed in terms of the content posted. The language of communication, discussion activity, emotional engagement, use of emoticons and content culture were examined.

The data were subjected to qualitative and quantitative analysis. The subject of the study was the information contained on the „Łączy Nas Piłka” portal website. The choice of subject was dictated as the European Championships 2024 and the interest in the Polish national football team related to the event. The increased number of activities influences the accuracy of the conclusions.

The result of the study is the identification of target segments among social media users in terms of their real activity and an attempt to determine the diversity of these segments in social media content marketing.

The entire analysis serves the appropriate management of social media content by sports organisations, clubs and sports-related sites.

The social media with the highest interest on 25 June 2024, namely Meta, Instagram and TikTok, managed by the Polish Football Association under the name „Łączy Nas Piłka”, were selected for the study. Each medium was subjected to observation on the day, after the last match of the Polish national football team at EURO2024. The following sites were subjected to the study:

1. <https://www.facebook.com/LaczyNasPilka/> (1.2 million likes).
2. <https://www.instagram.com/laczynaspilka/> (1.3 million observers).
3. <https://www.tiktok.com/@laczynaspilka> (1.6 million observers).

The “Łaczy Nas Piłka” page on the Meta portal mainly contains images and animations that relate to current affairs at the time of content creation. These are mainly sports results, player presentations, fan competitions and current news.

The “Łaczy Nas Piłka” page on Instagram is primarily made up of posts featuring photos, so-called reels (reels, or short videos) and page tags by other Instagram users.

The “Łaczy Nas Piłka” page on the TikTok portal consists primarily of short videos recorded by footballers, coaching staff and people connected with the Polish national team. Each page has a wide, daily reception, so posts on portals similar in terms of content and publication date will be selected for analysis.

Due to the amount of data and the variability of the subject of the study (different content), the day of 25 June, after the hour of the end of the last match of the Polish national team at the European Championships in Germany, was chosen for the analysis. The final sites were:

1. Meta: www.facebook.com/photo/?fbid=1011867543639914&set=a.819279436232060
2. Instagram: www.instagram.com/p/C8pfhGMAQ1X/
3. TikTok: www.tiktok.com/@laczynaspilka/photo/7381208626972724512

From these three sites, the first 250 comments were selected and assigned to categories so that each comment was only in one of them. The commentary was attributed at the discretion of the authors, according to the criteria adopted and the prevalence of predetermined characteristics. The results of this allocation and conclusions are presented later in the article.

3. Results

According to the methodology presented, data was collected to determine that the vast majority of recipients of content published by the Polish Football Association on social media are men.

In the course of the research, it emerged that women make up a relatively small proportion of the active audience of content on social media. The data collected on the basis of fan activity by gender is presented in Figure 1.

The data in Figure 1 shows that among users who are active and involved in commenting on sports pages, women only account for between 10 and 20%. Additional observation also showed that, despite the increasing interest in sport, women hardly engage in discussions on sports topics.

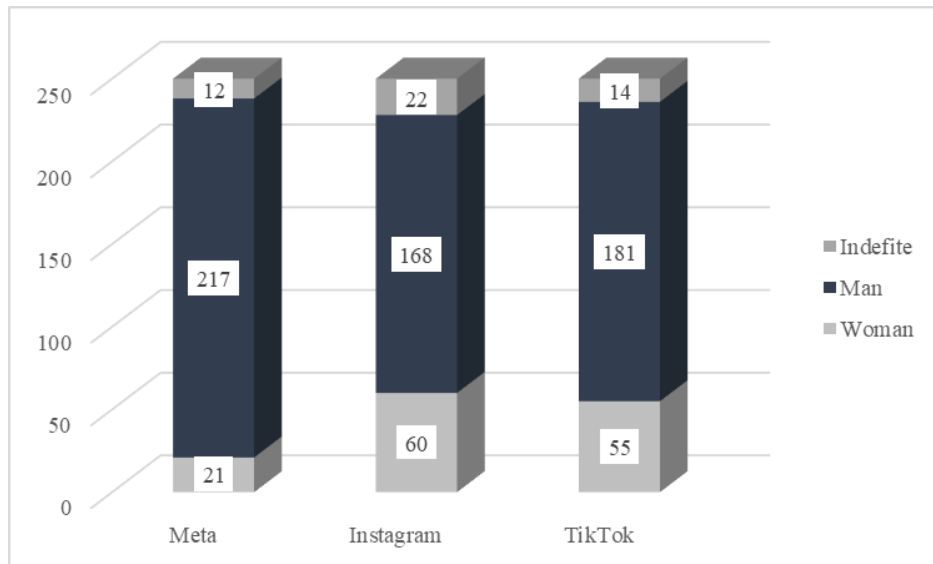


Figure 1. Gender structure of active social media users of the website “Łaczy Nas Piłka”.

Source: Own research.

Table 1. shows the number of comments, passive reactions and the percentage of reactions to comments (active reactions) from 25 June 2024. This indicates the engagement rate of passive and active reactions to content shared on various social media.

Table 1.
User engagement rate on social media

	Meta	Instagram	TikTok
Reactions	16000	75763	43700
Comments	1941	434	597
Comments/Reactions	12,13%	0,57%	1,37%

Source: Own research.

The information in Table 1 shows that the Meta portal is definitely regarded as a portal for exchanging opinions and interacting with other users. Despite the lower number of passive reactions, the percentage of engagement in discussions under posts is more than ten times higher than on other social media (more than 10% of active reactions compared to passive reactions). On Instagram, it is only around 0,5%, and on TikTok just over 1%. This means that younger media (Instagram, TikTok) with older users perform differently in the communication process via social media.

In the next step, data from all pages (in the form of comments) from the social media of the Polish Football Association (“Łaczy Nas Piłka”) were assigned to one of seven categories: *Jokers, Critics, Experts, Optimists, One Sentence, Rudes* and *Emoticons*. These differ in the length of the statements (*One Sentence, Critic, Expert*) and emotional involvement (*Optimists, Rudes, Jokers* and *Emoticons*). The results of the assignment to categories are presented in Figure 2.

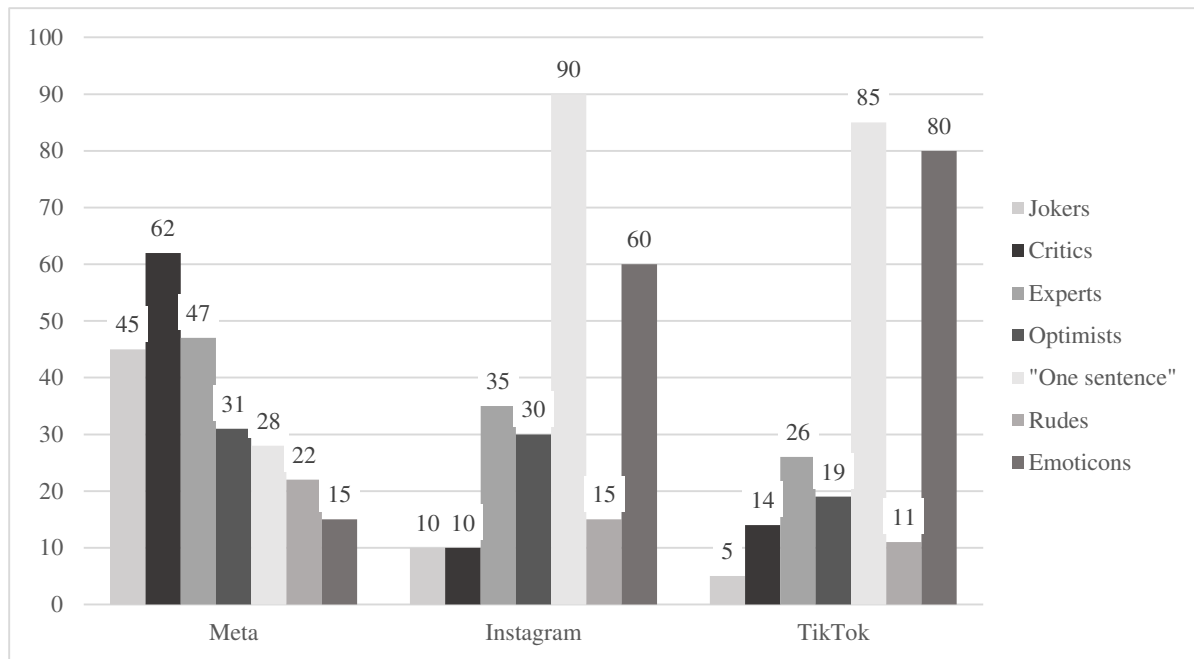


Figure 2. Categories of active social media users of websites “Łaczy Nas Piłka”.

Source: Own research.

As can be seen from the data in Figure 2, despite the differences in social media and their purpose, there are people who comment in very similar ways on each. The only differences are in the intensity of people from a particular category on a given medium.

Of the social media studied, the Meta portal is the most diverse and provides the greatest opportunities for different audiences. The high number in the *Jokers* category on the Meta portal is due to the possibility of freely adding viral marketing elements (memes, demots, reels and others). Also, the significant number in the *Critics* and *Experts* category on this portal is a result of the opportunities provided by Meta. It is a portal where people want to talk or give vent to their emotions in a longer form than a single sentence or emoticon. Consequently, rude and offensive statements also appear on Meta.

In the case of Instagram, users commenting with emotionicons and one sentence make up the largest share. For the most part, they do not expect any interaction or return to the page. Their engagement with the topic is cursory and shallow. There are also not many critics or jokers on Instagram. Nor do users treat it as a space for offensive comments. In part, this is due to the design of the portal, as well as the potentially lower reception of content.

The TikTok portal is the youngest of the popular social media. It gathers, in effect, a younger audience than Facebook and a less emotionally engaged audience than Instagram. For this reason, there is an increase in the number of comments in the form of emoticons and *One sentence*, and fewer longer statements of a *Critics* or *Optimists* nature. Here you can see a clear difference between this portal and others. On TikTok, relationships are quick and comments are short. Users do not require interaction with the others, they do not write relatively long sports or tactical analyses.

4. Discussion

The segmentation process depends on the point of view of the researcher. In sports marketing, this process mainly concerned fans of a sports team, the spectators of a sports event. Individual researchers created criteria by matching them to the results of the face-to-face surveys and creating individual sports fan segments. Social media users were also classified in this way, as in the research mentioned in the introductory section of this article. The research mainly involved the analysis of face-to-face surveys in the form of interviews using questionnaires. This provided a declarative picture based on the participant's own perception of themselves as an active social media user in sport.

This resulted in a research gap in the form of a failure to identify real rather than declarative responses to specific posts. This study was based on covert observation, where none of the users knew they were being observed. Therefore, the reactions were natural.

Hence, the conclusions are that all social media studied have a specific role in the online activities of their users. Depending on the portal, these roles vary and include:

- giving joy and a smile (*Jokers*),
- critically analysing a sporting event or team (*Critics*),
- demonstrating knowledge and being an online expert (*Experts*),
- giving comforting comments and looking for hope for the sporting future (*Optimists*),
- expressing one's own opinion quickly and briefly (*One sentence*),
- externalising own negative emotions (*Rudes*),
- showing momentary emotions (*Emoticons*).

Jokers are those for whom the motive for an active response is to introduce a viral marketing element. They are most often memes or demotivators taken from humour sites. Their importance in the communication management process of a sports organisation is negligible.

Critics are a group in which individuals make a brief but objective assessment of the content provided by a sports organisation. From a communication management point of view, their opinion can be valuable, as the degree of emotional involvement is at a medium level. Their numbers are high, especially on the Meta portal.

Experts brings together a relatively small group of people who analyse content or a sporting event in a professional manner. Most often, they do not give in to emotion. They practically bypass Instagram and TikTok, focusing on the Meta portal, due to the limitations of the other portals.

Optimists are a group characterised by faith and hope for a better future for the team being commented on. They are emotionally involved, but with a positive attitude. They are the largest group on the Met portal and lose relevance on the others.

One sentence is the most numerous group on Instagram and TikTok, characterised by a very short, one-sentence message, often accompanied by an emoticon. They are not emotionally involved, they do not waste time discussing, and what matters to them is leaving a mark on the page.

Rudes are a dwindling group of uncultured people who use the opportunity to comment to leave negative comments. Their behaviour calls for decisive action from managers.

Emoticons react most frequently on the TikTok portal. A characteristic feature is the use of emoticons only. This is most often the case with young people who do not want to engage in discussion in any way.

The information collected and defining these groups can also serve those in charge of social media in the sports organisation as a basis for social media content management. Although some of the user comments are an element of at least two categories, these are cases that do not affect the overall conclusions.

The problem to be solved for the future is to create a model that does not include one characteristic date, but is more universal and more comprehensive. The volume of this study does not allow for a broader coverage of this topic for the time being.

5. Summary

The article aimed to divide social media users in sport into relatively homogeneous groups. The research was conducted using a method of covert observation, supported by qualitative analysis. Three user groups of the Meta portal, Instagram and TikTok were studied. Each group consisted of the first 250 comments posted under the Polish Football Association's page posts (advertising slogan: 'Łączy Nas Piłka') from 25 June 2024. This was the date of the Polish national team's relegation from the European Football Championship in Germany.

The 750 units were finally divided into user groups, and the sizes of the user groups and their activities were presented in figures and tables. These groups were then described in terms of their behaviour on the study sites. This resulted in seven social media user groups (*Jokers, Critics, Experts, Optimists, One sentence, Rudes, Emoticons*). The basic characteristics of social media channels in terms of their users' behaviour were also identified.

The article achieved the objectives set. It was assumed that there were significant differences between the audiences of the same content depending on the qualitative criteria adopted. The qualitative criteria in this case were: comment length, excessive use of emoticons, level of personal culture, interacting with other users.

As a result of the qualitative analysis, it was confirmed that all of these behaviours are differentiators for the division of users engaging in social media activities and differences in the reception of the same content were found to exist.

The results of the research, the considerations and the categories described are intended to be helpful for communication management in sports organisations.

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INNOVATIVE FOOD PRODUCTS BASED ON EDIBLE INSECTS

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Purpose: The aim of this article is to investigate attitudes and intentions towards consuming food products based on edible insects.

Design/methodology/approach: In order to directly compare which statements (A. to F.) are more acceptable, a weighted average of the selected answers was calculated for each of them. The χ^2 statistic was used to examine whether there is a dependence between two nominal qualitative variables, and the Spearman's R rank correlation coefficients, which can be used for ordinal qualitative scales.

Findings: The study revealed a low readiness to frequently consume food based on edible insects in the daily diet. Among respondents, curiosity turned out to be an important variable related to the decision to try a product based on edible insects. Interest in food containing an insect component due to additional health benefits was not a factor convincing the respondents to be more interested in this type of food. Taking into account the diversity of responses among respondents, the study revealed that women, people with secondary education, rural residents and people aged 18–24 mostly had a negative attitude towards the intention to consume edible insect-based food. People belonging to the groups: men, people with higher education, city residents and people over 24 years of age seem relatively open to the idea of trying and consuming food products containing edible insects.

Research limitations/implications: There are some limitations to this study. The first is the use of a sample that is not representative and the results of the study cannot be generalized to the population. Another limitation is the fact that data was collected via the Internet, therefore, only users with access to the Internet and basic computer skills participated in the study.

Practical implications: This study provides new insight into the acceptance and intention to consume novel foods based on edible insects before an unknown food product is introduced to the market. The results of this study contribute to the existing literature on the intention to consume innovative foods.

Originality/value: The results of this study highlight the challenges associated with developing the edible insect market as well as the opportunity for education to help promote innovative edible insect-based products.

Keywords: edible insects, entomophagy, insects as food, insect-based products, insect consumption, novel foods.

Category of the paper: Research paper.

1. Introduction

The growth of the world population is causing an increasing demand for food. It is believed that edible insects can be a valuable source of protein in this regard (van Huis et al., 2015; Sun-Waterhouse et al., 2016). It is predicted that the production of insect-based protein powder will be more environmentally beneficial than conventional protein-rich food products (Smetana et al., 2016). Edible insects can thus provide ecological and economic benefits. Edible insects can be a cheaper substitute for expensive animal proteins. Breeding edible insects can reduce the climatic pressure exerted by agriculture and livestock farming, requiring less land, water or feed resources (Premalatha et al., 2011). Optimization of breeding is crucial for sustainable production of edible insects (Costa-Neto, Dunkel, 2016).

In recent years, a much larger variety of products based on edible insects has been offered in Western countries. There is also growing business interest in this new food ingredient, especially in processed insects, cricket or mealworm powder as a food ingredient for other products (e.g. French fries, energy bars and bakery products). Many small and medium-sized enterprises have been established in different European countries with the intention to enter and develop with an innovative food product in this new emerging market (La Barbera et al., 2018).

Previous studies have shown that curiosity is one of the main factors driving intentions and motivating consumers to take the first step towards trying an insect product (Detilleux et al., 2021; Sogari et al., 2017). The results of the study by Menozzi et al., (2017a) confirm that intention is the most important predictor of behavior related to the consumption of a new edible insect product. Consumers are also showing greater openness to consuming insect foods in “invisible” forms (Ruby et al., 2015; Tan et al., 2016a), such as flour or protein powder (Barton et al., 2020). The biggest challenge for the insect-food industry will be to introduce insects to the Western market as a food product that until recently was not considered food at all. The aim of this paper is to investigate attitudes and intentions to consume innovative edible insect-based foods.

2. Methods

2.1. Information about the study

Data were collected in an online interview (n = 477). The research instrument was a survey questionnaire divided into sections. The first one concerned the perception and intention to consume food based on edible insects. All items were measured using the 5 point Likert scale (from “definitely no” to “definitely yes”). The second one included the characteristics of the sociodemographic characteristics of the respondents.

The final sample ($n = 477$) consisted of 307 women and 170 men. Slightly more respondents had secondary education (50.7%) than higher education (49.3%). Of the respondents, 81.1% were under 24 years of age, and a smaller age group was 25 years and older (18.9%). A detailed description of the sample and the socio-demographic profile are presented in Table 1.

Table 1.
Characteristics of respondents

Feature		Number (N)	Structure (in %)
Gender	Female	307	64,4
	Male	170	35,6
Age	18-24 years	387	81,1
	25 years and more	90	18,9
Education	Secondary	242	50,7
	Higher	235	49,3
Place of residence	City	233	48,8
	Village	244	51,2
TOTAL		477	100,0

Source: Own research.

2.2. Statistical analysis of data

The results of the responses obtained were presented in analytical tables in the form of structures, presented as percentages.

In order to directly compare which statements (A. to F.) are more acceptable, a weighted average of the selected answers was calculated for each of them and based on this, a ranking was established from the most to the least acceptable. The following ranks were used to determine the average:

- "definitely not" – rank 1,
- "no" – rank 2,
- "neither yes/nor no" – rank 3,
- "yes" – rank 4,
- "definitely yes" – rank 5.

In order to examine the possible relationship between variables, two measures were calculated:

- 1) The χ^2 statistic, which examines whether there is a relationship between two qualitative nominal variables. The significance level of 0.05 was assumed and if the probability of the χ^2 distribution does not exceed this threshold (i.e. we reject the hypothesis H_0 about independence and accept the alternative hypothesis H_1 about the existence of a relationship between variables), then the strength of this relationship was calculated by determining the Pearson contingency coefficient C (and only then the value of C is determined in the tables). The following interpretation of this coefficient was used:

- $0 \leq C < 0,1$ – faint strength of the relationship,
- $0,1 \leq C < 0,3$ – weak strength of the relationship,

$0,3 \leq C < 0,5$ – average (mean) strength of the relationship,

$0,5 \leq C < 0,7$ – high strength of the relationship,

$C \geq 0,7$ – very high strength of the relationship.

where C takes a value in the range 0-1.

- 2) Spearman's R rank correlation coefficients, which can be used for qualitative ordinal scales. The following interpretation of this coefficient was used:

$0,2 \leq |R| < 0,4$ – weak dependency,

$0,4 \leq |R| < 0,7$ – moderate dependency,

$0,7 \leq |R| < 0,9$ – strong dependency,

$|R| \geq 0,9$ – very strong dependency,

where $|R|$ is the absolute value of R, since the correlation can be positive and negative, so the coefficient can take values from -1 to +1.

3. Results

It was checked (through ranking) which statements among the respondents were more and which were less acceptable. Tables 3, 4, 5, 6 present the results in the form of response rates (in %) and coefficients defining whether and to what extent for each of the statements (A. to E.) the responses vary depending on the four explanatory variables: "Gender", "Education", "Place of residence" and "Age".

Table 2.

Attitude and intention to consume food based on edible insects – opinion ranking

Analyzed statement	definitely not	no	neither yes/nor no	yes	definitely yes	weighted average	ranking
A. I would be willing to eat food based on edible insects in my daily diet	41,5%	26,8%	20,7%	7,6%	3,4%	0,41%	5
B. I would be happy to buy food made from edible insects if it were available on the market	45,1%	25,2%	11,7%	11,3%	6,7%	0,42%	4
C. I will recommend my friends to buy food based on edible insects if it is available on the market	44,2%	29,1%	20,3%	5,2%	1,1%	0,38%	6
D. I would be interested in trying a new dish/product made from edible insects	37,7%	20,1%	13,8%	17,2%	11,1%	0,49%	2
E. In special circumstances, I could eat a dish based on edible insects	31,9%	15,5%	14,3%	25,6%	12,8%	0,54%	1
F. I will be interested in food based on edible insects if it provides additional health benefits (e.g. improves physical condition, strengthens the immune system)	37,7%	16,8%	23,5%	17,8%	4,2%	0,47%	3

Source: Own research.

It should be noted that the differences in averages are not large (from 0.01% to 0.05%), but the first place in the ranking (with the greatest favorability) was taken by the opinion “E. In special circumstances I could eat a dish based on edible insects”, and the last place (the least favorable) was taken by "C. I will recommend my friends to purchase food based on edible insects if it were available on the market" (Table 2).

Table 3.

Attitude and intention to consume edible insect-based foods by gender

Analyzed statement	Gender (in %)										C (contingency coefficient)	R (rank correlation coefficient)
	Female					Male						
	definitely not	no	neither yes/nor no	yes	definitely yes	definitely not	no	neither yes/nor no	yes	definitely yes		
A. I would be willing to eat food based on edible insects in my daily diet	47,9	27,7	15,6	5,5	3,3	30,0	25,3	30,0	11,2	3,5	0,27	0,82
B. I would be happy to buy food made from edible insects if it were available on the market	52,1	29,3	10,1	6,5	2,0	32,4	17,7	14,7	20,0	15,3	0,43	0,50
C. I will recommend my friends to buy food based on edible insects if it is available on the market	49,8	29,6	15,0	4,6	1,0	34,1	28,2	30,0	6,5	1,2	0,25	0,90
D. I would be interested in trying a new dish/product made from edible insects	44,6	24,8	13,7	13,4	3,6	25,3	11,8	14,1	24,1	24,7	0,45	0,00
E. In special circumstances, I could eat a dish based on edible insects	37,1	18,9	17,3	23,1	3,6	22,4	9,4	8,8	30,0	29,4	0,47	0,20
F. I will be interested in food based on edible insects if it provides additional health benefits (e.g. improves physical condition, strengthens the immune system)	41,7	19,9	19,5	14,3	4,6	30,6	11,2	30,6	24,1	3,5	0,25	0,62

Source: Own research.

For the individual statements examined, the following relationships were observed.

3.1. Statement A. *I would be willing to eat food based on edible insects in my daily diet*

The Spearman's R rank correlation coefficient indicates a strong positive correlation with gender (R = 0.82), so it can be stated that both women and men gave similar answers. However, looking at the percentages, it can be seen that women are more negative, as many as 75.6% (47.9% "definitely not" and 27.7% "no"), while men had a negative attitude of 55.3% (30% "definitely not" and 25.3% "no") (Table 3).

In both age groups (Table 4), negative opinions predominate, with 73.1% (46.5%+26.6%) among people aged 18-24 and 47.8% (20%+27.8%) among people over 24. The similarity of opinions is indicated by the Pearson rank correlation coefficient R, although the strength of the relationship is moderate (R = 0.6).

Neither education nor place of residence differentiates the answers among the respondents, which in both cases is indicated by very strong positive correlations of 0.90. However, there are more negative opinions among respondents with secondary education, 74% (45.9%+28.1%), than those with higher education, 62.5% (37%+25.5%) (Table 5). The situation is similar when we analyze subgroups distinguished by place of residence. Negative opinions were expressed by 74.6% of rural respondents, while among urban respondents the percentage was 61.9% (Table 6).

Table 4.

Attitude and intention to consume edible insect-based foods by age

Analyzed statement	Age (in %)										C (contingency coefficient)	R (rank correlation coefficient)
	18-24 years					25 years and more						
	definitely not	no	neither yes/nor no	yes	definitely yes	definitely not	no	neither yes/nor no	yes	definitely yes		
A. I would be willing to eat food based on edible insects in my daily diet	46,5	26,6	15,0	8,0	3,9	20,0	27,8	45,6	5,5	1,1	0,38	0,60
B. I would be happy to buy food made from edible insects if it were available on the market	49,6	29,5	12,1	6,7	2,8	25,6	6,7	10,0	31,1	26,7	0,58	-0,60
C. I will recommend my friends to buy food based on edible insects if it is available on the market	48,3	30,0	15,5	5,2	1,0	26,7	25,6	41,1	5,6	1,1	0,31	0,70
D. I would be interested in trying a new dish/product made from edible insects	43,4	23,0	13,7	16,3	3,6	13,3	7,8	14,4	21,1	43,3	0,59	-0,80
E. In special circumstances, I could eat a dish based on edible insects	36,4	17,6	15,8	26,6	3,6	12,2	6,7	7,8	21,1	52,2	0,62	-0,20
F. I will be interested in food based on edible insects if it provides additional health benefits (e.g. improves physical condition, strengthens the immune system)	42,4	18,	18,6	16,3	4,7	17,8	11,1	44,4	24,4	2,2	0,34	0,50

Source: Own research.

3.2. Statement B. *I would be happy to buy food made from edible insects if it were available on the market*

Greater skepticism towards purchasing products based on edible insects is observed among women: 81.4% (52.1%+29.3%), while among men the same percentage is 50% (32.4%+17.7%). The difference can be seen here when analyzing the ranking of the number of individual answers, where women have the most negative opinions and these numbers gradually decrease, moving on the ordinal scale towards increasingly positive opinions. Among men, the most negative opinion is also the most numerous, but the second place is taken by the positive opinion "yes" (Table 3).

The situation is completely different when we ask people aged 19–24 and over 24 for their opinions (Table 4). Among younger people, the percentage of “definitely not” ratings is the highest - 49.6%, and decreases almost linearly to 2.8% for "definitely yes". On the other hand, the most frequently chosen answers among older people are positive opinions "yes" 32.1% and "definitely yes" 26.7%. Only in third place is the negative opinion "definitely not" 5.6%. It is clearly visible that the opposite of the previous group, positive opinions dominate (positive correlation), however, this relationship is moderate and the R coefficient is -0.6.

People with secondary education expressed a negative opinion in 76.9% (49.2%+27.7%), and those with higher education slightly less, i.e. 63.4% (40.9%+22.6%), however, it should be noted that there is a strong positive correlation (R = 0.7), so education does not differentiate preferences in this respect (Table 5).

The rank correlation coefficient for opinions among rural and urban residents (R = 0.7) also indicates similarity of opinions, but it should be noted that there are almost five times more positive opinions among urban residents (30%) than among rural residents (6.6%) (Table 6).

3.3. Statement C. *I will recommend my friends to purchase food made from edible insects if it is available on the market*

In the case of this statement, none of the explanatory variables significantly differentiate the answers provided. Regardless of the variable, the most common opinions were "definitely not" and this percentage decreases as we move on to increasingly positive opinions. This is confirmed by a very strong positive correlation, which for individual variables is: $R_{(Gender)} = 0,9$; $R_{(Education)} = 1,0$; $R_{(Place\ of\ residence)} = 0,9$ and a slightly smaller, moderate correlation for $R_{(Age)} = 0,7$ (Tables 3, 4, 5, 6).

Table 5.
Attitude and intention to consume food based on edible insects according to beducation

Analyzed statement	Education (in %)										C (contingency coefficient)	R (rank correlation coefficient)
	Secondary					Higher						
	definitely not	no	neither yes/ nor no	yes	definitely yes	definitely not	no	neither yes/ nor no	yes	definitely yes		
A. I would be willing to eat food based on edible insects in my daily diet	45,9	28,1	14,5	8,3	3,3	37,0	25,5	27,2	6,8	3,4	0,20	0,90
B. I would be happy to buy food made from edible insects if it were available on the market	49,2	27,7	14,9	6,2	2,1	40,9	22,6	8,5	16,6	11,5	0,32	0,70
C. I will recommend my friends to buy food based on edible insects if it is available on the market	49,2	30,2	14,5	5,0	1,2	39,2	28,1	26,4	5,5	0,9	0,19	1,00
D. I would be interested in trying a new dish/product made from edible insects	42,6	24,8	14,9	14,5	3,3	32,8	15,3	12,8	20,0	19,2	0,34	0,20

Cont. table 5.

E. In special circumstances, I could eat a dish based on edible insects	36,8	17,4	16,5	25,6	3,7	26,8	13,6	11,9	25,5	22,1	0,34	0,70
F. I will be interested in food based on edible insects if it provides additional health benefits (e.g. improves physical condition, strengthens the immune system)	43,0	18,6	19,4	14,5	4,6	32,3	14,9	27,7	21,3	3,8	0,19	0,90

Source: Own research.

3.4. Statement D. *I would be interested in trying a new dish/product made from edible insects*

The respondents' answers for both genders differ, with 69.4% of women having a negative attitude towards trying this type of products (44.6% "definitely not", 24.8% "no") and 16.9% having a positive attitude (13.4% "yes" and 3.6% "definitely yes"). There are almost half as many men with a negative attitude than women, i.e. 37.1% (25.3% "definitely not" and 11.8% "no"), and almost three times as many men with a positive attitude than women, i.e. 48.8% (24.1% "yes" and 24.7% "definitely yes"). However, the Pearson rank correlation coefficient R indicates a complete lack of relationship between this variable and gender ($R = 0$). This does not mean that there is no relationship between the two gender groups. The probability of the χ^2 distribution is 0.00, so the hypothesis of independence of variables should be rejected and it should be assumed that such a relationship exists. The strength of this relationship, measured by the Pearson C coefficient of 0.45, should be assessed as average (Table 3).

People aged 18-24 are much more skeptical than older people. Younger people most often chose the rating "definitely not" (43.4%), followed by "no" (23%), and this percentage further decreases when we move on to positive ratings "yes" (16.3%) and "definitely yes" (3.6%). The numbers of ratings are reversed for people aged 25 and over, where the majority of opinions are definitely positive (43.3%) and decreases when moving on to opinions that are definitely negative (21.1%; 14.4%; 7.8%; 13.3%). This is confirmed by the Pearson R rank correlation coefficient value of -0.8, so this relationship should be described as strong. The strong negative correlation indicates that it is possible to statistically justify the claim that older people (over 24 years old) have a different opinion than younger people (18-24 years old) (Table 4).

The relationship between the level of education and the analyzed variable is weak ($R = 0.2$), but the existence of this relationship is confirmed by the χ^2 test and the strength of the relationship is average ($C = 0.34$). There are more people with secondary education who have a negative attitude, 67.4% (42.6% "definitely not" and 24.8% "no"), and 17.8% have a positive attitude (14.5% and 3.3%, respectively). Among people with higher education, negative opinions also predominate, 48.1% (32.8% "definitely not" and 15.3% "no"), but there are fewer of them, less than half and not 2/3 as among people with secondary education. The percentage of people with a positive attitude is also correspondingly higher: 39.2% (20.0%+19.2%) (Table 5).

The percentages of positive/negative ratings are also different among rural and urban residents. 68.9% of rural residents rate this idea negatively (41.4%+27.5%), while the number of urban residents with a negative rating is 1/3 lower, at 46.4% (33.9%+12.5%). Similarly, there are more people with a positive attitude among urban residents - 40.3% (20.2%+20.2%), compared to 16.8% (14.3%+2.5%) of rural residents. The Pearson rank correlation coefficient R indicates no relationship between this variable and place of residence (R = 0.13), but as above, the probability that these variables are independent (measured with the χ^2 test) is too small (0.00) to accept this hypothesis. Therefore, there is an average (C = 0.31) relationship between urban and rural residents, although it is difficult to talk about the direction of this relationship (Table 6).

Table 6.
Attitude and intention to consume food based on edible insects by place of residence

Analyzed statement	Place of residence (w %)										C (contingency coefficient)	R (rank correlation coefficient)
	Village					City						
	definitely not	no	neither yes/nor no	yes	definitely yes	definitely not	no	neither yes/nor no	yes	definitely yes		
A. I would be willing to eat food based on edible insects in my daily diet	46,7	27,9	15,2	6,2	4,1	36,1	25,8	26,6	9,0	2,6	0,20	0,90
B. I would be happy to buy food made from edible insects if it were available on the market	50,0	31,2	12,3	4,9	1,6	39,9	18,9	11,2	18,0	12,0	0,37	0,70
C. I will recommend my friends to buy food based on edible insects if it is available on the market	48,8	31,2	13,5	5,7	0,8	39,5	27,0	27,5	4,7	1,3	0,22	0,90
D. I would be interested in trying a new dish/product made from edible insects	41,4	27,5	14,3	14,3	2,5	33,9	12,5	13,3	20,2	20,2	0,39	0,13
E. In special circumstances, I could eat a dish based on edible insects	34,0	18,4	18,4	25,4	3,7	29,6	12,5	9,9	25,8	22,3	0,36	0,67
F. I will be interested in food based on edible insects if it provides additional health benefits (e.g. improves physical condition, strengthens the immune system)	42,2	18,9	20,1	15,2	3,7	33,1	14,6	27,0	20,6	4,7	-	0,90

Source: Own research.

3.5. Statement E. *In special circumstances, I could eat a dish based on edible insects*

Opinions on the thesis differ between the genders. Women reject this idea in 56% (37.1%+18.9%) of cases, while 26.7% of women (23.1%+3.6%) accept it. More than twice as many men (59.4%) as women (26.7%) would consider eating such a dish. Although the hypothesis of the existence of a relationship between variables should be accepted, it should be assessed as weak (Table 3).

The answers given by both age groups differ significantly. Negative responses among people aged 18–24 amount to 54% (36.4%+17.6%) and positive responses to 30.2% (26.6%+3.6), while among people older than 24, negative responses are only 18.9% (12.2%+6.7%) and positive ones as many as 73.3% (21.1%+52.2%). The value of the coefficient $R = 0.2$ indicates that there is a negative correlation of ranks, although it is weak, while $C = 0.62$ indicates that the choices of both groups differ significantly (Table 4).

Among people with secondary education, negative attitudes dominate in 51.4% and positive attitudes in 29.3%. The situation is reversed among people with higher education, where 47.7% of attitudes are positive, compared to 40.4% of those who are reluctant (Table 5).

The place of residence differentiates the responses in a similar way, with rural residents reporting more negative opinions (52.5%) than positive ones (29.1%). Among urban residents, there were fewer negative responses (42.1%) than positive responses (48.1%). However, these are not large differences and the opinions of both groups are similar (the rank correlation coefficient $R=0.67$ shows that we can speak of a moderate positive relationship here) (Table 6).

3.6. Statement E. *I will be interested in food based on edible insects if it provides additional health values/benefits (e.g. improves physical condition, strengthens the immune system)*

The opinions of both gender groups do not differ much and are mostly negative, 61.6% among women and 41.8% among men (Table 3). Similarly, the level of education and place of residence do not differentiate opinions on the analyzed issue. It should be noted, however, that there are more negative opinions among people with secondary education (61.6%) than with higher education (47.2%) and among rural residents (61.1%) than urban residents (47.6%). The strength of the relationship measured by the Spearman's rank correlation coefficient R for gender is moderate (0.62) and for education and place of residence very strong (0.9) (Tables 3, 5, 6).

The analysis of both age groups confirms that they have similar opinions, which is confirmed by the calculated coefficient $R = 0.5$, although this relationship should be described as moderate. Among 18-24-year-old respondents negative opinions were expressed by 60.5% (42.4%+18.1%) and among those over 24 years of age by 28.9% (17.8%+11.1%). The main difference is the percentage of people expressing neutral opinions "neither yes/nor no", which is almost two and a half times higher among the older respondents (44.4%) compared to the younger respondents (18.6%) (Table 4).

4. Discussion

Comparison of our results with studies from other countries highlights differences in regional attitudes towards entomophagy. In our study, only 11% of respondents declared willingness to frequently consume food based on edible insects in their daily diet. On the other hand, 18% of respondents declared willingness to purchase food based on edible insects. The situation looks slightly better regarding the consumption of food based on edible insects in special circumstances - 38.4% of respondents declared such willingness. Studies conducted among Belgian consumers showed that less than half of respondents were willing to try insect products (Van Thielen et al., 2019), while in another study involving Belgian consumers, 77.7% reported willingness to consume products based on edible insects (Caparros et al., 2014). The results of studies on willingness to try have shown that US consumers seem relatively open to the idea of trying food products containing insects, with 72% of respondents in the study by Ruby et al., (2015) and 60% in the study conducted by Ardoin, Prinyawiwatkul (2020). In contrast, when similar questions were asked of Italian respondents, intention to try ranged from only 17% to 31% in three separate studies (Cicatiello et al., 2016; Laureati et al., 2016; Palmieri et al., 2019). In turn, Castro and Chambers (2019), collecting data from multiple countries, found similarly low willingness to eat insect-based foods among consumers in the UK, Spain, and Australia (all between 33% and 36%). Consumers in the USA seemed less willing to regularly eat insect-based foods (Woolf et al., 2019) than to try them (Ruby et al., 2015). In a Polish study, 41% of consumers would purchase insect-based products if they were available on the market (Zielińska et al., 2020).

Two important variables related to the decision to try edible insects among respondents are curiosity and interest (Berger et al., 2018). In the case of unfamiliar food such as insects, the first attempt to consume may consist of a level of interest and curiosity that exceeds fear and disgust (Tan et al., 2015; Balzan et al., 2016). In our study, 28.3% of respondents declared that they would try an insect-based product out of curiosity. Results from a study conducted among Belgian respondents who agreed to participate in an insect tasting experiment, curiosity (69%) was more common than fear (14%) and disgust (13%) at the thought of eating insect-based food (Caparros et al., 2016). Similarly to the study by Tuccillo et al. (2020), they noted that the main motivation for including insects in the Italian diet is curiosity. The intention to try is a strong predictor of the behavior of eating this type of food.

From the perspective of additional benefits, information about health values is important for consumers' perception of food based on edible insects. As found by de-Magistris et al. (2015), Dutch consumers were willing to pay a higher price for an insect-based product with a health claim related to the content of "omega 3". Interest in food due to additional health benefits, e.g. strengthening the immune system, was declared by 22% of respondents in our study.

The results of the studies show that men are more open to trying edible insect-based foods than women. Looking at the results of our study, it can be seen that women have a more negative attitude towards foods based on edible insects than men. The effect of gender on the likelihood of trying insect-based foods indicates that men were consistently more likely to eat insects than women (Sogari et al., 2019). These findings are consistent with other reports in which men are more likely to try entomophagy than women (Caparros et al., 2016; Menozzi et al., 2017). The influence of gender is also well demonstrated by other studies on edible insects (Hartmann et al., 2015; Michel, Begho, 2023; Sogari et al., 2017; Tan et al., 2016). These results confirm, as expected, that gender as a very important explanatory variable for consumer evaluation of food based on edible insects.

Young adults with higher education have been shown to be more open to food based on edible insects (Cicatiello et al., 2016; Roma et al., 2020). This is confirmed by our research results - there were more negative opinions among people with secondary education than among those with higher education. In both age groups, negative opinions prevail, but there were more of them among people aged 18-24 than among people over 24. Many studies have shown that age and education are predictors of willingness to eat insects, with younger and better educated participants more likely to have positive perception of edible insect-based foods (Cicatiello et al., 2016; Collins et al., 2019; Roma et al., 2020). It can be clearly stated that younger, male, and better educated consumers had a more favorable attitude towards foods based on edible insects.

5. Summary

In general, it should be stated that there is a negative attitude towards food based on edible insects. Out of 48 analyzed subgroups (6 issues studied divided into 4 sociodemographic features and each of them divided into 2 subgroups), only 7 of them had a predominance of positive opinions. Women, people with secondary education, rural residents and people aged 18-24 mostly chose the answer "definitely no" or "no" and in the minority these were positive opinions "yes" or "definitely yes". Among people belonging to the groups: men, people with higher education, city residents and people aged over 24, there were cases where the positive answers "yes" or "definitely yes" prevailed over the negative ones.

It should be emphasized that the production and availability of innovative food products based on edible insects should be regulated by guidelines regarding their safety. With increased exposure to edible insects will also come familiarity, which is necessary to overcome neophobia, where novelty is at the root of aversion. Even the most negative associations of edible insects with disgust may fade with time and well-directed product development (Simpson et al., 2006). Progress towards large-scale adoption of entomophagy will require

a gradual shift in the positioning of insects in the marketplace, as well as consumer acceptance. Finding a niche for insects in modern food systems, beyond novelty products, will require sustained effort by food companies and will be a very gradual process. Educational campaigns can prepare people to adopt entomophagy and help them overcome their reluctance (Costa-Neto, Dunkel, 2016; Hamerman, 2016). In the current environment, consumers do not seem prepared for a rapid shift towards insect consumption.

Changing the mindset and, more importantly, the behaviors of large segments of consumers is a difficult task, especially given that food choices are partly irrational and claims about environmental and social benefits are too distant in time and culture to seem relevant to consumers.

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EFFICIENCY AND QUALITY OF THE ALUMINIUM ALLOY WELDING PROCESS DEPENDING ON THE METHOD USED

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Purpose: The aim of this article is to analyse the criteria for selecting a welding method for aluminium alloys from the two most popular conventional methods: Metal Inert Gas (MIG) and Tungsten Inert Gas (TIG) and to assess their impact on the efficiency, quality and management of the welding process.

Design/methodology/approach: The results presented in the article were obtained by analyzing the available literature as well as our own practical experience related to the management of production processes, taking into account quality and operational aspects.

Findings: The selection of the welding method for aluminium alloys depends on many factors, including quality requirements and effective management of the production process. The criteria for selecting welding methods have been systematized and a comparative analysis of their impact on the efficiency and quality of welded joints has been conducted.

Practical implications: The choice of welding method for aluminium alloys is influenced not only by technical aspects, but also by economic, management and quality aspects. Proper process management and awareness of the limitations, advantages and disadvantages of individual welding methods allows obtaining aluminium joints of the required quality and optimization of operating costs.

Originality/value: The original achievement of the analysis is the establishment of comprehensive criteria for the selection of welding methods, taking into account quality management and the production process. The results can be useful to designers, manufacturers and managers, allowing for more effective management of the quality and efficiency of welding processes.

Keywords: welded joint, aluminium alloys, MIG, TIG, process management, quality management.

Category of the paper: Technical and managerial paper.

1. Introduction

Aluminium is a strong and lightweight element, with a density of 2.7 kg/dm^3 – 3 times less than steel. It is characterized by good electrical and thermal conductivity, high corrosion resistance, ease of forming, low price and can be recycled many times (Raabe et al., 2022).

Pure aluminium has limited technical use. By adding other elements to aluminium, alloys are created, which after appropriate heat treatment have very good mechanical parameters (Varshney, Kumar, 2021). The symbols of aluminium alloys are marked according to the standard (PN-EN 573-1:2006).

Due to their properties, aluminium alloys are used in various industries – they are used to make beverage cans, parts of various devices, car and ship components (Xie et al., 2024), high-speed trains (Deng et al., 2024) and airplane components (Li et al., 2023). Aluminium alloys have found wide application in civil engineering, both for the production of load-bearing structures, facades, and window, door and gate components (Kwiatkowski, 2011, 2012). Aluminium structures are designed based on Eurocode 9 (PN-EN 1999-1-1:2011). The use of lightweight aluminium structures saves energy and reduces pollutant emissions. This is facilitated by the use of environmental management systems in enterprises (PN-EN ISO 14001:2015-09).

The wide use of aluminium alloys in various industries often requires the use of welded joints. Unfortunately, the process of welding aluminium alloys is much more difficult than welding steel and requires not only the right selection of the welding method, but also highly qualified welders. Therefore, the development of efficient methods of welding structures made of aluminium alloys while obtaining high-quality joints is a current research topic. In order to ensure the proper quality of products and welded joints made of aluminium alloys, it is worth introducing quality management systems (PN-EN ISO 9001:2015-10) in companies involved in their production. This allows the efficiency of the welding process to be increased and, consequently, the efficiency of the company.

Efficiency is of great importance in management, as it affects various aspects of a company's operations: it allows to reduce costs, improve the quality of products or services, or increase production efficiency. At the same time, it means that the company is able to meet the expectations of its customers by producing products or providing services of high quality in accordance with standards.

In industrial practice, the choice of welding method for aluminium alloys is often limited by the welding equipment available to the company. These are usually welders using conventional MIG or TIG methods. Even if the company has both types of welders, it happens that the choice of method is random, usually resulting from a lack of knowledge of which method is more suitable for making a specific welded joint. The basis for comparing these welding methods was to identify the differences between them that affect the efficiency of using a given method.

2. Welding of aluminium alloys

The general guidelines for shaping welded joints of aluminium alloys are analogous to those for steel joints (Kubicki, 2022, 2023; Kubicki, Wojsyk, 2022). Arc welded joints in aluminium alloys should be made in accordance with the standard (PN-EN ISO 10042:2018-09). The properties of aluminium alloys affect the way welds are made and their weldability. All aluminium alloys from groups 1XXX, 3XXX, 4XXX, 5XXX and 6XXX can be arc welded. However, most alloys from groups 2XXX and 7XXX cannot be properly joined by arc welding, as they will crack during welding (AWS D1.2/D1.2M:2014). Technical aspects have a fundamental impact on the rational and economical design and execution of such joints. Due to the material properties, welding aluminium alloys requires specialist knowledge and high skills from welders.

Aluminium has a relatively low melting point (approx. 660°C), and its alloys, depending on the additives introduced, usually lower (even approx. 470°C). Only a few alloys of some series have a slightly higher melting point than pure aluminium. The classification and designation of casting alloys is given in the standard (PN-EN 1706+A1:2022-01), and alloys for plastic processing in the standard (PN-EN 573-3+A2:2024-06). On the surface of aluminium and its alloys, difficult-to-melt Al₂O₃ oxide films are formed, which do not melt until about 2050°C. On the one hand, they protect the metal itself against corrosion, on the other hand, they make welding very difficult. Additionally, due to their hygroscopicity, oxides can absorb moisture from the air, which increases the porosity of the joint. Therefore, immediately before welding it is necessary to remove oxides with a brass wire brush and degrease the material.

The weldability of aluminium alloys is influenced by many factors, but the most important one is the addition of alloying elements. Generally, silicon and magnesium-silicon alloys are characterized by good weldability.

Traditional MIG (Ferenc, 2018) or TIG (Ferenc, 2023) methods are usually used for welding aluminium alloys. The development of aluminium alloy welding methods expands the scope of application, eliminating the limitations and disadvantages of conventional methods. However, this is usually associated with an increase in the costs associated with the purchase of specialized equipment. Among modern methods of welding aluminium alloys, the following can be distinguished:

- pulsed CMT-MIG – cold metal transfer arc-metal inert gas (Brukner, 2009; Rajendran et al., 2024),
- double pulse MIG (Ye et al., 2024),
- high-speed MIG welding with external magnetic fields (Wu et al., 2022),
- pulsed hybrid laser (Wang M. et al., 2025),
- pulsed Laser-MIG hybrid welding (Jia et al., 2022),
- STT – surface tension transfer arc welding (Nagasai et al., 2023),

- variable-polarity plasma arc welding (Wang, X. et al., 2024),
- FSW – friction stir welded (Abolusoro, 2024; He et al., 2011; Lacki, Derlatka, 2013; Patel, Arora, 2024).

Some methods allow joining aluminium alloys with other metals, e.g. with steel (Chen, 2024; Feizollahi, Moghadam, 2023; Ghari et al., 2024), with copper (Eljasi et al., 2023) or with titanium (Shehabeldeen et al., 2021, Zhang et al., 2022).

3. Criteria for selecting a welding method for aluminium alloys

This analysis of the criteria for selecting welding methods for aluminium and its alloys covers only the two most popular and most accessible welding methods – MIG and TIG. Welding using these methods has been discussed in textbooks (Ferenc, 2018, 2023). Both methods are commonly used, but they are not always properly selected for specific welded joints.

There are certain features that both methods have in common:

- weldability of the same types and grades of aluminium alloys,
- use of the same shielding gases (mainly argon, rarely helium and mixtures of these gases),
- practically rare use of forming gas,
- possibility of welding in all positions,
- similar costs of welding consumables,
- limited outdoor applicability due to air movement that can disperse the shielding gas – welding tents required,
- analogous method of edge preparation.

This does not mean, however, that these methods are interchangeable in every case. Depending on the type of joint, thickness of the welded materials and quality requirements, the appropriate method should be selected.

Examples of MIG welds are shown in the figures below (Figure 1-5). Due to the specificity of aluminium alloys, weld imperfections occur more often than in steel. For butt joints of sheets (Figure 1), you can see especially from the side of the weld root the place where welding was interrupted and resumed.

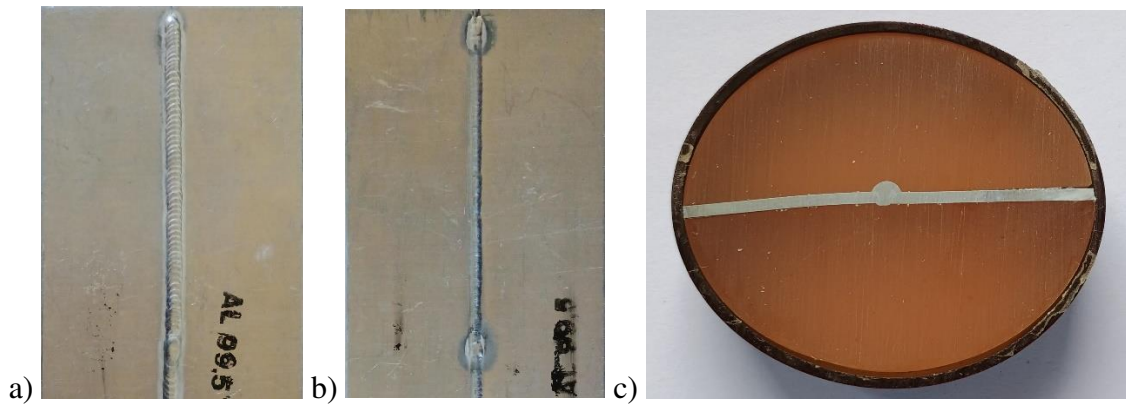


Figure 1. Butt joint of 1 mm thick sheets using the MIG method: a) weld face, b) weld root, c) metallographic section.

Source: own study.

This effect is not observed in lap joints (Figure 2), because there is no penetration to the weld root. However, in several places, a dark coating is visible, resulting from the condensation of magnesium vapors. This defect occurs when welding with the MIG method using Al-Mg wire.

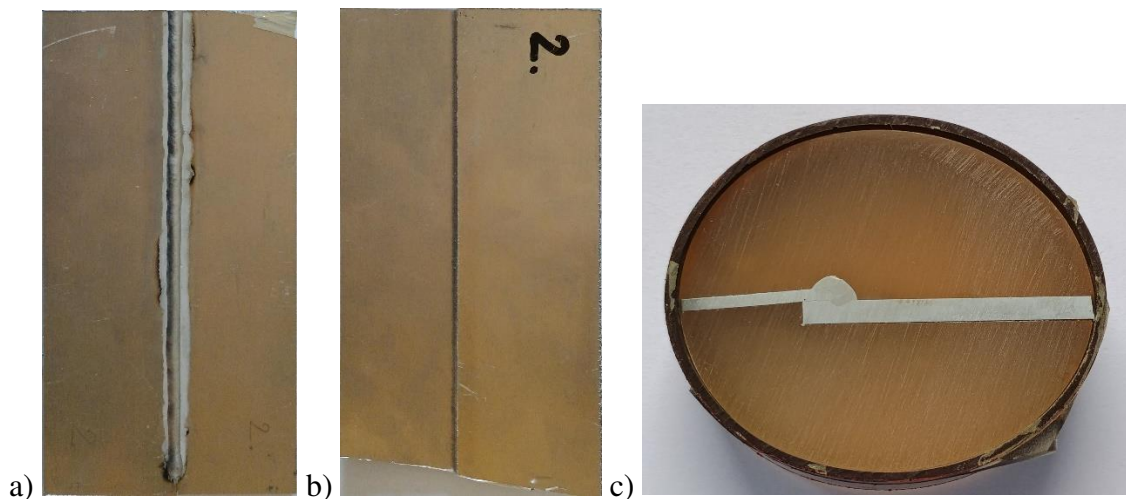


Figure 2. Lap joint of 1 and 2 mm thick sheets using the MIG method: a) weld face, b) weld root, c) metallographic section.

Source: own study.

Although the TIG method is recommended for butt joints of aluminium pipes, they can also be welded using the MIG method, achieving deeper penetration. The cross-section (Figure 3b) shows how deep penetration can be achieved with this method.

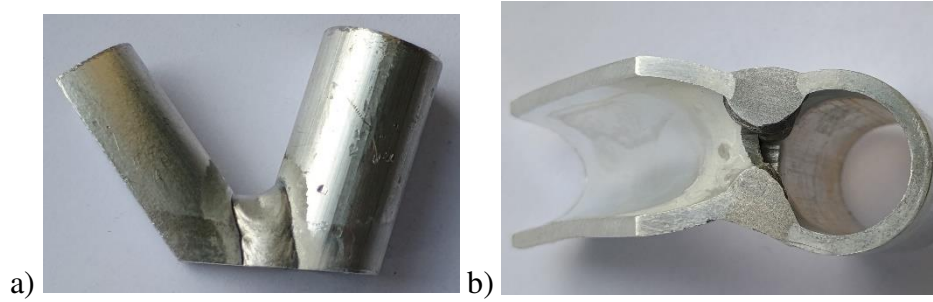


Figure 3. Pipe-to-pipe connection using the MIG method: a) weld face, b) joint cross-section.

Source: own study.

The MIG method is also used to weld other elements, such as sections, aluminium castings, or pipes with sheet metal. With the proper setting of welding parameters, a correct joint can be obtained without narrowing the pipe lumen (Figure 4).

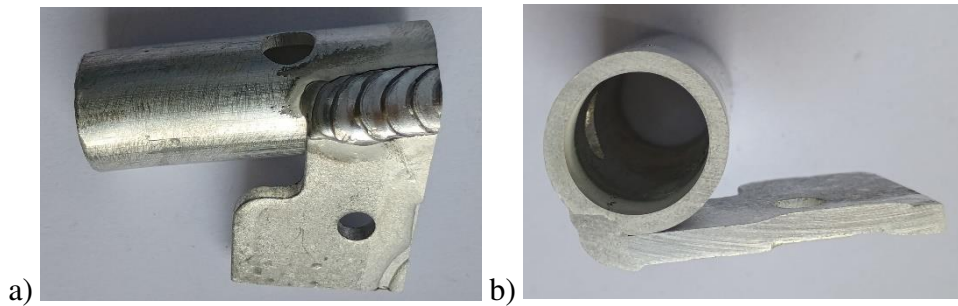


Figure 4. Pipe-to-sheet metal connection using the MIG method: a) weld face, b) joint cross-section.

Source: own study.

Due to the possibility of obtaining deeper penetration, the MIG method is also used in T-joints (Figure 5).

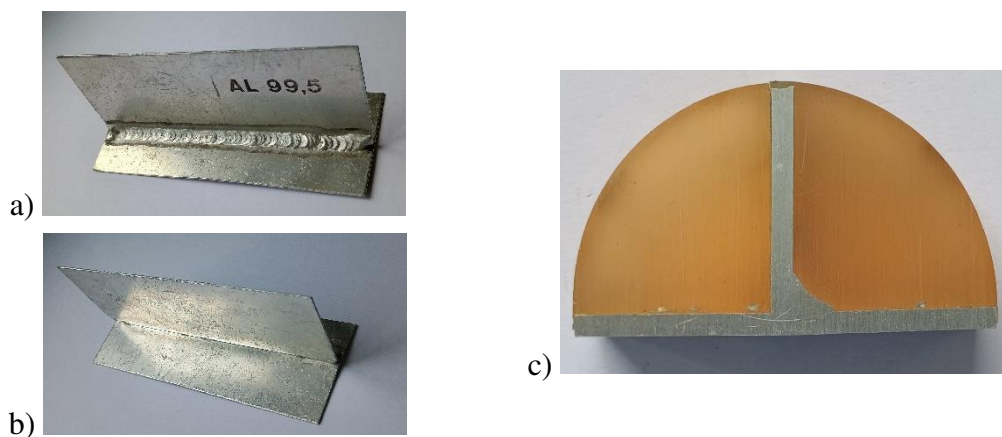


Figure 5. T-joint with single-sided fillet weld of 1 mm thick sheets using the MIG method: a) weld face, b) weld root, c) metallographic section.

Source: own study.

TIG joints have a more limited scope. They are generally made for thinner elements, for which high quality of the weld is required. A butt joint of sheets made by the TIG method is shown in (Figure 6). A characteristic end of the weld in the form of a crater can be observed. To avoid cracks in this place, run-off plates are used or the crater is cut out and re-welded. Modern welding machines have a function of filling the crater by gradually reducing the welding power at the end of the work.

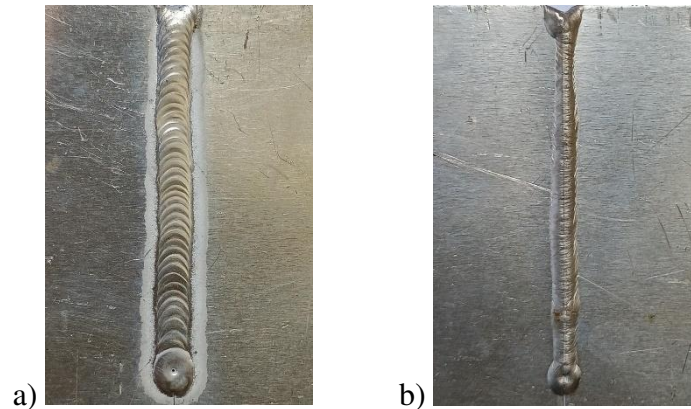


Figure 6. Butt joint of 2 mm thick sheets using the TIG method: a) weld face, b) weld root.

Source: own study.

In all joints, regardless of the welding method used, the heat-affected zone (HAZ) can be observed from the weld face as an area of light, matt discoloration. In this zone, the mechanical properties of the base material deteriorate (Aune et al., 2024).

Conventional MIG and TIG methods differ from each other in certain features that may determine the right choice. Table 1 presents the criteria for selecting a welding method.

Table 1.
Criteria for selecting MIG and TIG welding methods

Selection criterion	Method	
	MIG	TIG
Minimum joint thickness	1 mm	0,5 mm
Maximum thickness	25 mm with argon, 75 mm with helium	6 mm with argon, 10-18 mm with helium
Pipe root welding	not recommended	recommended
T-joint, Corner joint, Cruciform	deeper penetration of fillet weld roots	difficult to penetrate into corners and into the roots of fillet welds
Cost of welding equipment	high	relatively low
Costs of weld filler materials and gas	comparable	comparable
Possibility of automating the welding process	very good	limited
Quality of welds	high	very high
Cleanliness of welds	high	very high
Welder qualifications	average	high
Cleaning the edges of the joint before welding	the necessity of removing oxides mechanically and/or chemically	the necessity of very thorough cleaning
Cleaning the wire before welding	practically impossible	only when high quality is required

Cont. table 1.

Welding current type	direct current (DC+)	mainly alternating current (AC); exceptionally direct current (DC+, DC-) for thicker joints – then only helium as a shielding gas
Oxide film removal intensity	high – negative polarity on the material	sufficient for AC and negative polarity on the material
Welding deformations	less	greater
Generation of weld spatter	occurs when welding parameters are not selected correctly	does not occur
Susceptibility to lack of fusion	high	moderate
Dark coating formation	occurs mainly when welding with Al-Mg wire	practically does not occur
Reduction of joint strength in the heat-affected zone of the base metal	slightly smaller and narrower	slightly larger and wider
Interference with other electronic devices	none	may be caused by the ionizer

Note. MIG: metal inert gas welding; TIG, tungsten inert gas welding; AC: alternating current; DC: direct current.

Source: (AWS D1.2/D1.2M:2014; Ferenc, 2018, 2023; Olabode et al., 2013), own study.

4. Conclusion

Joining elements made of aluminium alloys by welding is the only method that simultaneously meets the three characteristics of a good connection, namely strength, tightness and durability. Therefore, such welded connections are often used in construction to make roofs, canopies and shell structures.

The choice of the conventional welding method for aluminium alloys is not always simple, although it is often limited to the use of the MIG method for thicker elements and TIG for thinner ones. However, this basic criterion is not the only one. The type of joint often favors the adoption of one of the methods, e.g. for butt joints of pipes – TIG, and for joints using fillet welds – MIG. The choice of the method is usually associated with the acceptance of a compromise between the higher quality of the weld and aesthetics in the TIG method and the higher speed of execution in the MIG method. This inconvenience can be eliminated by using the pulsed MIG method. In addition, the TIG method does not cause spatter, but it requires higher qualifications from the welder.

If the efficiency of the welding process is limited only to reducing costs, then the MIG method will be more beneficial due to the higher welding speed. Shortening the time of welds and lower requirements for welders' skills significantly affect the costs of the entire process. However, if ensuring high aesthetics of welded joints, without dark deposits and spatter, of high cleanliness and quality, is more important, then the choice of the TIG method will be more

appropriate. It should also be taken into account that the one-time cost of purchasing welding equipment with comparable parameters is relatively lower for the TIG method.

It seems that future research should focus on pulsed MIG welding methods. Their use can improve efficiency (higher welding speed than TIG) and quality of aluminium alloy welding processes (comparable to TIG) at relatively the lowest cost.

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UNDERSTANDING CUSTOMER NEEDS IN SHAPING SOCIALLY RESPONSIBLE ENTERPRISES IN INTER-ORGANIZATIONAL NETWORKS

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Purpose: The aim of the study is to understand the relationship between aligning with customer needs in the context of shaping corporate social responsibility for companies operating in inter-organizational networks and the benefits of improved access to market information, strengthening market position, and increasing the flexibility of business operations as advantages gained from mutual connections and relationships with market partners.

Design/methodology/approach: Based on literature studies and statistical analysis using the Kendall rank correlation and Kruskal-Wallis test, we analyze the relationship between adapting to customer needs and other benefits from mutual connections and relationships with market partners like improving access to market information, strengthening market position and increasing the flexibility of business activity.

Findings: The results suggest that in the case of enterprises operating in inter-organizational networks, better adaptation to customer needs is accompanied by strengthening the market position and providing better access to market information; however, it does not necessarily lead to greater flexibility of business activities.

Research limitations/implications: A clear implication of the theoretical assumptions and conducted research is that although it is believed that in the case of enterprises operating in inter-organizational networks, better adaptation to customer needs leads to greater flexibility of operations in exceptional situations, for example, in micro-entities, where the ability to current settlement of liabilities and obtaining funds is limited, there will not necessarily be an increase in the flexibility of their business, which, however, does not reduce the possibility of shaping their social responsibility.

Practical implications: This study supports the current view that understanding customer needs shapes socially responsible enterprises operating in inter-organizational networks in terms of strengthening market position and improving access to market information. Moreover, the multi-aspect nature of understanding customer needs in the context of shaping corporate social responsibility and the interdisciplinary nature of the considerations create grounds for further research and exploration in this area.

Originality/value: By focusing on the synergy of benefits generated by cooperation in inter-organizational networks, the article contributes to research on understanding how mutual connections and relationships with market partners allow for adaptation to customer needs that may shape corporate social responsibility.

Keywords: corporate social responsibility, customer needs, enterprise management, enterprises in inter-organizational networks.

Category of the paper: Research paper.

1. Introduction

Strengthening market position requires entrepreneurs to have the ability to adapt to changes occurring in the endogenous and exogenous environment of enterprises. In this context, adaptive capabilities taking into account values, such as sustainable development and social responsibility, are becoming more and more important (Bocken et al., 2014), as accurate identification of key business conditions allows enterprises to find new paths for sustainable development (Porter, Kramer, 2006). One of the crucial elements of the adaptability of enterprises is understanding and adapting to customer needs, especially concerning the functioning of enterprises within inter-organizational networks (Parkhe, Dhanaraj, 2003). Inter-organizational networks, bringing together various enterprises, institutions and organizations, jointly combine knowledge, experience and resources, translating into a better understanding of customer needs and creating unique opportunities for sustainable development (Dhanaraj, Parkhe, 2006). This approach not only strengthens the market position of enterprises but also promotes activities consistent with the principles of social responsibility (McWilliams, Siegel, 2000). Enterprises operating in inter-organizational networks focus on identifying and satisfying customer needs, thereby increasing their opportunities to positively impact the environment and society without giving up their economic goals (Prahald, Krishnan, 2012). Therefore, a better understanding of customer needs in enterprises operating in inter-organizational networks is crucial in strengthening market position (Ryall, 2013). Moreover, companies that effectively identify and meet customer needs are often perceived as more credible, thanks to which they can not only increase their market position but also stand out as leaders in the field of social responsibility (Robert et al., 2012).

However, there is still a cognitive gap in the literature on understanding customer needs, which may shape the social responsibility of enterprises operating in inter-organizational networks (Park, Kom, 2019). Moreover, there is a lack of research on better adaptation to customer needs, which will be accompanied by strengthening the market position, better access to market information and increasing the flexibility of business activities to, on the one hand, eliminate the negative consequences of unsustainable activities of enterprises and, on the other hand, to shape social responsibility of network enterprises positively. Therefore, the study poses

a research question: how does understanding customer needs shape socially responsible companies operating in inter-organizational networks? As a consequence of the question asked, the study aims to understand the relationship between adapting to customer needs in the context of shaping the social responsibility of enterprises operating in inter-organizational networks and improving access to market information, strengthening market position and increasing the flexibility of business as a benefit from mutual connections and relationships with market partners. To achieve the aim of the article, literature studies and statistical analysis of survey data based on the Kendall rank correlation coefficient and the Kruskal-Wallis test were used, which made it possible to explain the research problem. Understanding customer needs is important and topical because it allows for shaping the social responsibility of enterprises operating in inter-organizational networks.

The role of inter-organizational networks in sustainable adjustment to the needs of the customer and the enterprise

Inter-organizational networks are defined in management sciences as a system of two or more enterprises engaged in long-term interconnections and relationships (Thorelli, 1986). The essence of inter-organizational networks is a relatively permanent grouping of autonomous, specialized enterprises participating in a mutual system based on market cooperation (Kotler, Caslione, 2009). The influence of inter-organizational networks (Parkhe et al., 2006) allows the achievement of the synergy effect (Hamel, 2002), which involves sharing resources and integrating the activities of many economic partners in order to build a joint market position (Niemczyk et al., 2021).

The network approach highlights inter-organizational cooperation and competition relationships, which makes the customer a value driver, not only for a single company (Shafer et al., 2005). Therefore, one of the reasons for the emergence of inter-organizational networks is the ability to better recognize customer needs and priorities, adapt distribution channels that enable meeting customer needs and obtain key resources and unique competencies (West, 2007). Participants in inter-organizational networks engage in both competitive and cooperative behaviors simultaneously. This dual approach helps them build and enhance their market position (Amit, Zott, 2012) while also enabling them to adapt to the dynamic and uncertain conditions of the network environment (Regans, Zuckerman, 2008).

Inter-organizational networks are a source of resources, both tangible and intangible, enabling their value-creating structuring. The resource approach emphasizes that resources are a source of competitive advantage and building market position (Zott, Amit, 2011). The criterion for separating tangible and intangible resources of an enterprise is managerial decisions, which, in the case of enterprises operating in inter-organizational networks, become factors shaping value creation processes (Coff, 2010). In this context, it is worth noting that in enterprises operating in inter-organizational networks, managerial information is an important intangible resource (Demil, Lacocq, 2010), enabling making accurate decisions. This means

that the effectiveness of decision-making must consider the process of obtaining information over a given time horizon, which is associated with the risk of not achieving the intended goals (Chan Kim, Mauborgne, 2005). Therefore, the main advantage resulting from participation in inter-organizational networks is the synergy of resources, which is gradual and flexible (Dyduch, 2016). It is worth noting that resources require expenditure because they are rare and difficult to access, but they can also be in excess, are subject to consumption and express different levels of innovation, which means that, according to the assumptions of the resource-based school, they constitute the basis of the value creation process (Foss, 2005). Resources acquired by enterprises operating in inter-organizational networks enable building of a flexible enterprise architecture (Janssen, Feenstra, 2010). Enterprises that operate in inter-organizational networks respond flexibly to changing market conditions (Parkhe et al., 2006), can build a strong market position and gain customer loyalty by providing unique value (Lostakova, Pecinova, 2014) that meets their needs and expectations. Considerations related to the conceptual framework and the definition of the research goal created the possibility of adopting three hypotheses, assuming that:

H1: In enterprises operating in inter-organizational networks, understanding customer needs in the context of shaping social responsibility is accompanied by better access to market information.

H2: In enterprises operating in inter-organizational networks, adapting to customer needs in the context of shaping social responsibility entails strengthening the market position.

H3: In enterprises operating in inter-organizational networks, adapting to customer needs in the context of shaping social responsibility increases the flexibility of business activities.

The current state of knowledge in this field is characterized by methodological diversity, and the lack of in-depth theoretical research results in few attempts to examine the adjustment to customer needs that shape socially responsible enterprises operating in inter-organizational networks in the context of the relationship with other benefits resulting from interconnections with market partners. The above arguments led to the article attempting theoretical analysis and conducting empirical research to fill the noticed gap.

To sum up, one can expect that creating inter-organizational networks offers enterprises benefits, which should lead to better adaptation of the offer to customer needs. The synergy of benefits generated in the inter-organizational network creates network potential that combines the needs of customers and the expectations of enterprises, co-creating the inter-organizational network to strengthen their market position. Moreover, one can expect that the cooperation of inter-organizational network participants allows them to adapt to the customers' needs and, on the other hand, strengthen the market position, provide better access to market information, and increase the business's flexibility.

2. Materials and methods

2.1. Research dataset

In order to answer the research questions, we collected survey data using the CATI (Computer-Assisted Telephone Interviewing) method, which allowed us to conduct the research in an organized and effective way. One of the main advantages of CATI is the ability to get a large number of interviews in a relatively short period. In our research, this allowed for quick data collection and processing on almost 400 enterprises. The CATI method ensured uniformity of the data collection process and enabled the integration of the collected information directly into the database, which improved the entire research process. Despite many advantages, the CATI method also has its limitations. In the current study, the authors encountered difficulties due to the need to eliminate complex questions that are difficult to discuss in a telephone format and require additional attention from respondents when completing the questionnaire (Vogel et al., 2020).

This study analyzes four of the 22 questions included in the survey questionnaire. Respondents answered to what extent they agree that interconnections and relationships with market partners in inter-organizational networks allow for:

- adaptation to customer needs (*A1*),
- better access to market information (*A2*),
- strengthening market position (*A3*),
- greater flexibility of business activity (*A4*).

The questionnaire used a five-point Likert scale ranging from '1' – 'strongly disagree' to '5' – 'strongly agree'. Respondents were asked to indicate the answer that best described the degree to which they agreed or disagreed with each statement. They were also informed that answers were not graded as correct or incorrect.

Ultimately, the analyzed dataset included surveys completed by respondents holding managerial positions in 349 enterprises operating in Poland. Micro-enterprises constituted 68.5% of the surveyed entities in the dataset. Small enterprises also participated in the study, accounting for 12%, medium-sized enterprises 8.6% and large enterprises 10.9%. The dominant activity profile in the group of surveyed enterprises was service activity (72.8%), while production activity accounted for 21.2% and commercial activity for 6%. The structure of the studied dataset is presented in Table 1 and Figure 1.

The vast majority of the surveyed entities were national enterprises (45.8%). Enterprises that declared their operations to be global were approximately 14.1%, while 10.3% of respondents declared their operations to be European. The remaining part of the surveyed enterprises declared local operations (29.8%).

Table 1.
Dataset structure

Features of enterprises	Category description	Share of respondents
Enterprise size	Micro-enterprise (up to 10 employees on average per year)	68.5%
	Small enterprise (from 10 to 49 employees on average per year)	12.0%
	Medium-sized enterprise (from 50 to 250 employees on average per year)	8.6%
	Large enterprise (over 250 employees per on average per year)	10.9%
Dominant business profile	Service activities	72.8%
	Production activities	21.2%
	Commercial activities	6.0%
Scope of the business	A global enterprise	14.1%
	A European company	10.3%
	A national company	45.8%
	A local company	29.8%

Source: Own study based on conducted research.

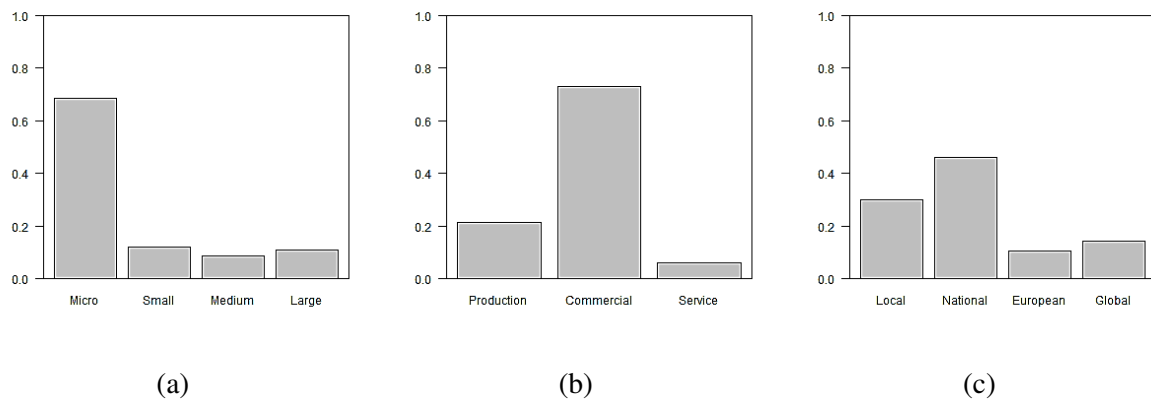


Figure 1. Structure of the surveyed enterprises according to the size of the enterprise (a), dominant business profile (b) and scope of the business (c).

Source: Own study based on conducted research.

2.2. Research procedure

The research procedure consisted of two parts. First, in order to identify trends in adapting to customer needs, strengthening market position, improving access to information and increasing the flexibility of business in enterprises operating in inter-organizational networks, we carried out an analysis of the frequency of positive answers (agree, strongly agree) of respondents to these questions. Then, we conducted a correlation analysis and applied the Kruskal-Wallis test to examine the relationship between adapting to customer needs in the context of shaping the social responsibility of enterprises operating in inter-organizational networks and other benefits arising from interconnections and relationships with market partners. The Kendall rank correlation coefficient assesses the strength and direction of the relationship between two variables measured on an ordinal scale. A positive value of the Kendall rank correlation coefficient indicates the consistency of the respondents' assessments in the two considered questionnaire questions, while a negative value indicates the contradiction

of the respondents' assessments. In order to test the statistical significance of the results, we used the *t*-test, assuming a significance level of 0.05. The null hypothesis states no relationship between the variables, while the alternative hypothesis states a similar (positive correlation) or dissimilar rank (inverse correlation) between the variables.

In the dataset, respondents' answers to the individual questionnaire questions do not come from a normal distribution, which we verified by the Shapiro-Wilk test at any low significance level. For this reason and due to the ordinal nature of the studied variables, in further analysis, we used the non-parametric Kruskal-Wallis test to compare at least two independent samples (Corder, Foreman, 2009). In this test, in considered case, the null hypothesis states that the respondents' answers to a given question (dependent variable) in each of the groups described by the factor (independent variable, grouping variable) are the same. However, the alternative hypothesis states that respondents from at least one group designated by the factor systematically tend to give higher (or lower) ratings (dependent variable values) than those in other groups of respondents. In order to identify this group (or groups) of respondents, in the next step, we compared the distributions of pairwise answers using the Dunn test with the Bonferroni correction.

In the article, we used the answers to the question regarding adaptation to customer needs (*A1*) as a grouping variable (factor). Thus, the *G1* group consists of companies in which respondents disagreed or had no opinion (responses from '1' to '3' on the Likert scale) regarding this question. In group *G2*, respondents agreed (response '4'), while respondents in group *G3* strongly agreed with this statement (response '5'). Using the Kruskal-Wallis test, we compared the distribution of ratings given by respondents in these groups in the context of statements regarding better access to information (*A2*), strengthening the market position (*A3*) and greater flexibility (*A4*). These variables sequentially served as the dependent variable. Then, using the Dunn test, we checked whether there was a group(s) of enterprises in which higher ratings on the Likert scale were more common in the distribution of the dependent variable (answers to questions *A2*, *A3* or *A4*, respectively). A significance level is set at 0.05.

3. Results

First of all, we analyzed what part of the respondents agreed (responses '4' or '5' on a five-point Likert scale) with the statements that interconnections and relationships with market partners allow for adapting to customer needs in the context of shaping corporate social responsibility, improving access to information, strengthening the market position and greater flexibility of the conducted business.

The research shows that most surveyed enterprises (88.3%) agreed that inter-organizational relations allow for adaptation to customer needs (A1), affecting social responsibility development. There are several reasons why this view is widely accepted. Inter-organizational relations enable the exchange of knowledge, experiences and best practices between various entities operating in the inter-organizational network. Thanks to this, companies can better understand the needs and expectations of their customers. Cooperation with market partners allows enterprises to respond faster to changes in customer preferences, which enables them to adapt products to customer expectations and increase competitiveness. Inter-organizational relationships allow enterprises to better understand their place and role in society and their impact on the environment and local communities. Moreover, by cooperating in an inter-organizational network, companies can better contribute to achieving sustainable development goals, which is crucial for building corporate social responsibility.

In the research, most of the surveyed enterprises (92%) agree that inter-organizational relations provide better access to market information (A2), which is essential both for business strategy and for shaping corporate social responsibility. Relationships with various market partners, such as suppliers, distributors, customers and other industry partners, create an extensive knowledge network. Each entity brings unique information about the market, trends, customer preferences and changing market conditions. Thanks to inter-organizational relationships, enterprises can more quickly identify new trends and consumer behaviour changes, allowing them to adapt their business strategies accordingly. Cooperation with market partners enables the exchange of experiences and best practices, particularly valuable in market uncertainty and rapid changes. Access to a broader market information database allows enterprises to better understand social expectations and the needs of the communities in which they operate. Comprehensive market knowledge enables enterprises operating in an inter-organizational network to make more conscious and responsible decisions that consider business goals and the impact on society and the environment. Moreover, companies that are well-informed about societal needs and challenges are more likely to engage in social and environmental initiatives that contribute to sustainable development.

According to most of the surveyed respondents (84.5%), inter-organizational relations allow them to strengthen their market position (A3), indirectly affecting their social responsibility development. This is because cooperation with market partners can increase the negotiating power of enterprises and provide access to new markets, strengthening their market position. Inter-organizational relationships enable the sharing knowledge, experience, technologies and resources, contributing to increased efficiency and innovation. Enterprises operating in networks are better informed about market trends and adapt to changes faster, which strengthens their competitiveness. Within the network, companies can learn from each other how to more effectively implement sustainable development and social responsibility practices. Inter-organizational relations often lead to joint social or ecological initiatives, which positively affect the image of enterprises and their relations with local communities. Enterprises

that actively participate in social initiatives demonstrate social responsibility and build trust and loyalty among customers and employees.

According to most of the surveyed enterprises (87.1%), inter-organizational relations, i.e. mutual connections and relationships with market partners, increase the flexibility of business activities (A4), which also affects the development of corporate social responsibility, because inter-organizational relations enable companies to use the resources, knowledge and skills of partners. Thanks to this, they can quickly adapt to changing market conditions and new challenges without having all the necessary resources internally. By collaborating with other organizations, companies can share the risks associated with new business initiatives, allowing them to have a more flexible approach to innovation and development. Thanks to networks of contacts and cooperation, enterprises are better informed and can respond faster to changes in demand, consumer trends and new technologies. Inter-organizational collaboration often drives companies to implement more sustainable business practices. By exchanging knowledge and experience with partners, enterprises can better understand how their activities affect the environment and society. Businesses can collaborate with partners on social and environmental initiatives, which increases their ability to shape corporate social responsibility. Thus, companies that are flexible and can quickly adapt to the needs of the community gain the trust and loyalty of customers and other stakeholders, which positively affects their reputation.

In the second part, the study examined whether enterprises in which mutual connections and relationships with market partners allow them to adapt to customer needs in the context of shaping corporate social responsibility also notice their impact on better access to information, strengthening their market position and greater flexibility of their business activities. For this purpose, we used the Kendall rank correlation analysis and the Kruskal-Wallis test. Such an in-depth analysis, in particular, allowed us to look at whether the way of answering questions was the same in the three groups of companies specified above, G1-G3, distinguished due to the answers provided in terms of adapting to customer needs. We verified the tested relationships at a significance level of 0.05. Tables 2 and 3 present the results.

Table 2.

The results of the Kendall rank correlation coefficient

In enterprises operating in inter-organizational networks, mutual connections and relationships with market partners allow for:	Adaptation to the customer needs in the context of shaping corporate social responsibility (A1)
better access to market information (A2)	0.65***
strengthening market position (A3)	0.49***
greater flexibility of business activity (A4)	-0.11**

Note: *** $p < 0.01$; ** $p < 0.05$.

Source: Own study based on conducted research.

Based on the results presented in Table 2, we can conclude that in the surveyed enterprises operating in inter-organizational networks, matching customer needs (A1) is generally accompanied by better access to market information (A2) (positive, statistically significant

Kendall rank correlation coefficient of 0.65), which influences the development of their social responsibility. For a more detailed analysis, we also examined whether the distribution of respondents' answers to the question about better access to information is the same in each of the groups of enterprises in terms of the answers to the question about adapting to customer needs as a consequence of mutual connections and relationships with market partners.

Table 3.

Results of the Kruskal-Wallis and Dunn tests in groups according to respondents' assessment of benefits from mutual connections and relationships with market partners in terms of adaptation to customer needs (A1) in the context of shaping corporate social responsibility

Dependent variable:		Better access to market information (A2)	Strengthening market position (A3)	Greater flexibility of business activity (A4)
Kruskal-Wallis:		176.60***	101.07***	5.72
Dunn:	G1 vs. G2	-1.36	-1.83	X
	G1 vs. G3	-9.26***	-7.56***	X
	G2 vs. G3	-11.72***	-8.46***	X

Note: *** p < 0.01.

Source: Own study based on conducted research.

The result of the Kruskal-Wallis test (176.60, see Table 3) indicates that the distribution of respondents' ratings (on a five-point Likert scale) is statistically significantly different in at least two groups out of G1–G3. However, in the Dunn test, we recorded negative and statistically significant values of the test statistics comparing groups G1 and G3 (-9.26) and G2 and G3 (-11.72) with no statistically significant difference between groups G1 and G2 (see Table 3). In particular, that means that respondents from the G3 group (i.e. who strongly agreed that functioning in inter-organizational networks allows their company to adapt to customer needs) more often agreed that it also entails better access to information (A2). The above results, including those regarding the correlation analysis, are statistically significant, which confirms the H1 hypothesis. It is worth noting that inter-organizational networks consist of various entities with extensive knowledge and experience in their operations. Thus, these companies have better access to a wide range of information about the needs and preferences of customers from various market segments. Therefore, through collaboration with partners, these companies can share information resources, enabling them to better understand the market and more quickly adapt their offer to customers' changing needs. Thus, networking enables companies to jointly innovate and develop solutions that better meet customer needs, allowing companies to offer more attractive products.

Moreover, greater access to market information allows companies to better understand social and environmental challenges. Enterprises operating in inter-organizational networks can use their cooperation networks to implement social and environmental projects, contributing to community development and sustainable development. It should be emphasized that a better understanding of customer needs and active participation in activities for the benefit of society builds trust, which positively affects relations with stakeholders, creating the basis for corporate social responsibility.

The Kendall rank correlation coefficient (0.49 – Table 2), in the case of the surveyed enterprises operating in inter-organizational networks, indicates a positive and statistically significant relationship between adapting to customer needs (*A1*) in the context of shaping corporate social responsibility and strengthening market position (*A3*). The results of the Kruskal-Wallis test (101.07, see Table 3), and then the test comparing pairs, indicated that in particular – as before – respondents who strongly agreed (group *G3*) with the statement that mutual connections and relationships with partners market relationships allow for adaptation to customer needs (*A1*), they more often agreed that these relationships also allow for strengthening the market position, i.e. they indicated higher ratings on the Likert scale in the questionnaire. As before, this is indicated by negative test statistics values indicating statistically significant differences between the distributions of groups *G1* and *G3* (-7.56) and *G2* and *G3* (-8.46) with no differences between groups *G1* and *G2* (see Table 3). The results are statistically significant, which confirms hypothesis *H2* that functioning in inter-organizational networks allows for adjustment to customers' needs and expectations, which entails strengthening enterprises' market position. In this way, functioning in inter-organizational networks may contribute to shaping corporate social responsibility because inter-organizational networks favor cooperation and exchanging ideas and innovations. Therefore, enterprises operating in inter-organizational networks can combine their resources and competencies, leading to the creation of unique value for customers. Moreover, these companies can effectively shape social responsibility by building stronger relationships with customers, suppliers, local communities and employees.

What is surprising is the statistically significant Kendall rank correlation coefficient, but with a negative sign (-0.11, see Table 2), suggesting that enterprises that agree to a greater extent that interconnections and relationships with market partners allow for adaptation to customer needs (*A1*), at the same time, they generally disagree to a greater extent that it may result in greater flexibility of their business (*A4*). It should be noted, however, that the obtained relationship is weak. In this case, an additional analysis of the examined questions using the Kruskal-Wallis test is useful. The results show that in the three groups of enterprises studied (*G1-G3*), there are no statistically significant differences between the distributions of respondents' answers regarding greater flexibility (5.72, $p = 0.06$, see Table 3). Therefore, we cannot link the impact of the company's operation in inter-organizational networks to adapting to customer needs and increasing the flexibility of business operations. Thus, we cannot confirm hypothesis *H3*.

It is assumed in the literature on the subject that better adjustment to customer needs in enterprises operating in inter-organizational networks usually contributes to increasing the flexibility of their operations (Osbert-Pociecha et al., 2008). Enterprises operating in inter-organizational networks can respond more effectively to changing market needs thanks to cooperation and exchange of information and resources with other entities in the network (Luangsakdapich et al., 2015). However, our research shows that adapting to customer needs

does not necessarily have a clear impact on greater flexibility of business activity. This may be because the surveyed companies are mostly micro-entities (68.5%), which are narrowly specialized and focused on particular niche needs of their clients. In this case, their activities may be less flexible because they are embedded in a specific market segment.

Moreover, some companies surveyed may engage in long-term strategies that limit their immediate flexibility. Additionally, liabilities arising from long-term contracts or industry regulations may be another factor limiting the flexibility and liquidity of the business. However, limited flexibility is not an obstacle to understanding customer needs and can foster more responsible business decisions that consider the long-term well-being of customers and communities. The consequence of meeting customer expectations may be building trust and credibility, which is an essential aspect of the social responsibility of the surveyed enterprises.

4. Discussion

This study is based on the assumption of complex relationships between understanding and adapting to customer needs in the context of shaping the social responsibility of enterprises operating in inter-organizational networks and improving access to market information, strengthening market position and increasing the flexibility of business operations. The study sought an answer to the question: How does adaptation to customer needs shape socially responsible enterprises operating in inter-organizational networks? The results of the conducted research suggest that in enterprises operating in inter-organizational networks, mutual connections and relationships with market partners allow for adaptation to customer needs in the context of shaping corporate social responsibility, which is accompanied by better access to market information and strengthening the market position.

The perspective of enterprises operating in inter-organizational networks contributed to a better understanding of customer needs in the context of shaping corporate social responsibility, which, however, may not result in greater flexibility in business activities. This means that operating in inter-organizational networks provides enterprises with better access to market information and allows for better adaptation of the offer to customer needs, but does not necessarily lead to greater flexibility of business operations. Therefore, by understanding and responding to market needs and engaging in social activities, enterprises operating in inter-organizational networks can build their image as responsible and committed entities, which should contribute to both economic and social benefits. Therefore, inter-organizational relations are not only a tool for strengthening market position through better adaptation to customer needs, but also a way to achieve social and sustainable development goals.

A clear implication of the theoretical assumptions and conducted research is that although it is believed that in the case of enterprises operating in inter-organizational networks, better adaptation to customer needs leads to greater flexibility of operations in exceptional situations, for example, in micro-entities, where the ability to current settlement of liabilities and obtaining funds is limited, there will not necessarily be an increase in the flexibility of their business, which, however, does not reduce the possibility of shaping their social responsibility. This is possible by building deep relationships with customers, as well as stability and commitment to their communities.

5. Conclusions and summary

Summarizing the considerations presented in this study, it is worth emphasizing that understanding and adapting to customer needs within inter-organizational networks allows enterprises to be socially responsible and ecologically conscious. Cooperation in networks enables more efficient use of resources, promotes innovation and enables the creation of products that respond to real social and environmental needs. In this way, companies not only increase their market value, but also contribute to building a better future for society.

The considerations presented in this study make it possible to confirm the implementation of the adopted research goal related to understanding the relationship between adapting to customer needs in the context of shaping the social responsibility of enterprises operating in inter-organizational networks and strengthening the market position, improving access to market information and increasing the flexibility of business activities as benefits from mutual connections and relationships with market partners. The literature studies and the results of empirical research allowed us to formulate the following conclusions:

- In enterprises operating in inter-organizational networks, a better understanding of customer needs in the context of shaping social responsibility is accompanied by better access to market information and strengthening the market position.
- Understanding customer needs in the context of shaping social responsibility in enterprises operating in inter-organizational networks will not always increase the flexibility of business operations.

This study supports the current view that understanding customer needs shapes socially responsible enterprises operating in inter-organizational networks in terms of strengthening market position and improving access to market information. The main contribution of the article is empirical evidence confirming that better adaptation to customer needs is not always accompanied by increased flexibility in business operations. Moreover, the multi-aspect nature of understanding customer needs in the context of shaping corporate social responsibility and the interdisciplinary nature of the considerations create grounds for further research and exploration in this area.

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CHANGES IN THE FUNCTIONING OF PASSENGER RAIL TRANSPORT IN POLAND DUE TO THE COVID-19 PANDEMIC

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Purpose: The purpose of this article is to examine the changes in the functioning of passenger rail transport in Poland due to the COVID-19 pandemic, focusing on shifts in passengers' transport preferences before and during the pandemic, as well as evaluating the preparedness of rail carriers in adapting to pandemic-related restrictions.

Design/methodology/approach: The research was conducted using a survey questionnaire composed of 11 questions, which collected responses from 366 participants across Poland. The study adopts an empirical approach to understand passengers' experiences and opinions on rail transport during the pandemic, focusing on their transport preferences and perceptions of carriers' preparedness.

Findings: The survey results show that the majority of passengers positively assessed the actions taken by rail carriers during the COVID-19 pandemic. The findings indicate a general satisfaction with the measures implemented to ensure safety and compliance with health guidelines, as well as a shift in passengers' transport preferences during the pandemic.

Research limitations/implications: The study is limited by the number of respondents (366), which may not fully represent the entire population of rail passengers in Poland. Future research could expand the sample size and explore a broader range of transport modes or compare the situation in other countries to provide a more comprehensive understanding of the pandemic's impact on public transport.

Practical implications: The research highlights the importance of adaptive measures in ensuring the continued functioning of rail transport during global crises such as the COVID-19 pandemic. Rail operators can use these insights to refine their contingency planning and improve crisis management strategies to maintain passenger trust and safety in future emergencies.

Originality/value: This article offers new insights into the specific challenges faced by passenger rail transport in Poland during the COVID-19 pandemic, as well as passengers' evolving preferences and expectations. It is valuable for transport policymakers, rail operators, and researchers interested in transport resilience and crisis management.

Keywords: passenger rail transport, COVID-19 pandemic, restrictions, proposals for improvement.

Category of the paper: Research paper.

1. Introduction

The COVID-19 pandemic has fundamentally altered various sectors of the global economy, with transportation being one of the most impacted areas (Dong et al., 2012). In Poland, passenger rail transport, a crucial component of the country's public transportation system, has faced unprecedented challenges due to the health crisis. As governments implemented lockdowns and social distancing measures, the volume of rail passengers plummeted, leading to significant operational and financial repercussions for rail carriers (Jahangiri et al., 2018).

Prior to the pandemic, rail transport in Poland was experiencing a renaissance, with increasing passenger numbers and investments in modernizing infrastructure. However, the onset of the pandemic necessitated a rapid adaptation to a new reality, compelling rail operators to reassess their strategies and operations (Lin et al., 2020; Zhou et al., 2020). Understanding these changes is vital for evaluating the resilience and adaptability of the rail transport sector in crisis situations.

This article aims to examine the changes in the functioning of passenger rail transport in Poland due to the COVID-19 pandemic. It will analyze shifts in passengers' transport preferences before and during the pandemic and evaluate the preparedness of rail carriers in implementing pandemic-related restrictions (Mohammadfam et al., 2020; Woodburn et al., 2019). By employing a quantitative approach, the study will provide insights into how the pandemic has reshaped passenger rail transport in Poland, revealing not only the immediate effects but also the potential long-term implications for the industry.

2. A Historical Perspective on Coronaviruses: From Early Discoveries to the COVID-19 Pandemic

Coronaviruses have been known in human medicine for a long time. The first mentions of coronaviruses that can infect humans date back to the 1960s. At that time, it was possible to isolate the first two pathogens causing respiratory diseases in humans, and for decades they were the only representatives of coronaviruses that could infect humans (Tyrrell, Bynoe, 1965). It was not until the beginning of the 21st century that the world was swept by an epidemic caused by the highly contagious SARS-CoV coronavirus species. Another wave of infections with the novel coronavirus took place in 2012 in the Middle East. This time the virus was called MERS-CoV and, like the previous one, it was a zoonotic virus (Coronavirus number infected latest tally). However, these epidemics did not pose a worldwide threat to humans.

The first cases of the new infectious disease-causing pneumonia were registered on November 17, 2019 in the city of Wuhan, in China's Hubei province. All of the infected people were associated with the Huanan Seafood Wholesale Market, a seafood and animal market located in the town. At the beginning of January 2020, Chinese scientists isolated a new virus genetically similar to the SARS-CoV virus from samples taken from patients, which is why it was named SARS-CoV-2. The infectious disease caused by this virus has been named COVID-19 (Coronavirus: China's first confirmed Covid-19 case traced back to November 17).

Initially, the virus spread among the people of Wuhan. However, the movement of Chinese people in connection with the Chinese New Year celebrations has greatly facilitated the development of infections at home and abroad. On January 13, 2020, the first case was confirmed in Thailand. The first cases of infection in Europe were confirmed on January 24, 2020, in three residents of France (Three cases of coronavirus in France. These are the first infections in Europe). The second half of February resulted in a sharp increase in the number of cases around the world. At that time, Italy became the most affected region in the world. In April 2020, the highest number of infections was recorded in the United States, which led the way until March 2021. Due to the situation, on 11 March the Director-General of the World Health Organization (WHO) described the development of the disease as a pandemic (World Health Organization Declares COVID-19 a 'Pandemic.' Here's What That Means).

In Poland, the first case of SARS-CoV-2 infection was reported on March 4, 2020. The virus infection was diagnosed in a hospital in Zielona Góra, in a resident of the Lubuskie province, who came to Poland by bus from Germany (First cases of coronavirus in Poland). In the period from 14 to 20 March, a state of epidemiological emergency was in force in Poland. In the period from 20 March 2020 to 15 May 2022, in accordance with the regulation of the Minister of Health, the state of epidemic was in force in Poland (Regulation of the Minister of Health of 20 March 2020 on the announcement of the state of epidemic in the Republic of Poland). As of May 16, 2022, the state of epidemiological emergency is in force again.

According to the draft regulation of the Minister of Health published on 2 May 2023 on the website of the Government Legislation Centre, the state of epidemiological threat in Poland is to end on 1 July 2023 (Hilgenfeld and Peiris, Regulation of the Minister of Health of 12 May 2022 on the announcement in the territory of the Republic of Poland).

3. A review of literature studies on the Covid-19 pandemic and the functioning of rail transport over time

The COVID-19 pandemic had a huge impact on various economic sectors around the world, and one of the most affected areas was passenger transport. Assessments of the impact of the pandemic on passenger rail transport were carried out using bibliometric analysis with VOSviewer. According to the Scopus database, approximately 79 different studies were conducted in the declared area from 2020-2024. The results of this scientometric analysis are shown in Figure 1.

As illustrated in Figure 1a, it is evident that the impacts of Covid-19 have been evaluated from various perspectives, including public transportation, railroad system effects, human feedback, and urban transportation systems. The bibliometric analysis based on the Scopus database revealed that this topic remained of significant interest, particularly in China, even after 2022.

The detailed analysis shows that the studies cover a broad range of aspects. Public transportation research primarily focuses on the decline in passenger numbers, changes in travel behavior, and adaptations in service operations. Railroad system effects include the analysis of operational efficiency, economic impacts, and infrastructural adjustments necessitated by the pandemic. Studies on human feedback emphasize passenger perceptions, behavioral changes, and compliance with safety measures. Urban transportation system research delves into the broader implications for city mobility and integration with other forms of transport.

Additionally, Figure 1b demonstrates that the topic remains a significant issue in Poland. The country has engaged in joint projects related to this field with the Czech Republic, Thailand, and Slovakia. This collaboration indicates that the subject of Covid-19's impact on passenger rail transport is an attractive and active research area in Poland. These international collaborations suggest a shared interest in understanding and mitigating the effects of the pandemic on rail systems. The research conducted in Poland, often in partnership with other countries, underscores the global nature of the challenges faced and the collective effort to develop effective solutions. This collaborative approach not only enhances the quality and scope of research but also facilitates the exchange of knowledge and best practices among countries facing similar issues in their transportation sectors.

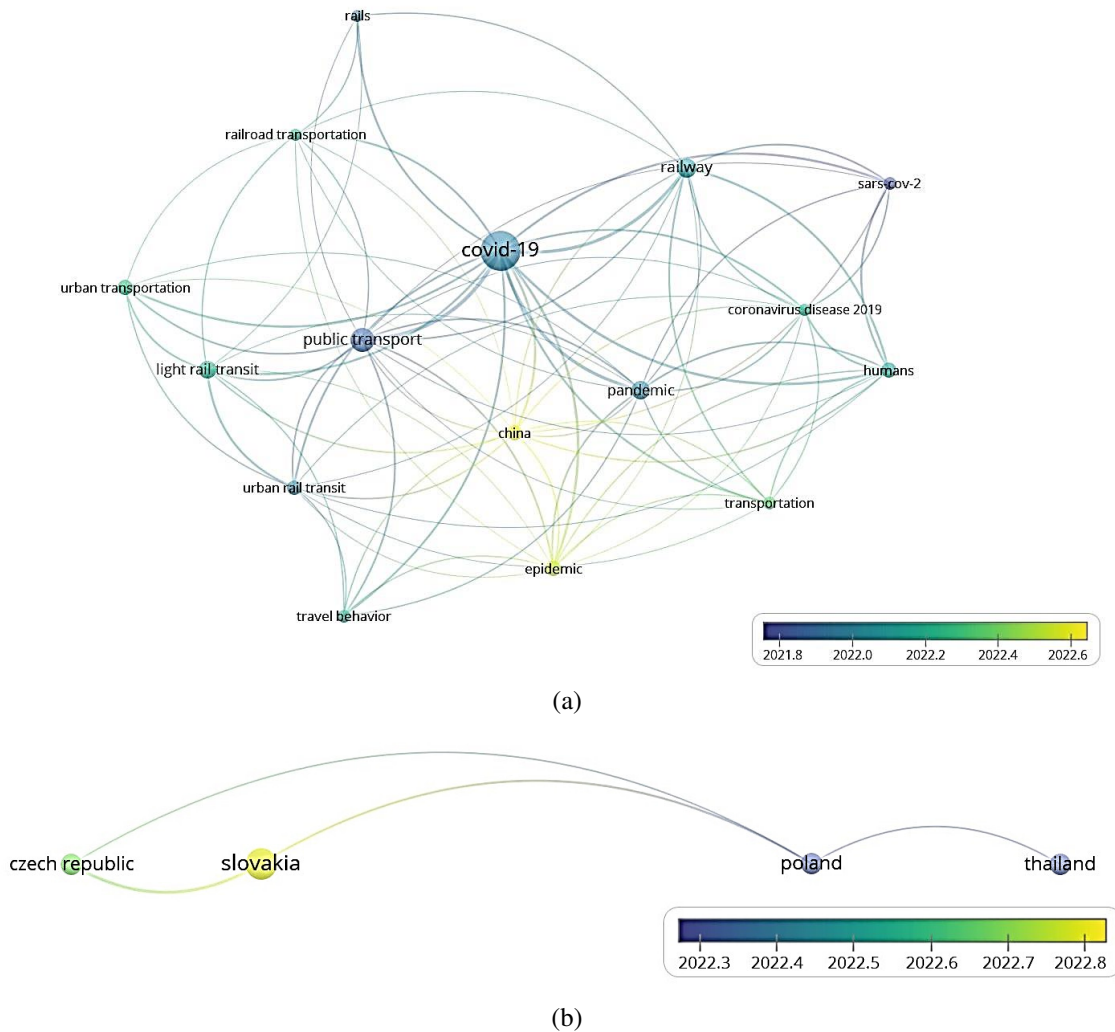


Figure 1. The bibliometric analysis of Covid-19 effects on rail transport system as per Scopus databank. Source: Own material.

It should be noted that understanding and mitigating the impact of the pandemic on rail transport cannot be effective without considering the context in which Poland faced the pandemic. From March 2020 to November 2022, there were six waves of increased SARS-CoV-2 infections in Poland. The first wave with confirmed daily infections, in the amount of about a thousand people a day, took place in August 2020. The second wave with confirmed daily infections of about 25,000 took place in November of the same year. The third wave reached Polish in the spring of 2021. At that time, more than 30,000 infections were recorded daily in Poland. The fourth wave reached our country at the end of 2021 – with confirmed infections at the level of 25 thousand per day. Soon after, in February 2022, the fifth wave of infections reached Polish. At that time, more than 50,000 confirmed infections were recorded. The last wave of the epidemic in Poland lasted from July to October 2022, with the daily number of confirmed infections at the level of several thousand per day. According to the data published on websites, 6 million 516 thousand 234 cases of SARS-CoV-2 infection have been confirmed in Poland since the beginning of the pandemic.

Unfortunately, 119 thousand 596 people died of COVID-19 in Poland (Coronavirus number infected latest tally). Figure 2 shows a graph with the daily number of confirmed infections from the beginning of the pandemic to May 2023.

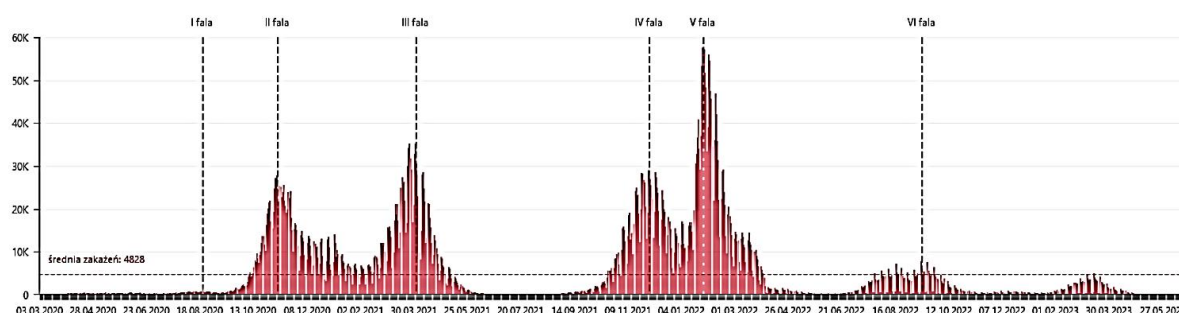


Figure 2. Daily number of confirmed infections from the beginning of the pandemic to May 2023.

Source: Information of the Chief Sanitary Inspector on mass events.

During this time, i.e. from March 2020 to March 28, 2022, various restrictions were introduced throughout the country. These were aimed at reducing the spread of the virus. The chronological dates of the introduction of restrictions and the dates of their easing in Poland are presented below.

- March 8, 2020 – The Chief Sanitary Inspector recommended the cancellation of all mass events with more than a thousand people – this applied to closed rooms (Information of the Chief Sanitary Inspector on mass events).
- March 10, 2020 – the majority of rectors of universities in Poland have decided to cancel classes for students and doctoral students from 11 to 14 March. On the same day, at a meeting of the National Security Council, Prime Minister Mateusz Morawiecki cancelled all mass events throughout the country (Action on coronavirus in Poland).
- March 11, 2020 – The Prime Minister and the Ministers of Health, National Education and Higher Education announced the preventive closure of all educational institutions for a period of 14 days – from 14 to 25 March 2020. This applied to all public and private schools, nurseries, kindergartens, as well as secondary schools and universities. These restrictions did not apply to special schools, educational centres and counselling and guidance centres (Coronavirus in Poland schools and kindergartens closed).
- March 13, 2020 – The Minister of Health announced that from 14 March 2020 a state of epidemiological emergency will be introduced in Polish (Regulation of the Minister of Health of 13 March 2020 on the announcement of the state of epidemic threat in the Republic of Poland). And from March 15, the borders of Polish will be closed. This restriction applied to air and rail traffic. At that time, passport controls were also introduced at all land border crossing points. Only workers working in border areas were allowed to enter the country upon presentation of the appropriate certificate. Polish citizens returning from abroad had to undergo a 14-day quarantine. At that time,

a ban on public gatherings of more than 50 people was introduced, including during state and religious ceremonies (State of epidemiological emergency).

- March 20, 2020 – on this day, the state of epidemic was declared in the Republic of Poland by the regulation of the Minister of Health. This state of affairs was in force until 16 May 2022 (Regulation of the Minister of Health of 20 March 2020 on the announcement of the state of epidemic in the Republic of Poland).
- March 25, 2020 – from that date, new safety rules related to COVID-19 were introduced. Gatherings of more than 2 people were banned, participation in religious ceremonies was limited to 5 people, and restrictions on movement by public transport and on foot were introduced.

At that time, the following principles were adopted:

1. for public transport – the maximum number of passengers in public transport may not exceed half of all seats in the rolling stock,
2. for pedestrians – two people could move at the same time at a distance greater than or equal to 1.5 meters (this restriction did not apply to people living in the same household). A ban on movement was also introduced (Regulation of the Minister of Health of 24 March 2020 amending the regulation on the announcement of the state of epidemic in the Republic of Poland).

This prohibition did not apply to:

1. performing official tasks or professional activities, conducting business activity, carrying out agricultural activity or work on the farm, and purchasing goods and using related services,
 2. meeting the necessities of life related to the affairs of everyday life,
 3. performing voluntary and unpaid – also in the form of volunteering – services to counteract the effects of COVID-19,
 4. worship or participation in religious worship, as well as religious rites (Regulation of the Minister of Health of 24 March 2020 amending the regulation on the announcement of the state of epidemic in the Republic of Poland).
- April 1, 2020 – further restrictions were introduced on that day to reduce the spread of the SARS-CoV-2 virus. Parks, boulevards and beaches were closed. Hairdressing salons, beauty salons and tattoo parlors were suspended. Persons under the age of 18 were allowed in public spaces only under the supervision of an adult guardian. In shops and service outlets, the number of customers could not exceed three times the number of cash registers. The so-called "senior hours" were introduced in supermarkets – this meant that from 10:00 a.m. to 12:00 p.m., only people over 65 years of age could be in stores. All stores had to equip staff with personal protective equipment, and customers were only allowed to wear protective gloves (Regulation of the Council of Ministers of 31 March 2020 on the establishment of certain restrictions, orders and prohibitions in connection with the state of epidemic).

- April 20, 2020 – the first stage of lifting restrictions began in Poland. The ban on movement for "recreational purposes" has been lifted. The limits of people who could be in shops and places of worship at one time were increased. The new limit allowed 1 person per 15 m². The age limit for people moving in public spaces has been reduced. From that day on, people under the age of 13 had to stay with an adult guardian, and not 18-year-olds as before (Regulation of the Council of Ministers of 19 April 2020 on the establishment of certain restrictions, orders and prohibitions in connection with the state of epidemic).
 - May 4, 2020 – the second stage of lifting restrictions began. This stage included, among other things:
 1. opening of shops in shopping centres and shopping malls, provided that the strict sanitary regime is observed,
 2. hotels have been opened and other accommodations have been allowed,
 3. rehabilitation for patients was launched,
 4. some cultural institutions were opened, such as libraries, museums and art galleries,
 5. small group organisations – childcare in crèches and kindergartens (for working parents) – has been allowed,
 6. the possibility of sports and recreation was restored – from that day some sports facilities were opened (Coronavirus stage 2, Regulation of the Council of Ministers of 2 May 2020 on the establishment of certain restrictions, orders and prohibitions in connection with the state of epidemic).
 - May 18, 2020 – the process of lifting restrictions has begun. This was the penultimate stage of lifting coronavirus restrictions. As of Monday, May 18, 2020, the following social life regimes have been lifted:
 1. it is allowed to organize sports events for up to 50 people (events in the open space, without the participation of spectators),
 2. school classes in grades 1-3 (with a maximum number of children in the room),
 3. the number of believers allowed to stay in places of worship or other religious ceremonies was increased (there had to be 10 m² of free space per person instead of 15),
 4. in public transport the number of passengers has been increased to an equal number of seats in the vehicle.
- Regimes in the area of economic activity have been abolished:
1. hairdressers and beauty salons were opened,
 2. shops in shopping malls have been opened – with a limit on the number of people allowed to stay in the store at one time,
 3. allowed to run stationary catering business (Coronavirus stage 3, Regulation of the Council of Ministers of 16 May 2020 on the establishment of certain restrictions, orders and prohibitions in connection with the state of epidemic).

- May 30, 2020 – on this day, the fourth stage of defrosting the economy began in Poland. During the fourth stage of defrosting the economy, the following rules were changed:
 1. the obligation to cover the mouth and nose in open spaces with a two-metre distance from others has been abolished. This obligation did not apply to parents with children and cohabitants, persons with disabilities. Covering the mouth and nose remained mandatory:
 - on public transport,
 - in stores,
 - in cinemas and theatres,
 - in tattoo and massage parlors,
 - in churches,
 - in offices (when dealing with matters),
 - at work (this requirement was not mandatory if the employer ensured adequate distances between workstations and met sanitary requirements),
 - in a restaurant or bar – until you take a seat at a table,
 2. the limit on people in the catering and retail industry has been lifted. Anyone could be in shops, post offices, markets, churches and places of worship (the obligation to cover the mouth and nose remained), during religious ceremonies and funerals, and in restaurants. However, in catering outlets, the appropriate distance between tables had to be maintained, and customers had to wear masks before sitting at the table,
 3. at that time, it was allowed to organize gatherings and open-air concerts in which up to 150 participants could take part, while maintaining a distance of 2 meters,
 4. hotels have fully reopened. It was also allowed to serve meals to guests in the hall in hotel restaurants and bars, and from 6 June hotel swimming pools, gyms and fitness clubs could reopen,
 5. from 6 June, weddings for up to 150 people were allowed. Also from 6 June, institutions such as:
 - cinemas, theatres, ballet and operas,
 - gyms, fitness clubs, playrooms, amusement parks and swimming pools,
 - tattoo and massage parlours, saunas and solariums,
 6. fairs, exhibitions and congresses were allowed (Coronavirus stage 4, Regulation of the Council of Ministers of 29 May 2020 on the establishment of certain restrictions, orders and prohibitions in connection with the state of epidemic).

It is worth mentioning that as of June 1, 2020, the ban on flights to and from airports located in EFTA (European Free Trade Agreement) member states and EU member states, with the exception of the Kingdom of Sweden, the Portuguese Republic and the Grand Duchy of Luxembourg, has been lifted. On 22 June 2022, rail traffic was restored within the internal borders of the European Union (Regulation of the Council of Ministers of 19 June 2020 on the establishment of certain restrictions, orders and prohibitions in connection with the state of epidemic).

The main objective of the article was to examine the impact of the COVID-19 pandemic on the functioning of passenger rail transport in Poland, to analyze transport preferences among passengers using passenger rail transport before and during the outbreak of the pandemic, and to examine assessments of the level of preparation of passenger carriers regarding the level of preparation and application of the introduced restrictions.

4. Study of the impact of the Covid-19 pandemic on the functioning of passenger rail transport in Poland

The COVID-19 pandemic and the restrictions introduced by the Polish government have somehow forced people in Poland and around the world to change their lifestyles and ways of working. The introduced restrictions have also forced a number of changes on rail carriers. These included, but were not limited to:

- mandatory wearing of masks,
- more frequent disinfection and cleaning of warehouses,
- limiting the number of passengers.

In order to examine how passengers perceive the impact of the COVID-19 pandemic on the functioning of passenger rail transport in Poland and how they assess the preparedness of rail carriers for the pandemic, an online survey was conducted on the Google Forms platform (<https://www.google.pl/intl/pl/forms/about/>). The survey was conducted among passengers using the services of the majority of carriers providing passenger rail transport in Polish. Thanks to the Google Forms platform and the ability to share the link to the survey in social media and send it by e-mail, a wider group of respondents could take part in the survey. The survey was anonymous and consisted of 11 questions. 366 respondents from sixteen provinces took part in the survey.

Figure 3 shows the gender breakdown of respondents.

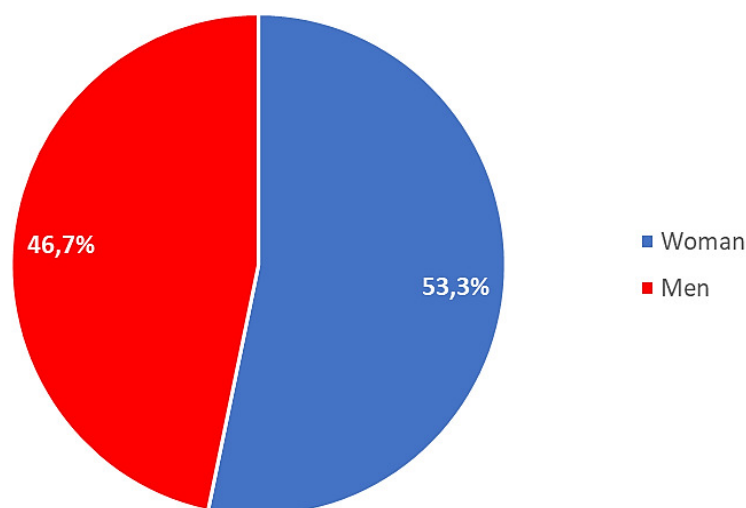


Figure 3. Gender breakdown of respondents.

Six age ranges were used to determine the age of the respondents: up to 18 years of age, from 18 to 25 years of age, from 26 to 40 years of age, from 41 to 50 years of age, from 51 to 60 years of age and over 60 years of age. The largest group of respondents – 115 (31.4%) people were aged 18 to 25, the second group were people aged 26 to 40 – 72 (19.7%) people, the third group were people aged 41 to 50, here 64 (17.5%) people completed the survey. On the other hand, 46 (12.6%) respondents were between 51 and 60 years old, and 42 (11.5%) were over 60 years old. The fewest surveys were completed by people under the age of 18. Only 27 (7.4%) respondents took the time to complete the survey. The largest number, i.e. 5 (18.52%) of people aged up to 18 years of age, came from the Zachodniopomorskie Voivodeship. In four voivodeships: Opolskie, Kujawsko-Pomorskie, Lubelskie and Świętokrzyskie, no one from this age group completed the survey. In the next group – from 18 to 25 years of age, the largest number of people – 56 (48.7%) – were from the Śląskie Voivodeship, and in the Łódź Voivodeship, no one completed the survey. In the next age group – from 26 to 40 years of age, the largest number 22 (30.56%) of questionnaires were completed by people from the Śląskie Voivodeship, while from five voivodeships: Kujawsko-Pomorskie, Lubelskie, Opolskie, Podkarpackie and Świętokrzyskie, 1 (1.39%) survey was received. In the next age group, i.e. from 41 to 50 years old, the largest number of questionnaires, i.e. 22 (34.38%) were completed by 76 inhabitants of the Śląskie Voivodeship, while in the Małopolskie Voivodeship, no one from this age group completed the survey. In the age group from 51 to 60 years old, the largest number 20 (43.48%) of questionnaires were completed by residents of the Śląskie Voivodeship. In three voivodships: Kuyavian-Pomeranian, Świętokrzyskie and Opole, no one filled out any questionnaire. In the last age group, i.e. over 60 years of age, the largest number of questionnaires, i.e. 8 (19.05%) was completed by residents of the Pomorskie Voivodeship, and in the following voivodeships: Kujawsko-Pomorskie, Świętokrzyskie, Opolskie and Podkarpackie no one completed any survey.

The second question in the survey concerned the education of the respondents. The respondents had a choice of the following answers: primary, vocational, secondary and tertiary. The largest number 173 (47.3%) of people declared secondary education. The second group – 115 (31.4%) – are people with higher education. 46 (12.6%) of the respondents had vocational education. Only 32 (8.7%) people declared primary education. The largest number of respondents with primary education were from the Śląskie and Zachodniopomorskie Voivodeships – 5 (15.63%) people each, in three voivodeships: Dolnośląskie, Opolskie and Świętokrzyskie, none of the respondents declared primary education. The largest number, i.e. 10 (21.74%) of people from the Śląskie Voivodeship declared vocational education. 1 (2.17%) of the survey – which is statistically the lowest – from people with vocational education came from the following voivodeships: Dolnośląskie, Łódzkie, Mazowieckie, Opolskie, Podkarpackie and Świętokrzyskie. As before, the largest number of people with secondary education was from the Śląskie Voivodeship – 62 (35.84%). None of the people from the Opolskie Voivodeship declared that they had secondary education. The largest number of people with higher education – 50 (43.48%) came from the Śląskie Voivodeship. On the other hand, no person from the Podkarpackie Voivodeship declared higher education. Figure 4 shows the breakdown of respondents participating in the survey according to their educational background.

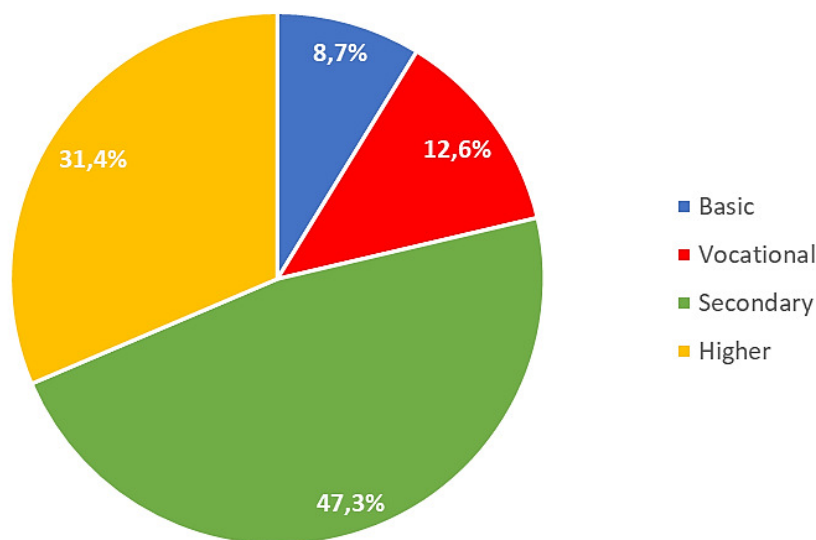


Figure 4. Distribution of respondents according to their education.

The next question in this part of the survey concerned the type of residence of the respondents. Here, the respondents had a choice between a village, a city of up to 50,000 inhabitants, a city of 51,000 to 100,000 inhabitants, and a city of more than 100,000 inhabitants. The largest number of surveys – 136 (37.2%) were completed by people living in cities with up to 50,000 inhabitants, rural residents completed 92 (25%) surveys and became the second most active participants in terms of the type of place of residence. Other respondents declared that they live in cities with more than 100,000 inhabitants and completed 79 (21.6) questionnaires. The fewest surveys, i.e. 59 (16.1%), were completed by bourgeois cities with a population of 51,000 to 100,000. Among the inhabitants of rural areas, the largest number (32 (34.78%) of

the questionnaires were completed by the inhabitants of the Śląskie Voivodeship, the fewest (1.09%) were completed by a resident of the Lubelskie Voivodeship. Among the respondents living in a city of up to 50,000 inhabitants, the largest number of surveys, 45 (33.09%), was completed by residents of the Śląskie Voivodeship. Not a single survey of a person living in a city of up to 50,000 was received from the Świętokrzyskie Voivodeship. In the next group, i.e. among the inhabitants of cities with 51 to 100 thousand, the largest number of surveys, i.e. 17 (28.81), were again completed by the inhabitants of the Śląskie Voivodeship. No survey was received from the inhabitants of cities in this area, living in the following voivodeships: Lubelskie, Łódzkie, Małopolskie, Opolskie and Świętokrzyskie. In the last group, i.e. among people living in cities with more than 100,000 inhabitants, the largest number of surveys, 32 (34.78%), were received from residents of the Śląskie Voivodeship. Residents of the Dolnośląskie and Lubelskie Voivodeships, living in the largest cities, completed the fewest, i.e. 1 (1.09%) survey. Figure 5 shows the breakdown of respondents by place of residence.

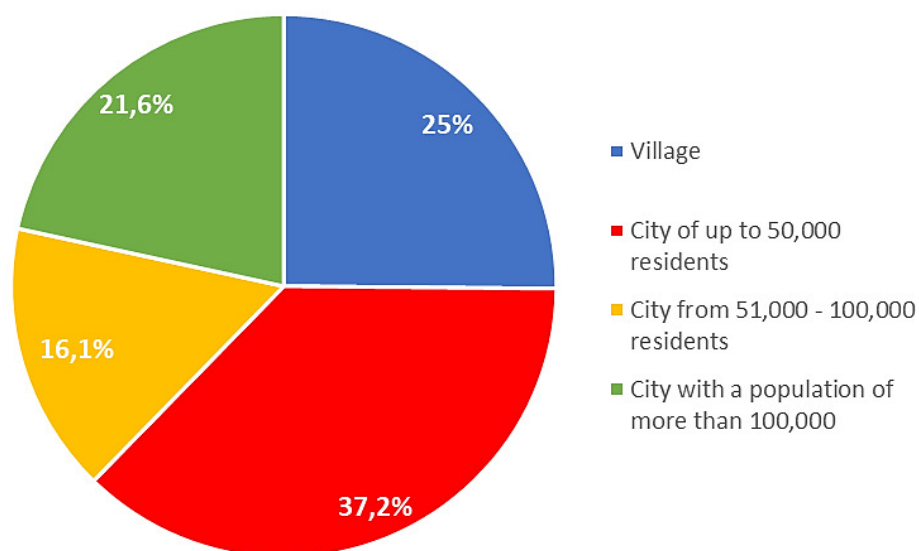


Figure 5. Breakdown of respondents by place of residence.

The next question was to answer what is the purpose of the respondents' trip. Respondents could choose from the following answers: "Commuting to work", "Commuting to school", "Commuting to universities", "Business trip", "Holiday trips" and the option to enter other travel destinations. Respondents gave 522 answers about their travel destinations. 70 (13.41%) of them were marked as "Other". Among others, the respondents indicated: commuting to the city – 13 people, visiting family – 12 people, commuting to the employment office – 10 people, going to the doctor – 9 people, getting to the family home – 7 people, visiting the country and recreational trips – 6 people, visiting friends – 4 people and 3 people entered private trips. Out of all the possible choices, the largest number of people, 145 (27.78%) chose "Commuting to work". Another reason was "Holiday travel", chosen by 134 (25.67%) people. For 76 (14.56%) people, the reason was "Business trips". For 67 (12.84%) of the respondents, the main reason for using it was "Commuting to universities", and for 30 (5.75%) "Commuting to school". Figure 6 shows the breakdown of the number of votes for each destination.

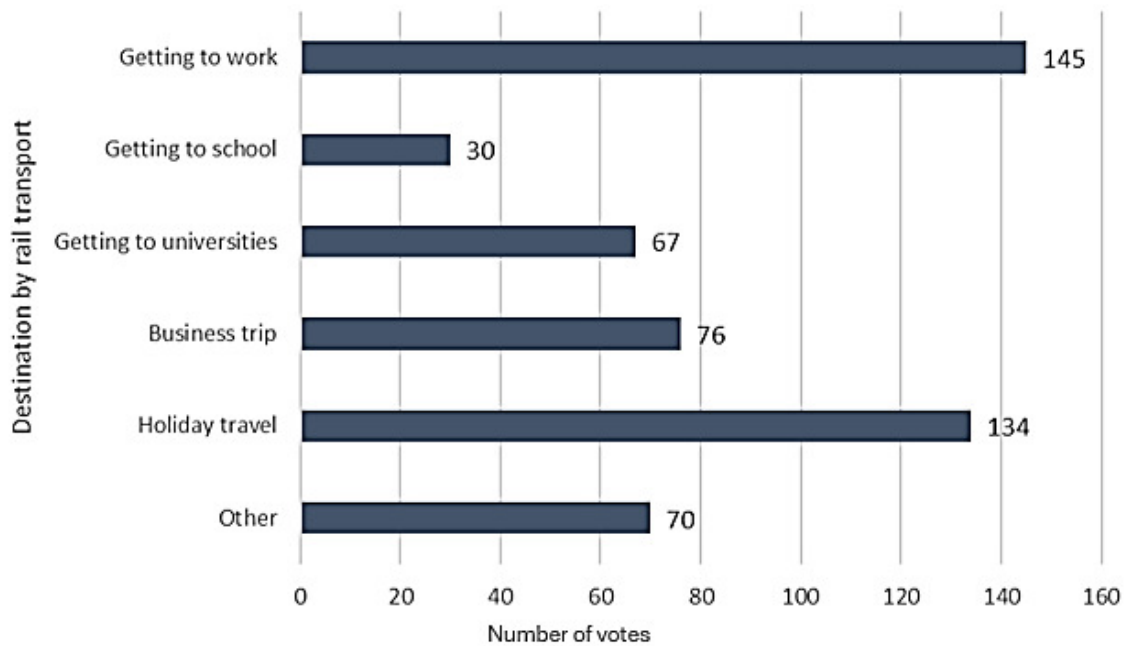


Figure 6. Distribution of votes for different destinations by rail.

The next question in the survey was to determine what discouraged respondents from using rail transport the most during the coronavirus pandemic. Respondents had a choice of the following answers: "Fear of infection", "Lack of availability of seats", "Failure to respect the obligation to cover the mouth and nose", "Mandatory wearing of protective masks", "Inability to disinfect hands", "Infrequent disinfection of rolling stock". In addition, respondents could enter restrictions in "Other". A total of 703 answers were given to the question asked. The fewest, 40 (5.69%), were individual entries of the respondents. The most popular of them was the post "Nothing discouraged". Out of 40 people, 35 (87.5%) made such an entry. Of the proposed answers, the answer "Lack of availability of seats" received the highest number of votes, 153 (21.76%). "Fear of infection" was chosen by 111 (15.79%) people. On the other hand, the answer "Not respecting the obligation to cover the mouth and nose" was chosen by 108 (15.36%) of the respondents, and the answer "Obligation to wear protective masks" was selected by 106 (15.08%) people. For 95 (13.51%) people, the cleanliness of the trains was a problem, so they chose the answer "Rare disinfection of rolling stock". On the other hand, the answer "No possibility to disinfect hands" was chosen by 90 (12.80%) of respondents. Figure 7 shows the answers to the question of what discouraged respondents from using rail transport during the pandemic.

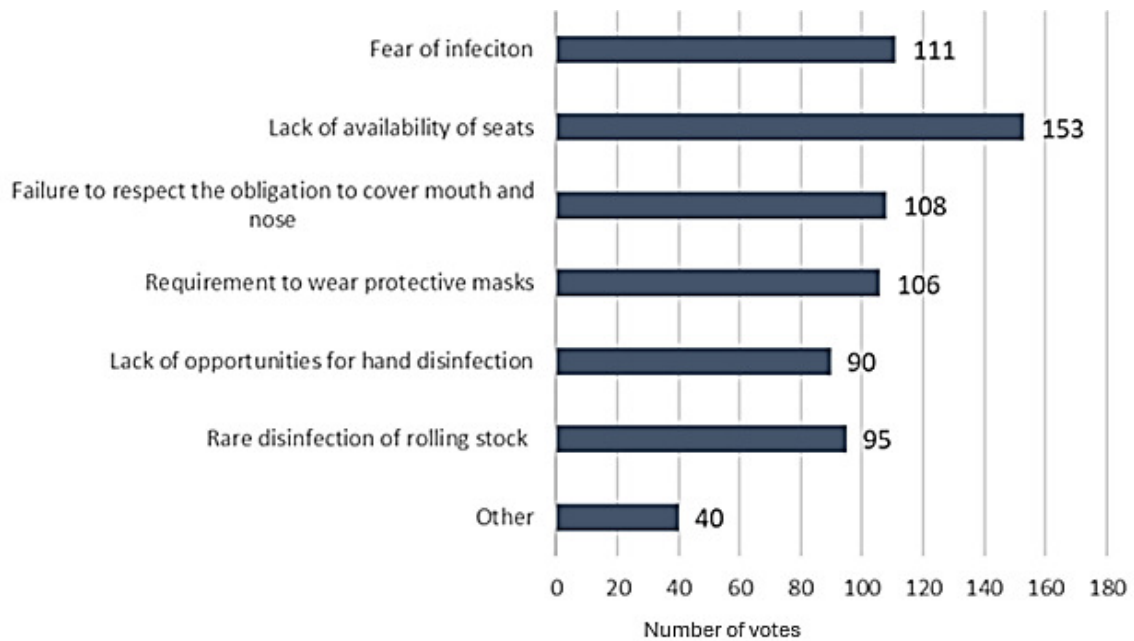


Figure 7. What discouraged respondents from using rail transport during the pandemic.

The sixth question concerned the assessment of the availability of disinfectants at passenger service points. As in the fifth question, a rating of '5' indicates a 'very high' availability of supplies, while a rating of '1' indicates the absence of disinfectants at passenger service points. In this question, the "3" rating received the most votes, this rating was chosen by 130 (35.52%) respondents. The second grade "4" received votes from 100 (27.32%) of the respondents. The third place is "1", which was chosen by 51 (13.93%), and the fourth "5" received 44 (12.02%) votes. The last grade, i.e. "2", received 41 (11.20%). Figure 8 shows the respondents' assessment of the availability of disinfectants at passenger service points.

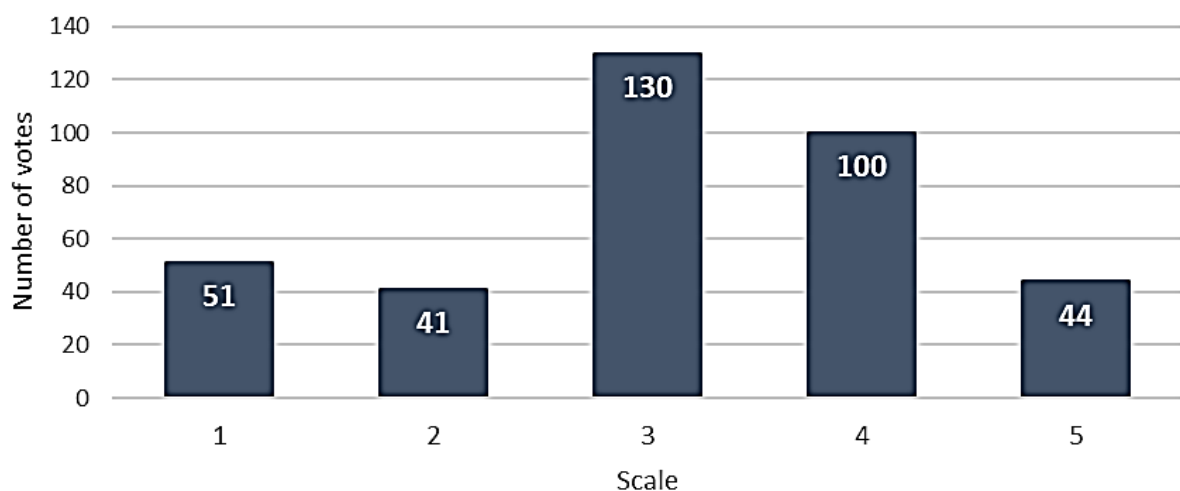


Figure 8. Assessment of the availability of disinfectants at passenger service points.

The next question concerned the assessment of the transmission of information and basic safety rules by means of information carriers in rolling stock during the pandemic. In the case of this question, a rating of "5" indicates that the information is very well conveyed, while a rating of "1" indicates no information. In the case of this assessment, "4" received the most votes, marked by 154 (42.08%) of respondents. The second is the "3" rating, chosen by 100 (27.32%) people. The third highest rating was "5" by 79 (21.58%) people. The fourth grade "2" was chosen by 25 (6.83%) of respondents. The fewest respondents chose the "1" rating, 8 (2.19%) of respondents did so. Figure 9 shows the respondents' assessment of the information provided and the basic safety rules implemented during the pandemic with the use of information media in rail transport.

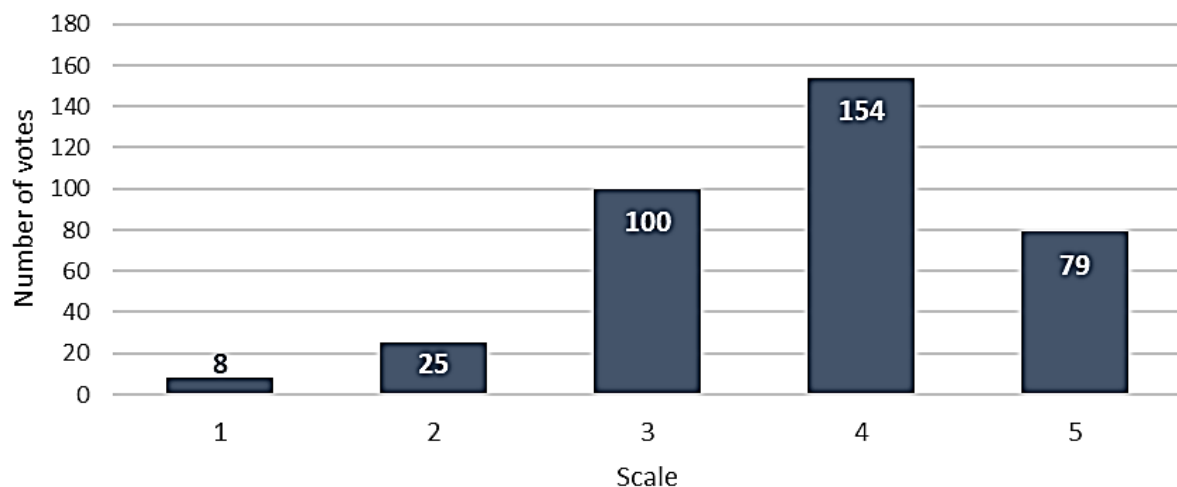


Figure 9. Evaluation of the information provided and safety rules on information carriers in rail transport.

The eighth question concerned the safety of rail travel during the Covid-19 pandemic. For this question, a rating of "5" is the highest grade and a rating of "1" is the lowest degree of safety. In the case of this question, the highest number of votes was received by the "3" rating, which was chosen by 128 (34.97%) people. The second in line was a grade of "4". It was chosen by 109 (29.78%) of respondents. The third "2" received 62 (16.94%) votes from the respondents. The "5" rating is fourth in the ranking, with 44 (12.02%) votes. The lowest number of votes was received by the "1" rating, for which 23 (6.28%) votes were cast. Figure 10 shows the assessment of the safety of rail travel during the pandemic.

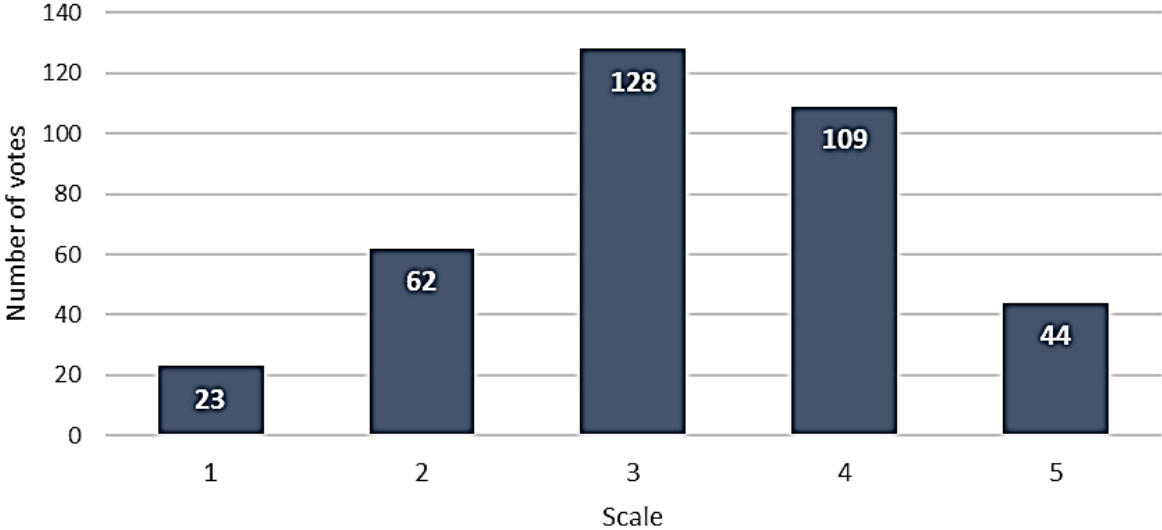


Figure 10. What discouraged respondents from using rail transport during the pandemic.

The next questions had only two answers – "YES" and "NO". One of the questions concerned whether respondents declared their resignation from rail transport during the Covid-19 pandemic. For this question, 259 (70.8%) of respondents chose "NO" and 107 (29.2%) of respondents chose "YES". The second question could only be answered if you selected "NO" in the previous question. The second question concerned the respondents' declaration of a return to using rail transport after the lifting of pandemic-related restrictions. In this question, 87 (81.3%) respondents chose the answer 'YES' and 20 (18.7%) chose the answer 'NO'. Figure 11 shows the percentage of responses from individuals, while Figure 12 shows the percentage distribution of people declaring a return to rail transport.

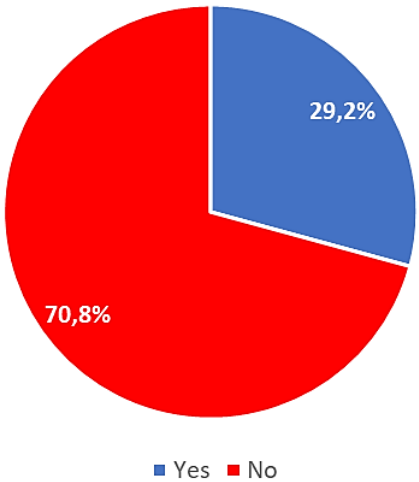


Figure 11. Percentage distribution of declarations regarding the abandonment of rail transport.

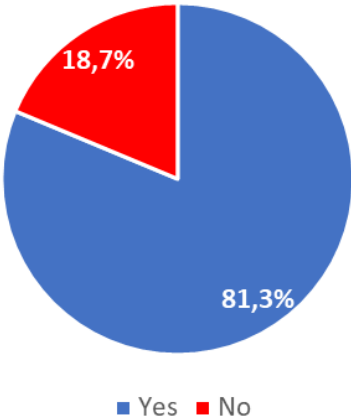


Figure 12. Percentage distribution of declarations regarding the return to rail transport after the lifting of pandemic-related restrictions.

The last question concerned the respondents' assessment of the impact of the Covid-19 pandemic on the functioning of rail transport in Poland. In this question, a score of "5" indicated that the pandemic had a very high impact, while a rating of "1" indicated that the impact on transport was very low. In the case of this question, 121 (33.06%) of respondents considered that the pandemic had a very large impact on the functioning of rail transport and chose a rating of "5". As many as 101 (27.60%) respondents chose a "4" rating, and 96 (26.23%) considered that the pandemic had a moderate impact and chose a "3" rating. The "2" rating was chosen by 27 (7.38%) of respondents. On the other hand, 21 (5.74%) respondents chose a rating of "1", thus recognizing that the pandemic had very little impact on the operation of the railways. Figure 13 shows an assessment of the impact of the COVID-19 pandemic on rail transport operations.

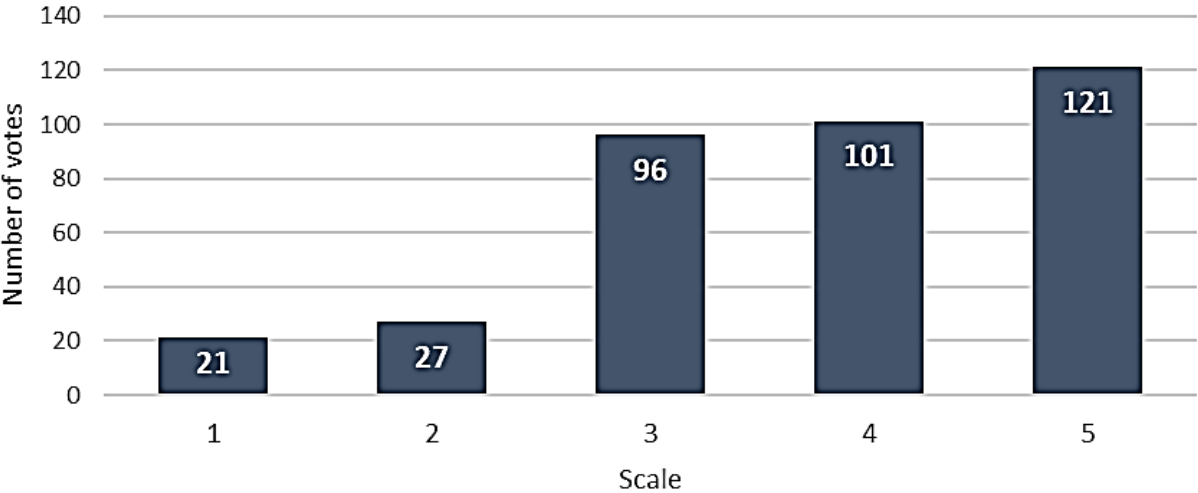


Figure 13. The impact of the Covid-19 pandemic on the functioning of rail transport.

5. Discussion

The COVID-19 pandemic has had a profound impact on various economic sectors globally, and one of the most affected areas has been passenger transport. This article reveals several key aspects of the pandemic's effects on passenger rail transport in Poland. The survey data provides valuable insights into passenger preferences, carrier preparedness, and the general perception of the measures implemented during this unprecedented period.

The survey results indicate a significant adjustment in travel habits among passengers in response to the pandemic. A marked decline in travel frequency was observed, with many individuals opting for remote work or refraining from non-essential trips. This aligns with findings from other studies indicating that pandemics can drastically alter travel behavior, leading to long-term changes in transportation patterns (Burdzik, 2021). Despite these changes, rail transport emerged as the preferred mode for those who needed to travel, showcasing a degree of resilience in this sector. This preference for rail transport during the pandemic can be attributed to the effective implementation of health and safety measures by carriers, which reassured passengers about the relative safety of train travel compared to other public transport modes. Research conducted by Davalbhakta et al. (2020) supports this notion, emphasizing that perceived safety is critical in influencing transport choices during health crises.

A significant finding of this study is the positive assessment of carrier preparedness by passengers. The majority of respondents expressed satisfaction with the actions taken by rail carriers to ensure passenger safety. Measures such as increased cleaning frequency, availability of disinfectants, enforcement of mask-wearing, and clear communication regarding safety protocols received high ratings. This positive feedback highlights the importance of proactive and transparent actions in maintaining passenger confidence and ensuring continued use of rail services during health crises. Previous research by Carteni et al. (2021) also notes that transparency and effective communication are crucial for maintaining public trust in transport systems during emergencies.

To enhance the resilience of railway transportation systems during pandemics, several strategies are pivotal. Firstly, integrating robust decision-making frameworks allows for agile adjustments to operations amid evolving pandemic impacts (Jenelius, 2022). Furthermore, adopting a comprehensive resilience framework that accounts for supply shocks and demand fluctuations enables railways to sustain operations efficiently (Schofer et al., 2022). These measures are complemented by technological advancements for real-time monitoring and predictive maintenance, ensuring operational continuity and reliability (Tardivo et al., 2021). Moreover, optimizing resource allocation, such as strategically positioning relief trains, enhances response capabilities during disruptions (Xiao et al., 2022). Collaborative efforts among stakeholders further strengthen resilience by facilitating resource sharing and

coordinated response strategies. Research by Jenelius and Mattsson (2022) emphasizes the importance of stakeholder collaboration in enhancing system resilience. Together, these strategies bolster the ability of railway systems to navigate challenges posed by pandemics and maintain essential transport services. The schematic plan of managerial insights is demonstrated in Figure 14.

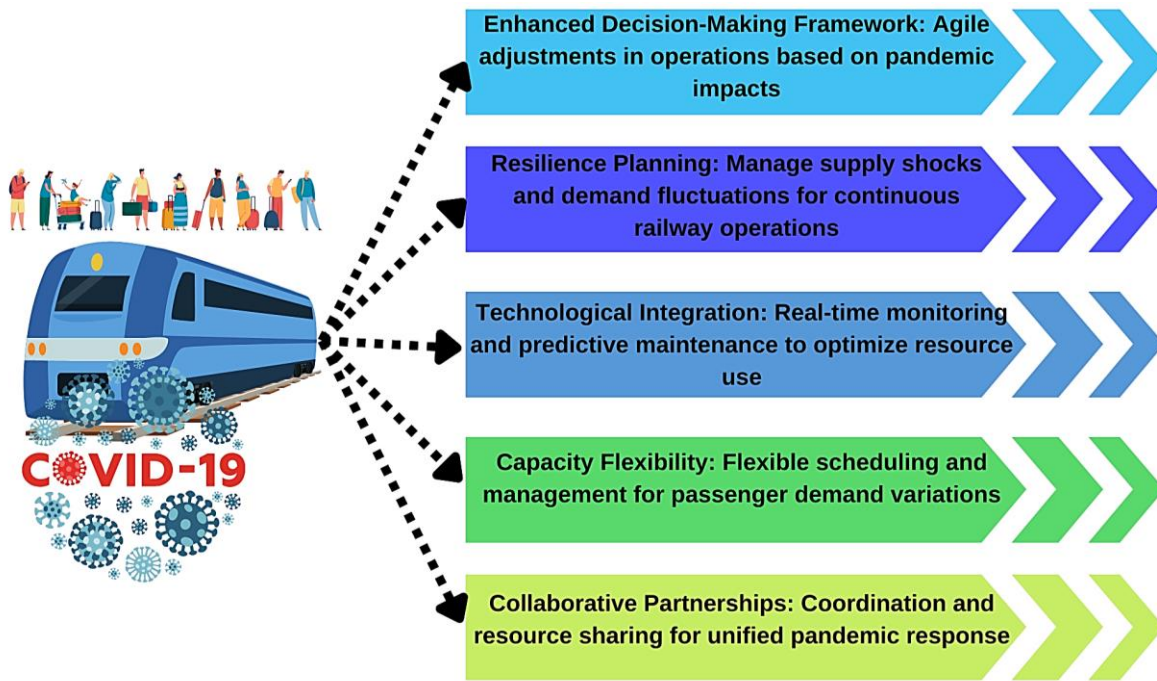


Figure 14. The schematic plan of managerial insights in the present research.

The research indicates that the rail passenger transport sector in Poland has demonstrated a significant ability to adapt and respond to the COVID-19 pandemic. However, there is a pressing need for further investment in health and safety infrastructure, staff training, and better communication with passengers to ensure resilience against future disruptions. In line with the findings of this study, it is recommended to develop contingency plans for various crisis scenarios, drawing upon insights from studies that advocate for scenario planning in transport systems (Burdzik, 2023; Carteni et al., 2021). Additionally, effective and transparent communication with passengers is crucial for building trust in rail transport, as emphasized by the American Public Transportation Association (2021), which underscores the need for consistent messaging during crises.

Regular research and analysis of passenger preferences and the effectiveness of implemented security measures are essential to adapt operational strategies to current challenges. Research conducted by Chen et al. (2021) highlights the importance of continuous evaluation and adaptation in transport systems to address shifting passenger needs during and post-pandemic.

In summary, the COVID-19 pandemic has catalyzed significant transformations in the passenger rail transport sector in Poland. While the sector has shown resilience, ongoing efforts in infrastructure investment, staff training, and stakeholder collaboration are vital to preparing for future challenges.

6. Conclusions

To sum up, the COVID-19 pandemic has forced passenger rail transport in Poland to make a number of adaptations and introduce new standards aimed at increasing passenger safety and adapting the offer to the changing conditions and needs of travelers.

The following conclusions can be drawn from the survey:

- the largest number of respondents use the train as a means of transport to get to work, for whom the price of the service and safety during the journey is very important,
- regardless of the voivodship in which the respondents lived, 77% of respondents did not change their attitude towards the choice of means of transport,
- before the pandemic, the largest number of people using the survey used rail transport several times a week, during the pandemic the frequency changed to several times a month, and after most restrictions were lifted, the frequency returned to the level of several times a week,
- as a result of the outbreak of the pandemic, a significant number of people who had previously used rail transport 'switched' to private cars. This is due to the fact that some respondents were afraid of contracting the virus in rail transport. Another factor was the lack of adequate seating,
- the respondents assessed the general preparedness of rail transport for the pandemic and the activities aimed at informing about the situation and basic safety rules presented on the information carriers installed in the rolling stock relatively well,
- according to respondents, the Covid-19 pandemic has had a very large impact on the functioning of rail transport in Poland by reducing revenues, which was the result of a reduction in the number of passengers transported.

The results of the survey on the improvement of the quality of rail travel, whether during the pandemic or after its end, may be an important indication for rail carriers and provincial authorities as to how passengers use rail transport and what are the expectations towards it.

To sum up, the COVID-19 pandemic has created serious challenges for passenger rail transport in Poland, but has also become an impetus for many positive changes and innovations that can contribute to the long-term development and resilience of the sector.

Acknowledgements

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INEQUALITIES IN THE SOCIAL DEVELOPMENT OF EUROPEAN COUNTRIES

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Purpose: Socio-economic inequalities are an inherent part of the functioning of societies. These inequalities primarily concern differences in income, material living conditions, education, and health. Despite progress in civilizational development, this issue persists, leading to increased societal discontent, which in turn results in uncontrolled migration, terrorism, and difficulties in ensuring energy security. The rejection of global inequality (both social and consequently political) has become one of the most important reasons for seeking ways to mitigate these unfavorable phenomena. Developmental issues threaten political stability, but above all, they weaken the dynamics of socio-economic development in countries. These considerations do not aspire to comprehensively address the issue of social inequalities worldwide but instead focus on selected aspects analyzing the asymmetry of social development. The aim of this research is to assess the differences in the level of social development in selected European countries in the years 2010 and 2022.

Methodology: For the assessment in question, a descriptive method was applied using the Human Development Index (HDI) and Gini coefficient indicators, Ward's method, and the Lorenz curve. These were used to analyze and evaluate the variations in the level of social development in selected European countries, along with determining their ranking positions. The HDI indicator allowed for capturing the distance that separates European countries in terms of social development (long and healthy life, knowledge, and a decent standard of living). Based on data obtained from HDI, the Gini coefficient enabled the evaluation of income distribution inequality in the studied countries, while cluster analysis helped identify similarities between countries concerning their level of social development.

Findings: The research results indicate that despite overall progress in social development, inequalities in the level of social development persist among the 32 European countries analyzed. The countries studied exhibit significant disparities in social development levels, despite the fact that nearly all of them belong to the group of nations with the highest levels of social development worldwide (with only Bulgaria holding the top position among countries with high social development). Widening asymmetries are even observed, as evidenced by Bulgaria's HDI indicator.

Research limitations/implications: Due to the still significant inequalities, there is a need to intensify efforts aimed at counteracting them, which could ultimately lead to an improvement in the quality of life.

Originality/value: The analysis is crucial for assessing the gap between European countries in terms of social development levels, in the context of global efforts aimed at improving societal well-being and promoting social inclusion.

Keywords: human development, social inequality, European countries, HDI index, Ward's method.

Category of the paper: research paper.

1. Introduction and review of the literature

Socio-economic development and its measurement are crucial issues for the functioning of economies at local, regional, national, and global levels. Economic aspects play a leading role in such analyses. However, the importance of the social dimension should not be overlooked (Szewczuk, 2011, p. 13). In both perspectives, the focus is on change, that is, the process of transitioning from a particular form or state to a more complex, developed, and advanced one, with the changes resulting from events occurring in a given area and having a long-lasting character (Parysek, 2018, p. 38). It is important to emphasize that this refers to a process of significant and irreversible transformations in social structures. These transformations have a specific direction and are determined by specific demographic, environmental, economic-social, and political factors. Development, as a directed and long-term sequence of positive changes in systems, encompasses both quantitative and qualitative transformations, resulting from a series of changing combinations of factors over time. Key factors include human, social, material, financial capital, and innovations. Global socio-economic conditions, or megatrends, such as globalization, economic integration, postmodernization, and systemic and economic transformation, force modifications to the described developmental conditions, and according to P. Churski, even lead to a redefinition of these factors. The scope of this redefinition, according to him, is broad and can represent both opportunities and challenges for the development policies of countries (Churski et al., 2018).

As mentioned, development factors are continually evolving. In the 1970s, the concept of social development emerged, emphasizing the social dimension of economic growth as a result of criticism of the previous approach to development, which focused primarily on the growth of production of final goods and services. Consequently, contemporary social development is considered in relation to the process of transforming social systems over time, while economic growth should be viewed as a condition for improving overall social well-being. In other words, economic development cannot be discussed separately from social development (Stanny, 2012, pp. 95-96). The United Nations Development Programme (UNDP) defines social development as a process of expanding human choices, through which individuals gain long and healthy lives, acquire knowledge, and achieve a satisfactory standard of living (UNDP, 1990, p. 10). Although the overall effect of development should be distinctly positive, its various components

may constitute separate elements of analysis and, importantly, may change with uneven intensity and direction (Gorzela, 1989, p. 15). Social transformations, therefore, proceed with varying dynamics in different countries, leading to a diverse level of social development on an international scale. It is important to note that overall social well-being is highly differentiated in the contemporary world (Iwaszczuk et al., 2016; Dziembała, 2023, p. 20). The issue of social inequalities is becoming increasingly serious, given global progress, and is exacerbated by the aforementioned megatrends in the world economy. Key aspects differentiating well-being include income and wealth, opportunities for personal development, participation in cultural and political life, and access to information, which also present significant challenges (Piketty, 2014). Consequently, social inequalities are framed as unequal access or unequal opportunities to socially valued goods, which are inaccessible due to membership in certain social groups or due to specific social positions (Sztompka, 2020, p. 200). A. Sen asserts that inequality should have a defined dimension to ensure relative well-being for as many individuals as possible, especially since people differ in physical and mental condition, intellectual abilities, gender, and various other factors. “What should equality address?” — this is the question, following A. Sen, that should be posed when discussing the issue of inequality (Sen, 2000, p. 7). The referenced economist clarifies that the focus is on equality of freedom to achieve individual benefits, i.e., actual achievements. He emphasizes that it is not only about defining equality but also about the criteria and areas of its measurement, which include: income, wealth, primary goods, and capabilities (Sen, 2000, p. 154). While it would be utopian to believe in a world without social inequalities, the issue certainly requires ongoing inquiry and actions to mitigate the consequences of stark social disparities, as they significantly affect the lives and functioning of individuals (Wilkinson, Pickett, 2010; Wiatrowski, 2018).

This article addresses fundamental issues related to the essence of social development in the context of deriving benefits from it by the general population or the lack thereof. A key question is the scale of social inequalities in Europe, as it could serve as a starting point for policymakers to decide on measures to address these inequalities. The aim of the research is to assess the variations in the level of social development in selected European countries for the years 2010 and 2022. Thirty-two European countries were arbitrarily chosen for the analysis, including all EU member states and the following economically closely linked countries: the United Kingdom, Switzerland, Norway, Liechtenstein, and Iceland.

The complexity of the issue of social development means that various indicators can be applied to study its level. The literature indicates that several indicators are particularly noteworthy, such as those related to life expectancy or, more broadly, the effectiveness of the health system, the level of urbanization, and the level of education. A commonly used synthetic measure of social development is the Human Development Index (HDI), adopted by the United Nations and calculated annually for all countries worldwide (UNDP, 2024). The HDI presents the achievements of countries according to three dimensions: knowledge, long and healthy life, and a decent standard of living. Health, education, and income thus represent three facets of

human life on which the level of social development in countries is assessed. It is important to emphasize that the HDI has become a widely accepted measure of development due to its focus on fulfilling basic human needs, which is not guaranteed by the income-focused GDP measure. Economic growth does not automatically translate into greater access to food, clean water, housing, healthcare, education, or social security. Since 1990, the UNDP has published reports on social development, presenting information on the social development of countries based on the HDI and conveying the message that the ultimate criterion for assessing a country's development is its people and their capabilities, not just economic growth (UNDP, 2024). However, the widespread use of the HDI does not ensure its universal acceptance. Problems associated with calculating the HDI generally arise from constructing complex indicators, including the selection of weights for its components and access to reliable and accurate data. Issues also include oversimplifying the phenomena under study and generalizing for the purpose of drawing conclusions for a comprehensive assessment of the phenomenon. The shortcomings of measurement are addressed by calculating the Inequality-Adjusted Human Development Index (IHDI), which accounts for inequalities present in societies. Based on the same indicators, adjusted for the level of inequality, inequality indices are created for all adopted dimensions, as well as a synthetic non-income indicator. The higher the IHDI, the greater the level of social disparities. Conversely, the smaller the difference between the IHDI and the HDI value for a given country, the lower the social inequalities observed; whereas the closer the values of the indices are to each other, the smaller the social inequalities (Rojek, 2019; Krzyminiewska, 2013). The IHDI does not indicate the distribution of resources within a country but rather shows the "loss" resulting from inequalities in access to health, education, and income within a society. It is also important to note that a key measure in contemporary social development measurement is the Gini coefficient, which assesses the level of material inequality within a society. Developed by Corrado Gini, the coefficient is expressed in decimal numbers, while the equivalent measure, the Gini index, is expressed in whole numbers (Kołodko, 2014, p. 27). It ranges from 0 (indicating complete material equality) to 1 (indicating complete inequality).

Thus, a descriptive method was employed in the assessment using the Human Development Index (HDI) and Gini coefficient indicators, Ward's method, and the Lorenz curve. These were used to analyze and evaluate the variations in the level of social development in selected European countries, along with determining their ranking positions. The HDI indicator allowed for capturing the distance that separates European countries in terms of social development (long and healthy life, knowledge, and a decent standard of living). Based on the data obtained from the HDI, the Gini coefficient facilitated the evaluation of income distribution inequality in the studied countries, while cluster analysis helped identify similarities between countries concerning their level of social development.

Europe, as one of the smallest continents in terms of land area, stands out from other parts of the world and is difficult to generalize. Primarily, it is commonly associated with a high level of socio-economic development, a digital society, and a high standard of living. However, European society, whose roots trace back to the Mediterranean civilizations of Greece and Rome, faces numerous problems and challenges. Among these challenges are terrorism arising from Islamic fundamentalism, which threatens Europe's security (Fiszer, 2013, p. 271). Another example is multiculturalism, which differentiates European countries in terms of their policies and simultaneously creates many problems that often hinder the peaceful coexistence of diverse ethnic groups within a given social space (Śliz, Szczepański, 2021, p. 40). International migrations, particularly the management of migration and asylum (including smuggling and human trafficking), pose a difficult challenge based on solidarity, responsibility, and respect for human rights (European Commission, 2024, pp. 117-120; Kacperska et al., 2019). Moreover, Europe is the continent with the fastest-aging population due to declining fertility rates and increasing life expectancy (Okólski, 2013, p. 38). Literature also emphasizes that Europe is a continent with diverse national images, as highlighted by W. Chlebda, who identifies a common axiological denominator for the continent. This is defined by a six-point formula at a very high level of generality: "1. part of the world, 2. whose inhabitants, 3. faithful to their national traditions, 4. profess a set of positive values, 5. which could form the basis for their supranational community, 6. in both human and institutional dimensions" (Chlebda, 2018, pp. 36-37). According to the author, this represents a three-dimensional view of Europe: as a localist dimension (part of the world), an institutional dimension (European Union), and a symbolic dimension (a set of traits and values) (Chlebda, 2018, p. 37). Particular value is attributed to the phenomenon of European integration (with most of the 42 European countries being EU members), which initiates dialogue, cooperation, and joint efforts not only for social and economic cohesion but also for preserving cultural continuity and identity of societies (Żebrowski, 2003, p. 109). The European Union, in its actions, focuses on increasing competitiveness and striving for an ecological, digital, and resilient economy, while it cannot neglect activities that promote social inclusion (European Commission, 2024, p. 23). The EU is characterized by inequalities in many areas, which are particularly evident at the national level, and the current ambitious goals for green transformation pose a serious risk of exacerbating issues such as energy poverty (European Commission, 2024, p. 23). However, as E. Mączyńska emphasizes, although social inequalities in the EU are lower compared to the US or other developed economies, the risk of increasing inequalities is growing. This poses a threat to achieving convergence and social cohesion goals (Mączyńska, 2021, p. 64).

2. Research method

To measure and assess the level of social development in European countries, several tools were used, including the Human Development Index (HDI)¹, the Gini coefficient, the Lorenz curve, and Ward's method. The HDI is a commonly applied indicator for analyzing the phenomenon of social development at the national level. Its development was greatly influenced by two economists, Mahbub ul Haq from Pakistan and Amartya Sen from India, who published the first Human Development Report in 1990. Since then, the report has been released annually by the United Nations Development Programme (UNDP) (Antczak, 2012, pp. 7-24; Oesterreich, 2018, pp. 303-313; Aksentijević, Ježić, 2017, pp. 109-112). This extensive and detailed report covers various socio-economic aspects of the countries under study, including the ranking of countries based on their level of human development (UNDP, 2024). The HDI measures three key dimensions: long and healthy life, knowledge, and a decent standard of living. As of 2010², four specific components are used to determine the HDI (Figure 1):

- life expectancy,
- the average number of years of education received by residents aged 25 and older,
- the expected number of years of education for children entering the education process,
- national income *per capita* in U.S. dollars, calculated according to the purchasing power parity of a given currency³.

The health condition, identified with longevity, is measured using the life expectancy index. Education is assessed based on the average years of schooling for adults and the expected years of schooling for children of school age. Income, reflecting the wealth of societies, is measured through the gross national income per capita, adjusted for purchasing power.

¹ It should be emphasized that the HDI reflects not only the sphere of wealth (as in the case of GDP-related indicators), but also education and the health condition of citizens, hence it is considered to indicate the level of socio-economic development of individual countries.

² In 2010, changes were made to the HDI's construction concerning its components, implemented in response to the European Commission's Report on the Measurement of Economic Development and Social Progress (the so-called Stiglitz Report: Stiglitz, Sen, Fitoussi, 2009).

³ Purchasing Power Parity (PPPs) measures the differences in price levels between countries. It provides information on the cost (expressed in currency units) of specific goods and services in different countries. By using PPPs to convert expenditures expressed in national currencies into a common, artificial currency, the impact of price level differences caused by exchange rate fluctuations is eliminated (Eurostat).

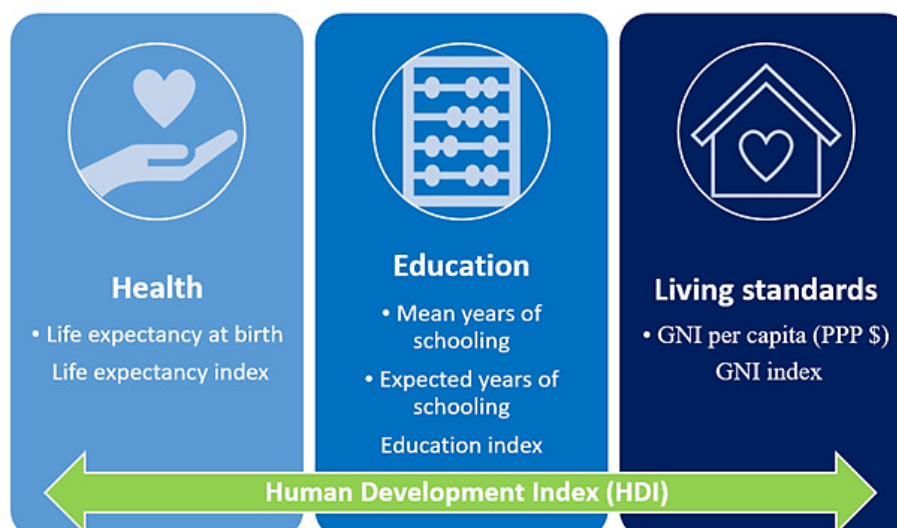


Figure 1. Human Development Index (HDI) and its components.

Source: the authors' own study based on UNDP 2010, pp. 215-222.

The underlying premises for creating the HDI indicator include the following (Ul Haq, 1999; Sompolska-Rzechuła, 2016, pp. 62-78):

- a. A flexible approach to the HDI indicator in terms of its scope and methodology;
- b. The identification of an indicator that extends beyond income while maintaining methodological reliability;
- c. Limiting the number of component variables to ensure simplicity and functionality;
- d. The creation of a single, synthetic indicator rather than an extensive set of indicators;
- e. Incorporating both social and economic components into the indicator⁴.

Currently, since 2010, HDI is calculated as the geometric mean of the normalized average indices for each development component. It ranges from 0 (low level of development) to 1 (very high level of development), and based on this, countries are grouped as follows (Hozier-Koćmiel, 2018, pp. 40-49; Pangsy-Kania, 2015, pp. 152-162; Rojek, 2019, pp. 40-51):

- Very high development: 0.800-1.000,
- High development: 0.700-0.799,
- Medium development: 0.550-0.699,
- Low development: 0-0.550.

Approximately 30% of countries are classified as very highly and highly developed, around 51% as moderately developed, and about 19% as low developed (Śleszyński, 2016, pp. 40-54).

The concept of the Lorenz curve, which is used to assess inequality, was introduced in 1905 by American economist Max Lorenz (1905, pp. 209-219). He proposed a graphical representation of wealth or income inequality (Jędrzejczak, 2011). The Lorenz curve shows the relationship between the cumulative percentages of the population (specifically, the poorest

⁴ The methodological aspects related to determining the HDI index were presented in the work of Anand, Sen, 1994.

segment) and the percentage of total income they receive (wages)⁵. The 45° line is called the line of equal distribution and represents a situation where a given percentage of total income is owned by the exact same cumulative percentage of the population being studied. The further the Lorenz curve deviates from this line, the greater the degree of income inequality (Kumor, Sztaudynger, 2007, pp. 233-246). The Lorenz curve is mainly used in economics to measure income concentration (Gastwirth, 1971, pp. 1037-1039; Arnold, 1987).

The Lorenz curve is closely associated with the Gini coefficient, the most commonly used measure of inequality (Farris, 2010, pp. 851-864). Geometrically, the Gini coefficient can be represented as twice the area between the Lorenz concentration curve and the line of equal distribution. It is calculated using formula 1:

$$K = 1 - \sum_{i=1}^k (s_{i-1} + s_i) \cdot w_i \quad (1)$$

where:

s_i – cumulative trait frequencies,

w_i – relative frequencies of units.

The Gini coefficient is a normalized measure, taking values between 0 and 1, where 0 indicates no concentration (income is equally distributed among all individuals in the population), while a value of 1 signifies complete concentration (Hasell, 2023).

Complementing the descriptive analysis, which is based on the HDI index, the Gini coefficient, and the Lorenz curve, is Ward's method (Ward, 1963, pp. 236-244). This method was used to identify groups of countries with similar levels of social development based on HDI components. The method involves data segmentation to isolate homogeneous objects within the studied population. The division is carried out in such a way that clusters are formed where elements within the same group are similar to each other but differ from elements in other groups (Gatnar, Walesiak, 2004). Ward's method ensures homogeneity within clusters and heterogeneity between clusters. However, it should be noted that it tends to cluster a relatively small number of observations together while producing clusters with similar sizes (Ward, 2004; Strahl, 2006; Młodak, 2006; Szkutnik et al., 2015). The study was carried out on the basis of standardized variables, and the Euclidean distance was used to form clusters. The effects of using the Ward method have been presented in the form of a cluster tree – dendrograms (using Statistica 13.1). In the conducted study, a critical value was established based on the analysis of the agglomeration process plot.

⁵ By assumption, the individuals in the population should be ordered in a non-decreasing manner with respect to income.

3. Results and discussion

Based on the Human Development Index (HDI), Switzerland has been the leader in the HDI ranking during the examined years of 2010 and 2022. This trend also holds over a broader time frame. In 2010, 2015 (tied with Norway), 2021, and 2022, Switzerland consistently maintained the top position, with its HDI values showing an upward trend, recorded at 0.940, 0.952, 0.965, and 0.967, respectively (Figure 2).

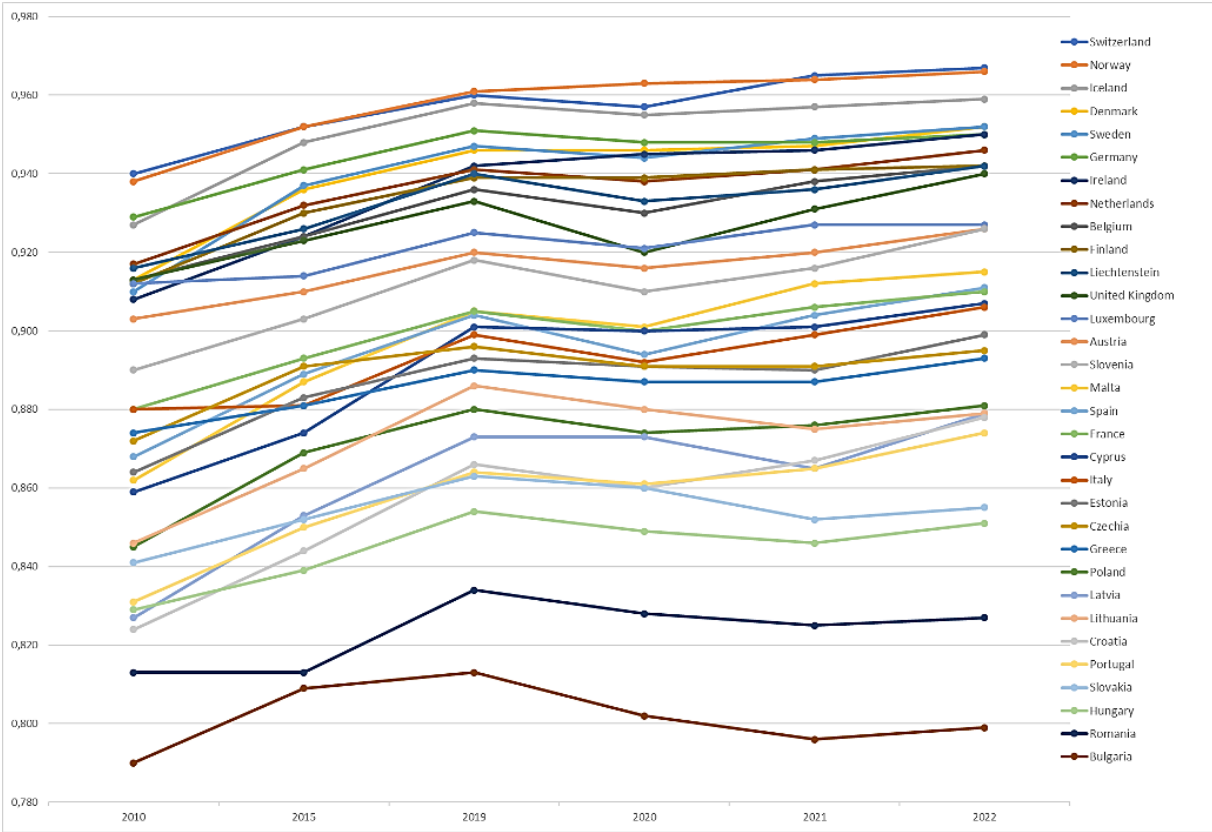


Figure 2. HDI Values in Selected European Countries in 2022.

Source: Own elaboration based on the Human Development Report (UNDP, 2024).

The HDI value increased by 0.027 points (2.9%) in 2022 compared to 2010. In 2019 and 2020, Switzerland surpassed Norway, with an HDI value of 0.961 in 2019 and a slightly higher value of 0.963 in 2020. Romania and Bulgaria recorded the lowest results across the three examined aspects (life expectancy, education, and GNI) in each of the analyzed years. The gap between the leading country and Bulgaria, which held the lowest position, was as follows in the studied years: 0.15; 0.14; 0.15; 0.16; 0.17; and 0.17. It is important to note that, except for Bulgaria, the countries examined were in the highest development group globally during the analyzed years, with an HDI index ranging from 0.800 to 1.000. All these countries exhibited a higher HDI in 2022 compared to the baseline year. The highest growth dynamics were observed in Croatia, Malta, and Latvia, while the lowest were noted in Bulgaria, Romania, and Slovakia.

The data presented in Table 1 show that there have been positive changes in the level of social development in most of the selected European countries over the studied years.

Table 1.

Positions of European Countries in the HDI Ranking for 2022 Compared to 2010, Position Changes, and HDI Distance from the Leader in Each Year

Country	Ranking position in 2010.	Ranking position in 2022.	Change of position 2021/2022 [number]	Distance to ranking leader (according to HDI)	
				2010 leader - Switzerland)	2022 leader - Switzerland)
Austria	11	10	↑1	0.037	0.041
Belgium	7	7	=	0.027	0.025
Bulgaria	28	26	↑2	0.150	0.168
Croatia	26	21	↑5	0.116	0.089
Cyprus	19	14	↑5	0.081	0.060
Czechia	15	17	↓2	0.068	0.072
Denmark	7	4	↑3	0.027	0.015
Estonia	17	16	↑1	0.076	0.068
Finland	8	7	↑1	0.028	0.025
France	13	13	=	0.060	0.057
Germany	3	5	↓2	0.011	0.017
Greece	14	18	↓4	0.066	0.074
Hungary	24	24	=	0.111	0.116
Iceland	4	3	↑1	0.013	0.008
Ireland	10	5	↑5	0.032	0.017
Italy	13	15	↓2	0.060	0.061
Latvia	25	20	↑5	0.113	0.088
Liechtenstein	6	7	↓1	0.024	0.025
Lithuania	20	20	=	0.094	0.088
Luxembourg	8	9	↓1	0.028	0.040
Malta	18	11	↑7	0.078	0.052
Netherlands	5	6	↓1	0.023	0.021
Norway	2	2	=	0.002	0.001
Poland	21	19	↑2	0.095	0.086
Portugal	23	22	↑1	0.109	0.093
Romania	27	25	↑2	0.127	0.140
Slovakia	22	23	↓1	0.099	0.112
Slovenia	12	10	↑2	0.050	0.041
Spain	16	12	↑4	0.072	0.056
Sweden	9	4	↑5	0.030	0.015
Switzerland	1	1	=	x	x
United Kingdom	7	8	↓1	0.027	0.027

= no change; x – ranking leader; ↓ – decrease in position; ↑ – increase in position.

Source: the authors' own study based on: Latosińska, Milek, Gibowski 2024, pp. 1-20.

Fourteen countries ranked higher in 2022 compared to the baseline year of 2010. This is particularly evident in the case of Malta, which moved from 18th place in 2010 to 11th place in 2022 - a rise of 7 positions. Similarly, Croatia, Cyprus, Ireland, Latvia, and Sweden saw an improvement of 5 positions each. Eight of the 32 countries experienced a decline in their ranking, with the largest drop affecting Greece - 4 positions. Six countries maintained their position across the analyzed years. A noticeable difference is seen in the distance of countries from the leader in the studied years, which was Switzerland. In 2010, eleven countries had

a distance ranging from 0.002 to 0.030 from the leader, with Norway having the smallest distance at 0.002, and Romania the largest at 0.127. Similarly, in 2022, eleven countries had a distance between 0.001 and 0.027, with the smallest distance for Norway (0.001) and the largest for Bulgaria (0.148). It is worth noting that this distance has significantly increased, indicating a widening disparity in the level of social development. Additionally, in 2010, fifteen countries ranked above the average for the studied entities in terms of the HDI, whereas in the most recent analyzed year, this number increased to seventeen countries⁶. As previously mentioned, all countries, except for Bulgaria (Group II – HDI for world countries: 0.700-0.799), were classified in Group I, i.e., the highest level of social development based on HDI.

In contrast, the findings from the analysis of the Gini coefficient and the Lorenz curve indicate a relatively even distribution of socio-economic development levels among the selected European countries (see Figures 3 and 4). The Lorenz curve almost coincides with the equality line (ideal state), meaning that nearly every country has a proportionally equal share in the total social development. The minimal deviation of the curve confirms the low degree of inequality among these countries, which is consistent with the Gini coefficient calculated based on Formula 1. In 2010, the Gini coefficient was 0.0256, indicating a low degree of concentration ($0 \leq G < 0.25$). This suggests that even in 2010, the level of development among countries with very high HDI scores exhibited relatively low variability. Therefore, the level of inequality in socio-economic development, as measured by HDI, was low among economically advanced countries.

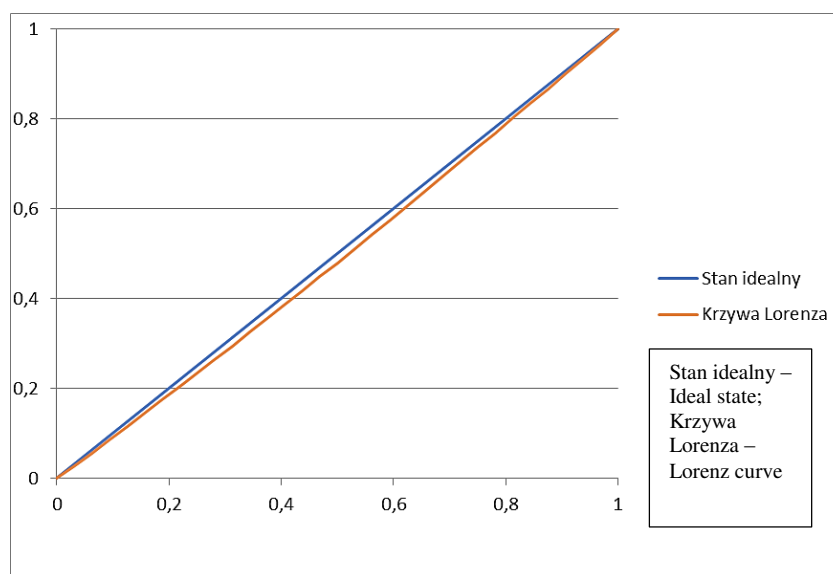


Figure 3. Lorenz Curve for the level of social development of selected European countries in 2010.

Source: The author's own study.

⁶ For all countries in the world (193 entities), the average HDI in 2022 was 0.724, indicating that all the studied countries achieved a level of social development above the global average.

Similarly, in 2022, the Lorenz curve almost coincides with the equality line (ideal state), indicating that nearly every country has a proportionally equal share in the total social development (see Figure 4). The minor deviation of the curve confirms the level of inequality among the studied countries and is consistent with the Gini coefficient (calculations based on Formula 1). In 2022, the Gini coefficient for the selected European countries was 0.0248, falling within the range of $0 \leq G < 0.25$, indicating a low level of concentration. The Gini coefficient decreased by 3.34% compared to 2010, reflecting a reduction in the disparity of HDI among countries. The very high HDI scores of individual countries in 2022 are relatively evenly distributed, showing a low degree of concentration. The level of development among countries with very high HDI scores exhibits relatively little variation. This is because, today, economically advanced countries experience a low level of inequality in socio-economic development, as measured by HDI. This results from the fact that differences in the distribution of individual HDI components, such as health, education, and income, are minimal in these countries (compared to countries that still have a low or medium level of socio-economic development based on HDI, such as countries in Sub-Saharan Africa).

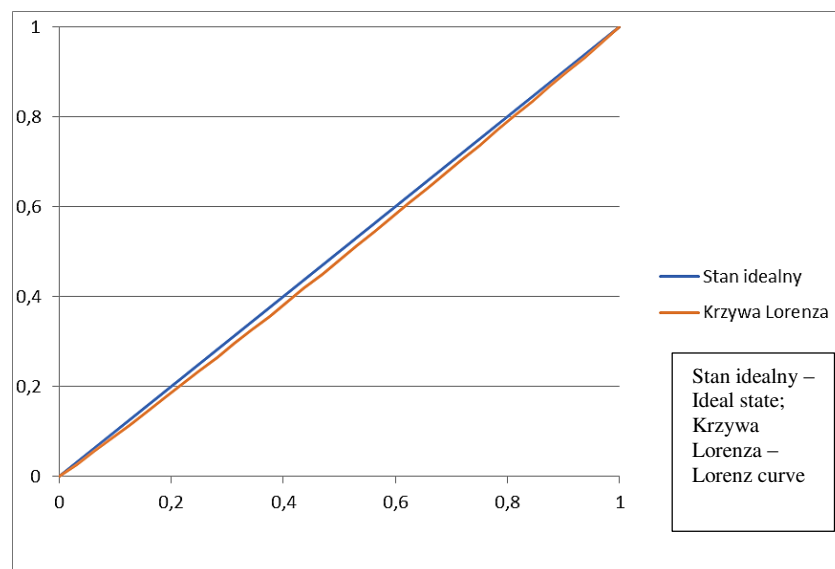


Figure 4. Lorenz Curve for the level of social development of selected European countries in 2022.

Source: The author's own study.

To confirm the results presented above, this study includes the Lorenz curve for the HDI of countries worldwide in 2022 (see Figure 5). The deviation of the Lorenz curve from the equality line is small, indicating a moderate level of inequality, with a slightly greater bulge in the initial segment of the curve. For the 193 countries worldwide in 2022, the Gini coefficient of 0.1222 falls within the range of $0 \leq G < 0.25$, signifying a low degree of concentration. This indicates moderate variation in the level of social development among countries in 2022.

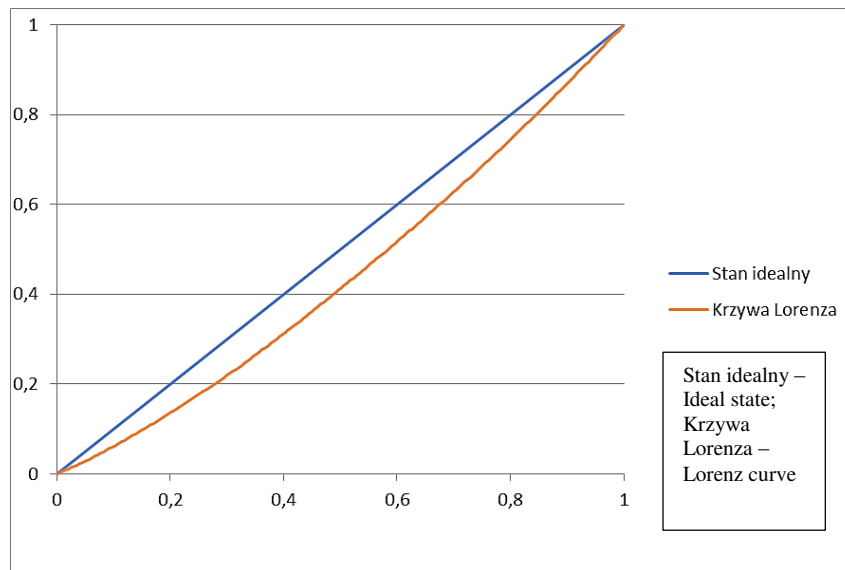


Figure 5. Lorenz Curve for the level of social development of the world's 193 countries in 2022.

Source: The author's own study.

To identify similarities among selected countries based on their level of social development, the Ward's method was employed. An important element of cluster analysis is the cut off point of the dendrogram, which allows to determine the number of clusters in the analyzed study. In the conducted study, an attempt was made to determine the critical value based on the analysis of the line chart of linkage distances across subsequent stages of the clustering process. The analysis of the agglomeration plot for 2022 allows us to conclude that the optimal place to cut the dendrogram should be set at step 26 (the longest vertical line in Figure 6), which indicates that the linkage distance is between levels 3 and 4. For the study the cut-off point of the dendrogram for the connectivity distance of 4 was adopted.

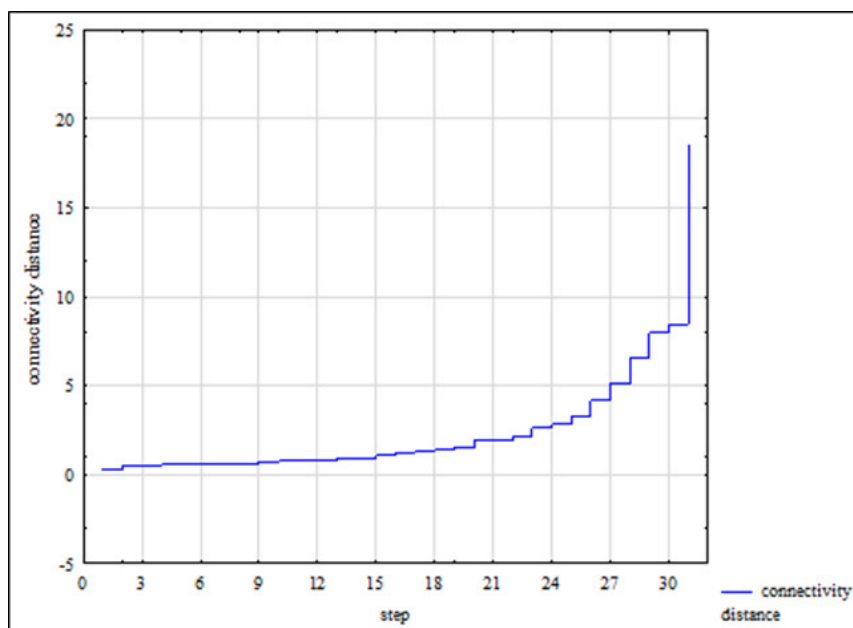


Figure 6. Diagram of the course of agglomeration for 2022.

Source: The author's own study.

Based on this analysis, six clusters were identified in 2022 (Figure 7). The classification of selected European countries resulted in the following groups: single-, three-, four-, five-, nine-, and ten-member clusters. The first cluster, consisting of four countries, includes Switzerland, Germany, the United Kingdom, and Slovenia. These countries share similarities in terms of health and education indices, particularly in the average number of years of education received by residents aged 25 and older. The second cluster consists of five countries that exhibit similarities in terms of life expectancy, which ranges from 81.9 to 83.7 years. This cluster includes Luxembourg, Austria, Cyprus, Malta, and France. An independent, single-member cluster is formed by Liechtenstein, which stands out due to its exceptionally high GNI (Gross National Income) of 146,673 PPP dollars, significantly distancing itself from other countries. The fourth cluster consists of three countries - Spain, Italy, and Portugal - which are grouped together due to their comparable values in life expectancy and average years of education, i.e. Spain, Italy and Portugal. The fifth group, the largest with nine countries, consists of Northern European countries: Norway, Denmark, Sweden, the Netherlands, Belgium, Finland, Iceland, Ireland, and Greece. The sixth cluster includes eight countries, predominantly from Central and Eastern Europe: Estonia, Czechia, Poland, Latvia, Lithuania, Slovakia, Hungary, and Croatia. These units demonstrate significant similarities in terms of GNI values. The final, eighth cluster consists of two countries with relatively low HDI scores compared to the other analyzed units - namely, Romania and Bulgaria - indicating that these nations differ markedly in terms of social development compared to the rest of the group.

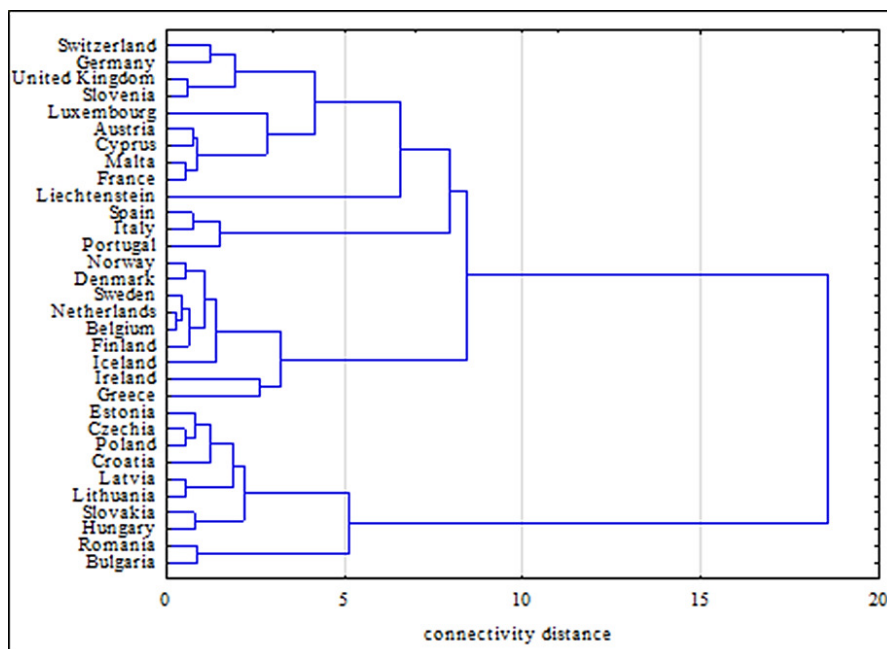


Figure 7. Cluster of selected European countries with similar levels of social development based on the synthetic HDI indicator in 2022.

Source: The author's own study.

The Human Development Index (HDI) is currently employed for a wide range of purposes, from serving as a comparative index to guiding public policy decisions. The noticeable improvement in the level of social development for many European countries in 2022, compared to 2010, can be attributed to public authorities' efforts to provide favorable conditions for living, working, healthcare, and entrepreneurship. These improvements also stem from the strengthening of European integration and financial support, particularly for European Union countries.

However, the HDI does not fully capture the disparities in social development. By employing the mean and standard deviation, the analyzed European countries were grouped into four categories. This approach helped highlight internal inequalities. Thus, the countries were categorized based on their level of social development into four groups: highest ($HDI \geq \overline{HDI} + S_{HDI}$), high ($\overline{HDI} \leq HDI < \overline{HDI} + S_{HDI}$), low ($\overline{HDI} - S_{HDI} \leq HDI < \overline{HDI}$), and very low ($HDI < \overline{HDI} - S_{HDI}$). These classifications are presented in Table 2:

where:

\overline{HDI} - arithmetic mean of the HDI indicator;

S_{HDI} - standard deviation of the HDI indicator.

Table 2.

HDI Human Development Index in selected European countries in 2010 and 2022

2010			2022		
Ranking position	Country	Indicator Value HDI	Ranking position	Country	Indicator Value HDI
Group of countries with the highest level of human development					
$HDI \geq 0.920$			$HDI \geq 0.952$		
1.	Switzerland	0.940	1.	Switzerland	0.967
2.	Norway	0.938	2.	Norway	0.966
3.	Germany	0.929	3.	Iceland	0.959
4.	Iceland	0.927	4.	Denmark	0.952
			5.	Sweden	0.952
Group of countries with a high level of human development					
$0.880 \leq HDI < 0.920$			$0.911 \leq HDI < 0.952$		
5.	Netherlands	0.917	6.	Germany	0.950
6.	Liechtenstein	0.916	7.	Ireland	0.950
7.	Denmark	0.913	8.	Netherlands	0.946
8.	Belgium	0.913	9.	Belgium	0.942
9.	United Kingdom	0.913	10.	Finland	0.942
10.	Finland	0.912	11.	Liechtenstein	0.942
11.	Luxembourg	0.912	12.	United Kingdom	0.940
12.	Sweden	0.910	13.	Luxembourg	0.927
13.	Ireland	0.908	14.	Austria	0.926
14.	Austria	0.903	15.	Slovenia	0.926
15.	Slovenia	0.890	16.	Malta	0.915
16.	France	0.880	17.	Spain	0.911
17.	Italy	0.880			

Cont. table 2.

Group of countries with a low level of human development					
0.839 ≤ HDI < 0.880			0.869 ≤ HDI < 0.911		
18.	Greece	0.874	18.	France	0.910
19.	Czechia	0.872	19.	Cyprus	0.907
20.	Spain	0.868	20.	Italy	0.906
21.	Estonia	0.864	21.	Estonia	0.899
22.	Malta	0.862	22.	Czechia	0.895
23.	Cyprus	0.859	23.	Greece	0.893
24.	Lithuania	0.846	24.	Poland	0.881
25.	Poland	0.845	25.	Latvia	0.879
26.	Slovakia	0.841	26.	Lithuania	0.879
			27.	Croatia	0.878
			28.	Portugal	0.874
Group of countries with very low levels of human development					
HDI < 0.839			HDI < 0.869		
27.	Portugal	0.831	29.	Slovakia	0.855
28.	Hungary	0.829	30.	Hungary	0.851
29.	Latvia	0.827	31.	Romania	0.827
30.	Croatia	0.824	32.	Bulgaria	0.799
31.	Romania	0.813			
32.	Bulgaria	0.790			

Source: Own elaboration based on the Human Development Report (UNDP, 2024).

Nearly 47% of the units were classified into Groups III and IV in both 2010 and 2022. The vast majority of countries in both years fell into the groups with low and very low levels of social development, with the exception of two countries (Spain and Malta), which advanced to Group II in 2022. It is notable that in both analyzed years, Bulgaria, Romania, and Hungary formed a group with a very low level of social development based on the HDI.

According to Oxfam studies, global inequality in wealth distribution is deepening. The fortunes of the world's five richest men have doubled since 2020, while nearly five billion people globally have fallen into poverty during this time. At the current pace, it is estimated that it will take 230 years to eliminate poverty. The authors of the report suggest that global inequality is exacerbated by the significant concentration of corporate and monopolistic power, which exploits masses of oppressed workers, avoids taxes, and contributes to climate change (Riddell et al., 2024). Europe is not exempt from social disparities either. Currently, research on social inequalities takes a multidimensional approach, in which authors investigate a broad range of aspects related to the nature and causes of asymmetry (Pilch, 2023; Kaczmarek et al., 2007; Wielecki, 2019; Żyżyński, 2023; Wesołowska, 2024). A key issue here is determining the extent of the inequalities facing the world today, including in Europe. The analysis suggests that social inequalities continue to be observed on the continent, resulting from the asymmetric allocation of resources (Reczuch, 2022). Many authors emphasize that inequalities are a complex phenomenon present in nearly all countries (Bilińska, 2020; Wiatrowski, 2016), leading to numerous social and economic problems (Krzyminiowska, 2013). According to M. Lange's research, the most significant social problems correlated with income inequality are found in Southern Europe (Portugal, Spain, Greece), the Baltic States (Latvia, Lithuania, Estonia), as well as in Bulgaria and Romania - the least affluent countries. Lange notes that the

rise in socio-economic inequalities within the EU is the result of labor market changes driven by technological advancements in a globalized world, along with national policies concerning income redistribution. It is also worth mentioning that the smallest inequalities are found in countries like Slovenia, the Netherlands, and Scandinavian countries (Lange, 2015).

The analysis presented in this article confirms ongoing disparities in terms of HDI. The gap between the top-ranking country and others increased by 0.018 between 2010 and 2022, reaching 0.168 in 2022 (the gap between Bulgaria and Switzerland). The most challenging situation continues to affect Bulgaria, Romania, Hungary, and Slovakia. These findings are consistent with other studies. For example, N.K. Aksentijević and Z. Ježić (2017) highlight weaker social development in parts of Central and Eastern Europe, particularly in Romania, Bulgaria, Serbia, North Macedonia, Ukraine, Albania, and Bosnia and Herzegovina. Similarly, K. Wielecki's research on disposable incomes within EU countries also supports the thesis of stable income disparities globally (Wielecki, 2019). Wielecki points out that the greatest asymmetry was observed in Lithuania, Romania, Bulgaria, Latvia, and Estonia. A. Kuczyńska-Zonik noted similar observations regarding the Baltic States (Lithuania and Latvia), highlighting a high poverty rate (the highest after Bulgaria and Romania), which she attributes to inadequate government social support. This reflects the weaknesses in the tax and social security systems, which are less effective than in other EU countries (Kuczyńska-Zonik, 2021). K. Wójtowicz offers a different perspective on fiscal policy's effectiveness, suggesting that spending tools (mainly increasing social transfers) are more effective in reducing income inequality than tax tools. Among tax measures, raising income taxes for the wealthiest individuals and reinforcing progressive taxation proved most effective (Wójtowicz, 2016). T. Pilch further argues that government efforts have been ineffective, highlighting the helplessness of democracy in addressing social inequalities, with education and wealth emerging as new creators of asymmetry (Pilch, 2023). Additionally, J. Żyżyński points out that the rise in income and wealth inequalities in the U.S. and Europe began in the early 1980s with the expansion of neoliberal ideology, as many countries rolled back progressive taxation mechanisms (Żyżyński, 2023).

4. Conclusions

Inequality, including social inequality, has always been a global issue. There is broad consensus that inequality generally harms economic growth and public financial stability, leading to rent-seeking behavior, the accumulation of negative effects, and the exclusion of many people from the benefits of economic growth. Although Europe, in global terms, is considered the continent with the lowest levels of social inequality, significant internal disparities exist between European countries. Despite the consistent progress in social

development observed across European countries, these advancements are accompanied by persistent developmental asymmetries. The analyzed countries exhibit substantial social inequalities, even though most are classified among the world's nations with the highest levels of social development (with Bulgaria occupying the highest position among countries with a high level of social development). In fact, these asymmetries are deepening, as demonstrated by the HDI; the gap between Switzerland (the leader in both 2010 and 2022) and Bulgaria (the lowest-ranked country in both years) widened to 0.168 in 2022, compared to 0.150 in 2010. Bulgaria's social development progress has been considerably weaker than that of Switzerland. This issue of disparities is further highlighted by the division of European countries into groups with the highest, high, low, and very low levels of social development, with nearly 47% of the countries classified into the two weakest groups. The existence of inequalities is also reflected in the results of studies using Ward's method, which reveal several clusters of countries with homogenous characteristics. For example, Estonia, Czechia, Poland, Latvia, Lithuania, Slovakia, Hungary, and Croatia show significant similarities in terms of GNI per capita.

According to the authors of the article, although the existence of socio-economic inequalities is an immanent feature of development, it is necessary to take action to eliminate them. Otherwise, the accumulation of adverse phenomena will exacerbate the already existing problems in the pursuit of social inclusion, which is the goal of both European and international politics. The persistence of significant disparities will probably result in the deepening of the global economy problems in the future, such as the intensification of illegal migration, including climate migration, ensuring food and health security, and the problem of social poverty. The subject of inequality, particularly the discussion around it, requires in-depth research on both a global and European level. A critical issue for future studies would be to answer the pressing question of what level of inequality is acceptable. However, finding a definitive answer to this question remains a complex and challenging task.

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GREEN TRANSITION IN POLAND – OPPORTUNITIES AND THREATS

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Purpose: The objective of this article is to identify the opportunities and threats that have emerged as a result of the energy transition process in Poland, with a particular focus on the economic implications of the measures that have been implemented. The analysis commences with a theoretical considerations of the identification and categorisation of the objectives of the European Union's climate and energy policy, together with an investigation of their environmental and economic consequences for Poland.

Design/methodology/approach: The article employs a critical analysis of the existing literature on the subject, later used to conduct a SWOT analysis for the purpose of identifying potential opportunities and threats to the current transformation processes in the energy sector in Poland. The research problem was also analysed and synthesised using the aforementioned investigative and synthesis method.

Findings: The key finding of the study is that the energy sector in Poland is not appropriately prepared to accommodate such wide changes which are going to be certainly brought about the energy transition process. The restructuring of the existing energy mix is contingent upon substantial financial commitments, which Poland is currently not prepared to undertake. Furthermore, the implementation of the assumptions of energy system transformation requires the allocation of financial resources between the sectors of the national budget.

Originality/value: The consideration carried out constitute the author's assessment of the opportunities and threats to the assumptions of the energy transition in Poland carried out on the basis of SWOT analysis. The article is directed towards all the individuals involved in the resolution of this issue. The secondary objective is to present a realistic evaluation of the assumptions underlying the energy transition in Poland.

Keywords: energy transition; electrical power engineering sector; SWOT analysis.

Category of the paper: research paper.

1. Introduction

One of the European Union's primary objectives in the area of climate and energy policy is to reduce the proportion of conventional energy resources in the energy mix. For a significant number of countries within the European Union, including Poland, the necessity arises for the implementation of a low-carbon or, ideally, a zero-carbon economy that is largely independent of fossil fuels. The process, referred to as the energy transition or green transition, presents significant challenges for the electricity sector in Poland, which currently relies on fossil fuels. Lignite, hard coal and natural gas are the key energy resources for the Polish electricity market. A significant reduction in the proportion of energy derived from non-renewable sources in favour of renewable energy sources is a challenging, time-consuming and, most importantly, expensive process. This leads to the question of whether Poland is capable of meeting the demands placed upon it, and what the resulting consequences may be.

The objective of this article is to identify the opportunities and threats that have emerged as a result of the energy transition process in Poland, with a particular focus on the economic implications of the measures that have been implemented. The analysis commences with a theoretical considerations of the identification and categorisation of the objectives of the European Union's climate and energy policy, together with an investigation of their environmental and economic consequences for Poland.

1.1. The fundamental principles and objectives of the European Union's climate policy

The issue of global climate change and the associated need for restructuring the energy sectors of countries within the European Union and beyond has been the subject of extensive research, analysis and discussion for an extended period of time. The continuing phenomenon of globalisation, accompanied by ongoing technological advances is influencing a number of factors, including the increase in demand for electricity or global climate change. A significant challenge in the context of energy demand is the question of how energy is sourced and produced. Indeed, in the majority of economic contexts, similarly to Poland, the primary raw material used for the generation of electricity are lignite and hard coal, which are classified as conventional energy sources. The utilisation of these resources has the unintended consequence of contributing to an increase in carbon dioxide emissions (CO₂), which has been recognised by the European Commission as an adverse phenomenon requiring 'immediate' intervention. For this reason, since 2008 the European Commission has been adopting series of documents pertaining to the measures to be taken with regard to the European Union's energy and climate policy. The initial package of climate and energy measures, designated as the 20-20-20 targets, was enacted in 2008, with targets set until 2020 (Commission of the European Communities, 2008). In turn, 2014, the preceding assumptions were revised and a package of measures up to 2030 was adopted (Commission of the European Communities, 2014a, 2014b). In summary, the principal objectives of the European Union's energy and climate policy include:

- the reduction of gas emissions by 20% by 2020 and by at least 40% by 2030 (relative to levels observed in 1990),
- increasing the proportion of renewable energy in the EU's total energy consumption to 20% by 2020 and to ensure that the share reaches at least 27% by 2030,
- achieving a 20% increase in energy efficiency by 2020 and a minimum of 27% by 2030.

In addition, long-term objectives have been established for the following areas:

- transitioning to a competitive, low-carbon economy by 2050 – in accordance with the assumptions entailing reducing emissions by 80% (compared to 1990 levels) through reducing domestic emissions (Commission of the European Communities, 2011) and
- establishing a sustainable, competitive and secure energy system by 2050, through the implementation of enhanced energy efficiency, augmented renewable energy, nuclear energy and carbon capture and storage (Commission of the European Communities, 2014b).

In order to reduce greenhouse gas emissions, the European Commission proposed the establishment of the European Emissions Trading System (EU ETS), which was implemented in 2003 (Commission of the European Communities, 2003). The objective of this system is to regulate the emission of greenhouse gases by energy-intensive industries, energy producers, airlines, road and maritime transport (*Ustawa z Dnia 12 Czerwca 2015 r...*, 2015). This concerns mainly emissions of gases such as carbon dioxide (CO₂), nitrous oxide (N₂O), perfluorocarbons (PFCs) from large power plants and industrial installations and air transport. The ETS establishes a ceiling on the emission allowances that companies are permitted to purchase or receive. The issue is that the cost of these allowances remains relatively high, at approximately EUR 80 per tonne. However, in recent years, prices have reached record highs of EUR 100/tonne (approximately EUR 50/tonne in early 2021 and EUR 24/tonne in early 2020), which was undoubtedly influenced by Russia's aggressive behaviour in the European energy market and military action in Ukraine (Polski Komitet Energii Elektrycznej, 2022).

A further objective of the European Union's energy and climate policy is to increase the proportion of renewable energy sources in the energy sectors of the Member States. The scope of permissible action in this area varies from one country to another and is defined by the binding national targets that have been set. The quantity of the share to be established is contingent upon the advancement of renewable energy solutions and the country's capacity to increase it. Each Member State was obliged to delineate the manner in which it would fulfil its obligations. The advancement of these initiatives is evaluated on a biennial basis and documented in pertinent reports. Nevertheless, the European Commission has not neglected the sector of renewable energy sources, aiming to accelerate progress towards the 2030 energy and climate policy target of increasing the share of renewable energy sources (RES) in the energy mix to 27%, the Commission has developed a number of supporting measures. These include – among others – financial support schemes, restrictions on the level of energy consumption or

district heating and cooling systems, rules for cross-border cooperation, administrative simplification and greenhouse gas emission limits for biofuels.

In addition to the aforementioned objectives, the European Union's energy and climate policy also aims to enhance the energy efficiency of its Member States. This primarily concerns the commitment of these countries to more efficient energy use, beginning with the production, distribution and final consumption of energy. The realisation of this objective necessitates – among others – a number of amendments to existing legislation, as well as the allocation of significant financial resources for implementation. The energy union, established in 2015 aims to provide support for energy efficiency improvements, its objective is to (Commission of the European Communities, 2015):

- diversify European energy sources, ensuring energy security through the fostering of solidarity and cooperation between European Union Member States;
- ensure the optimal functioning of a fully integrated internal energy market, which enables the free flow of energy within the European Union through the implementation of appropriate infrastructure and without technical and regulatory barriers;
- enhance energy efficiency and diminish reliance on imported energy sources, while concurrently reducing emissions and stimulating job creation and economic growth,
- decarbonise the economy and transition to a low-carbon economy in accordance with the Paris Agreement,
- promote research in low-carbon and clean energy technologies, with a particular priority on research and innovation which facilitate the energy transition and enhance competitiveness.

All Member States, including Poland, are obliged to implement the aforementioned objectives of the European Union's energy and climate policy. For this reason, the subsequent section will present a synthetic characterisation of the condition of the energy sector in Poland in light of the ongoing energy transition process.

1.2. Energy transition in Poland

As previously stated, one of the primary objectives of the European Union's energy and climate policy is the decarbonisation of the energy sectors of its member states. Nevertheless, the Polish energy sector will continue to rely on coal, including both hard coal and lignite, for the foreseeable future. This assertion is proven by the data presented in Figure 1, which demonstrates that the general share of energy generated by conventional power plants in 2022 was 72.4%, out of which 69.1% was derived from the combustion of coal and lignite, while 3.3% was derived from the combustion of natural gas. The remaining 27.6% is accounted for by renewable energy sources, including wind power, photovoltaics and other similar technologies.

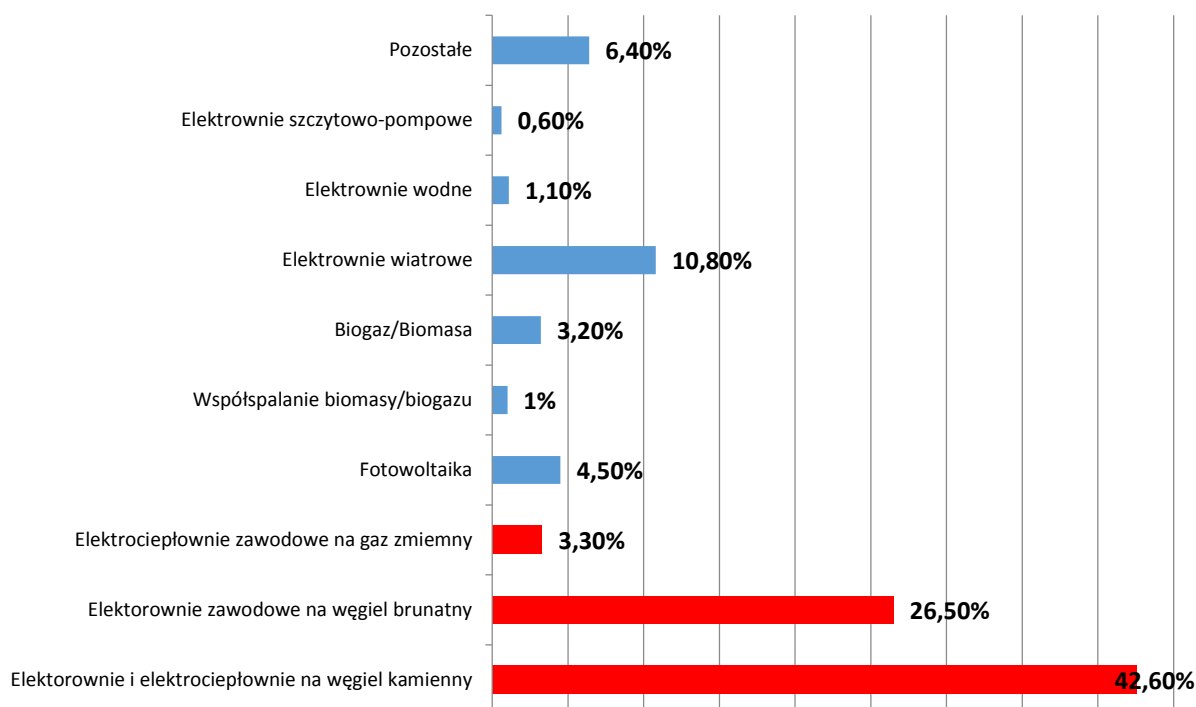


Figure 1. Structure of electricity production in Poland (January-December 2022).

Source: Own elaboration based on data from the Energy Market Agency's Statistical Information on Electricity, No. 12(348), December 2022.

The structure of electricity production in Poland presented in Figure 1 demonstrates that the role of conventional energy resources play a key role in the Polish energy sector while, abandoning these resources entirely would present a significant challenge to Poland's energy security. Conversely, however, these raw materials are at risk of depletion, which is why the Polish energy sector requires significant and far-reaching changes towards the decarbonisation of electricity production. Unfortunately, this comes at a high cost.

The stated objective is therefore to establish a low-carbon and sustainable energy sector, powered by renewable energy sources. These measures are aligned with the aforementioned objectives of the European Union's climate and energy policy, which is why Poland has assumed the responsibility of enhancing energy efficiency in order to adapt to the requirements imposed by the European Union carrying out a process of transformation of its own energy sector. It is important to note that condition of the infrastructure of the Polish energy sector and the country's reliance on coal, particularly hard coal and lignite requires Poland to overcome a number of difficulties, primarily economic and financial, in order to achieve its goals, set by the European Union. The transformation process of this sector should consider Poland's initial position, its socio-economic circumstances, and the equitable distribution of the costs associated with the implementation of the proposed solutions (Ministerstwo Klimatu i Środowiska, 2021). The economic aspect is going to be the key to the success of the transformation processes. The implementation of the adopted measures necessitates considerable investments where the EU's contribution is of key importance. Simultaneously,

investment decisions must consider the implications of green and low-carbon recovery in order to maintain socially acceptable energy prices. The projected financial outlays for the restructuring of the Polish energy sector between 2021 and 2040 is estimated at approximately PLN 1.6 billion. It is estimated that the fuel and energy sectors will receive approximately PLN 867-890 billion in funding, while projected investments in the electricity generation sector are expected to reach around PLN 320-342 billion, out of this amount, approximately 80% is going to be assigned for the development of capacities such as renewable energy sources and nuclear power (Ministerstwo Klimatu i Środowiska, 2021). The real prospect of rising energy costs represents a significant threat to the ongoing changes in the fuel and energy sector. Financial support, both operational and related to investment resources, will be instrumental in accelerating the implementation of the proposed changes allowing for their implementation in the shortest possible time and on the most extensive scale possible. It is also important that the manner in which the transition is executed incorporates socially acceptable energy prices, while simultaneously preventing the exacerbation of energy poverty. This, in turn, constitutes a distinct issue that evokes considerable negative sentiment and controversy within society.

The strategic document titled Energy Policy of Poland until 2040 (EPP2040) delineates the scope of transformational activities that Poland plans to implement in the period leading up to 2040 (Ministerstwo Klimatu i Środowiska, 2021). The document considers the difficulties of harmonising the national economy with the European Union's regulations on the 2030 climate and energy targets, the European Green Deal, the recovery plan after COVID pandemic and the drive towards climate neutrality. EPP2040 is consistent with the National Energy and Climate Plan for the years 2021-2030, offering a comprehensive account of the current state and circumstances of the energy sector. EPP2040 consists of three fundamental pillars containing eight detailed objectives (these objectives will be considered in detail in the subsequent part), along with the actions and strategic projects required for their implementation as well as strategic projects. Furthermore, the document delineates the territorial scope and identifies the sources of funding. The legislative objective of Poland's energy policy is to guarantee energy security while simultaneously maintaining and enhancing the competitiveness of the national economy, promoting energy efficiency, and reducing the adverse environmental impact of the energy sector. The first pillar of EPP2040 regards just transition. This entails the transformation of the regions most adversely affected by the low-carbon energy transition, with the objective of creating new development and employment opportunities. The second pillar is an emission-free energy system. The deployment of nuclear and wind power, in addition to the increased role of distributed energy installations, including those set up by households and industrial centres, will play a significant role in this regard. The final – third pillar – good air quality, is concerned on the allocation of resources towards the transformation of the systemic and individual heating sector, the electrification of transport, and the promotion of contemporary solutions in the form of passive and zero-emission houses that utilise local energy sources.

In conclusion, EPP2040 describes the fundamental tenets of Poland's energy transformation, delineates the primary objective of the country's energy policy, such as ensuring energy security, enhancing the competitiveness of the economy, promoting energy efficiency and mitigating the environmental impact of the energy sector and elucidates specific objectives encompassing the entire energy sector, from the acquisition of raw materials to their utilisation and sale of energy. The three pillars of the energy transition set out by Energy Policy of Poland until 2040 provide a framework for the country's energy transition, outlining the direction in which it should proceed while establishing fair rules for achieving a zero-carbon Polish energy sector while ensuring energy security. It is thus recommended that the efficacy of the proposed transformational solutions be evaluated in light of the opportunities and threats they present, which represents the primary objective of this paper. The third section of this paper presents the findings of the analysis and offer an evaluation thereof.

2. Methods

As mentioned, the objective of this article is to identify the opportunities and threats that have emerged as a result of the energy transition process in Poland, with a particular focus on the economic implications of the measures that have been implemented. The implementation of the objective formulated in such manner necessitated the utilisation of research methods, including the method of literature analysis and criticism, the method of analysis and logical construction, SWOT analysis (i.e. strengths, weaknesses, opportunities, threats) and inference. The article's analysis of the opportunities and threats inherent in Poland's energy sector transformation processes required a comprehensive review of documents, reports, and legal instruments at both the EU and national levels. A critical analysis of the literature in this area enabled the identification of opportunities emerging from changes in the Polish energy sector. In contrast, the utilisation of the analytical method and logical construction facilitated the identification of the key risks. The combination of both methods has enabled the execution of a SWOT analysis of the green transition in Poland. This analysis formed the basis for answering the question of whether the energy transition in Poland presents opportunities for the modernisation of this sector of the Polish economy, or whether it will instead give rise to intractable problems and difficulties. In the adopted approach, it is crucial to focus the analysis on the energy sector in Poland and the SWOT analysis was limited to the identification and assessment of opportunities and threats to the assumptions and expected results of the transformation processes. The utilisation of the inference method enabled the results of the research to be evaluated and commented upon.

The subsequent section of this paper will present the problem under discussion in tabular form, accompanied by appropriate commentary and conclusions.

3. Results

As previously stated, the fundamental objective of the energy transition, otherwise known as the green transition, is to establish a sustainable, low-carbon economy that is based on renewable energy sources and environmental protection. Given the current level of knowledge and technological capabilities, this appears to be a realistic and achievable goal. Nevertheless, concerns pertaining to this matter are intensified by the fixed temporal framework, delineated by the deadlines stemming from the stipulations of the package documents, the European Green Deal, and Fit for 55.

The European Green Deal is a set of policy initiatives from the European Commission, which was announced in December 2019 in a Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions titled *European Green Deal* (Commission of the European Communities, 2019). Its main objectives include:

- reducing EU greenhouse gas emissions by 55% by 2030 in comparison to 1990, with the ultimate goal of achieving climate neutrality by 2050,
- decoupling economic growth from the amount of consumed resources,
- achieving a state of equilibrium in the level of development of all European regions.

These assumptions seemed to be realistic for Poland to achieve through effective collaboration between the energy and political sectors. The reasonably planned timeframe for the implementation of the adopted assumptions did not present a significant challenge in achieving the aforementioned objectives. Nevertheless, the European Union has recently set forth a new objective – to reinforce its status as a global leader in the energy and climate markets. Consequently, in 2020, the European Council endorsed a revised objective to curtail greenhouse gas emissions by a minimum of 55% by 2030 in comparison to 1990 levels by the introduction of the Fit for 55 Package in 2021. The recently adopted regulations have notably intensified and expedited the assumptions set forth in the European Green Deal for 2030. The assumptions made in the Fit for 55 package cover a range of areas, including modifications to district heating and cogeneration, land use and forestry, the road transport sector, and energy taxation. This package includes changes mainly to:

- emissions trading scheme,
- Effort Sharing Regulation,
- CO₂ emission standards for cars and vans,
- Renewable Energy Directive,
- Energy Efficiency Directive,
- Regulation on land use, land use change, and forestry,
- Energy Taxation Directive

as well as the introduction of a new CO₂ border price adjustment mechanism. The recently introduced regulatory framework has considerably intensified and, furthermore, hastened the energy transition procedures across the member states. Some countries, such as Poland, are confronted with significant challenges in implementing the legislative changes required by the Fit for 55 package, as the complexity of the legislative processes, the lack of financial resources, and the necessity to implement changes that have already been imposed all contribute to making the assumptions of the package nearly impossible to fulfil within the limited timeframe. This led to the decision to conduct a SWOT analysis of the opportunities and threats associated with the green transition in Poland. The results of this analysis are presented in Table 1.

Table 1.

SWOT analysis – opportunities and threats of the green transition in Poland

	Opportunities (O)	Threats (T)
Energy efficiency	<ul style="list-style-type: none"> • a reduction in greenhouse gas emissions, • decarbonising the economy and transition to a low-carbon economy in accordance with the Paris Agreement, • a reduction in energy consumption in production facilities, • more efficient and less carbon-intensive energy and heating solutions, • more efficient and less carbon-intensive extraction of hydrocarbons 	<ul style="list-style-type: none"> • the absence of regulatory frameworks that would facilitate expeditious investment in energy sources that can achieve the targeted reduction of greenhouse gases (by at least 55% by 2030 in comparison to 1990), • a reform of the energy tax system, entailing the removal of exemptions and the reduction of rates that encourage the use of fossil fuels, • changes to CO₂ (EU ETS) emissions trading, including: an increase in the price of CO₂ allowances, a reduction in the overall emissions cap and an increase in the annual rate of reduction, and the abolition of free allowances for aviation, • an increase in the level of effort-sharing reduction values
Energy sources	<ul style="list-style-type: none"> • diversification of energy sources, • greater own energy production derived from RES, • greater energy independence through a reduction in the importation of traditional raw materials, • advancement of innovative technologies and the utilisation of nuclear energy represent pivotal areas of development 	<ul style="list-style-type: none"> • achieving a 40% share of renewable energy sources in total energy production by 2030. • lack of funding for retrofitting electricity grids, • lack of legal regulations in the area of nuclear energy investments
Products and services	<ul style="list-style-type: none"> • the provision of zero- and low-carbon energy sources (including clean electricity, low-carbon heat, renewable hydrogen, biomethane, biofuels, and synthetic fuels), • development of non-energy-intensive products and services, • business diversification based on new technologies (electromobility). 	<ul style="list-style-type: none"> • the advancement of zero-emission mobility after 2035 in the automotive industry, particularly in the category of cars and vans, • the need to enhance the charging capacity of zero-emission vehicles in direct correlation with their sales figures and implementing a comprehensive network of charging and refuelling stations along motorways at regular intervals, • the necessity to renovate 3% of public sector buildings with the objective of reducing energy consumption

Cont. table 1.

Research and development	<ul style="list-style-type: none"> • promote research in low-carbon and clean energy technologies, with a particular priority on research and innovation which facilitate the energy transition and enhance competitiveness 	
Social aspect	<ul style="list-style-type: none"> • stimulating job creation and economic growth 	<ul style="list-style-type: none"> • fear of increasing energy prices, • the lack of financial resources allocated to the modernisation of domestic heating systems, • a concern regarding the potential for a shift in the conditions governing the consumption and uptake of energy produced within the micro-installation of a renewable energy system (RES)
Cooperation with other EU Member States	<ul style="list-style-type: none"> • ensuring the optimal functioning of a fully integrated internal energy market. which enables the free flow of energy within the European Union through the implementation of appropriate infrastructure and without technical and regulatory barriers 	<ul style="list-style-type: none"> • unpredictable events hindering the ability to foster collaboration with both EU and non-EU countries such as COVID-19 pandemic, Russia's aggression against Ukraine

Source: Own elaboration based on: (Ministerstwo Klimatu i Środowiska, 2021).

A critical examination of the principal assumptions underlying the transformation of the energy sector in Poland has revealed that, while the process of change offers numerous opportunities, it also gives rise to a number of risks. It is of the utmost importance to recognise that the Polish energy infrastructure is outdated and not prepared for such significant changes that are currently taking place, in particular, the development of the green energy sector and the construction of short transmission networks powered by renewable energy sources (Moskwa-Bęczkowska, Moskwa, 2022). For years, Poland has been a nation reliant on coal and lignite as its primary energy sources. Therefore, that the production and distribution of energy, and indeed the entire energy infrastructure, have been largely adapted to accommodate these raw materials. While the renewable energy sector has been experiencing robust growth for an extended period, with this growth being both desirable and welcome, the majority of these installations are situated within individual households. In light of these circumstances, Poland is confronted with a challenging and, most notably, an expensive setback, particularly in view of the time limits set by the European Commission. In this context, a significant challenge for Poland may emerge from the potential consequences of failing to achieve the objectives set out in the European Union's climate and energy packages.

The economic and financial aspects are a distinct issue, as Poland lacks the requisite financial resources to implement the full range of climate and energy targets approved by the European Union by 2050. It has been estimated that the energy transformation of Poland, as designed in EPP2040, will require significant investment. This is contingent upon the transformation being carried out in a socially acceptable manner, while guaranteeing energy security, maintaining the competitiveness of the economy and limiting environmental impact. The scale of the investment required is estimated to reach approximately PLN 1600 billion

between 2021 and 2040 (Ministerstwo Klimatu i Środowiska, 2021). The aforementioned funds are – mainly – to be provided as part of an increase in budgetary outlays for the development of the energy sector in Poland. In light of the considerable scale of the planned changes and their associated costs, it is inevitable that national financial resources will prove inadequate in achieving the objectives of the energy transition. It is important to note that the national funds will be allocated through transfers between the sectors of the newly created state budget; this will inevitably result in a reduction of funds in other sectors of the Polish economy. An opportunity for stable development of the sector, made available through external funding under the support schemes and aid programmes on offer, including for example: InvestEU, the Recovery and Resilience Facility, the Life Programme, the Modernisation Fund, without which the energy transition in Poland would not be possible.

4. Summary

As evidenced by the preceding discourse, the process of energy transformation in Poland is both necessary and desirable, offering numerous opportunities for the modernisation of the energy sector – however, it also gives rise to significant doubts and controversies regarding the feasibility of meeting the assumed time limits for implementation and the potential consequences of the implemented solutions. The primary focus is on the comprehensive decarbonisation of the Polish energy sector, which will necessitate the cessation of hard coal and lignite mining, resulting in the closure of numerous industrial facilities. It is indubitable that this will have a deleterious effect on the Polish economy. The considerations presented in this paper represent a preliminary investigation into the author's broader research project, which aims to analyse and evaluate the effects of the energy transition in Poland.

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THE STRUCTURE AND EFFECTIVENESS OF APPLYING FOR EU FUNDS IN POLISH VOIVODSHIP CITIES – COMPARISON OF THE FINANCIAL PERSPECTIVES 2007-2013 AND 2014-2020

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Purpose: The article compares the structure and effectiveness of obtaining financial resources for EU projects in provincial cities from two financial perspectives: 2007-2013 and 2014-2020.

Design/methodology/approach: The comparative analysis used secondary data obtained from the Central Statistical Office (GUS) regarding cumulative values for the years 2015 and 2023. The following categories were considered: the number of submitted applications for co-financing, the number and value of signed co-financing agreements, and the effectiveness of obtaining funds.

Findings: From the 2014-2020 financial perspective, the process of obtaining and distributing funds considered local conditions, which was the result of the use of the place-based policy concept, increasing the available regional financing. Some activities related to human capital development have been transferred to regional programs. The most expensive projects were implemented under OPIE. In both periods, a small share of soft projects in the structure of the value of contracts and a high value of projects implemented regionally were noted, with a simultaneous reduction in the number of beneficiaries and the value of contracts, which, however, improved the effectiveness of applying for EU funds.

Research limitations/implications: The study focuses only on provincial cities. Results may not represent smaller towns and rural areas, which may have different experiences and challenges. The effectiveness of obtaining funds is assessed based on the number of signed contracts relative to the number of submitted applications. However, this does not consider the quality of implemented projects and their long-term effects, which are also important in assessing the real effectiveness of cohesion policy.

Social implications: Due to the issues raised related to development programming, it may arouse the interest of people responsible for development policy, potential beneficiaries, and the local community.

Originality/value: The text refers to classic works on the theory of regional development and spatial inequalities but focuses on the specific context of Polish voivodeship cities and their experiences with obtaining EU funds.

Keywords: EU funds, EU projects, financial perspective, voivodeship cities.

Category of the paper: research paper.

1. Introduction

Poland's membership in the European Union and its cohesion policy creates additional development opportunities for beneficiaries using funds allocated for the development of countries belonging to the community. Regional policy pursued by the Polish authorities focuses on strategic planning and management at both the national and local levels. Beneficiaries implementing development projects with EU funding demonstrate adaptability, which is the key to running a business and obtaining resources from outside the organization. Dedicated in terms of territory and area, obtainable financial resources obtained by the beneficiaries contribute to equalizing the level of socio-economic development in the regions, as well as between regions in the country (Kaźmierska, 2017; Słodowa-Hełpa, 2005). They also act indirectly by implementing the main goal of cohesion policy, which is equalizing inequalities between countries.

The article emphasizes that the observation of the redistribution of EU funds *ex post* in various fields and areas allows us to learn what changes occur during the planning and implementation of development projects (Dorożyński, 2013; Gawlikowska-Hueckel, 2002). Comparing the structure of areas to which financial resources are allocated, as well as the ability of entities to obtain financing, allows us to detect changes in the implementation of development policy by state bodies. The article compares the structure and effectiveness of obtaining financial resources for EU projects in voivodeship cities from two financial perspectives: 2007-2013 and 2014-2020.

2. Redistribution of EU funds in the implementation of cohesion policy in Poland

Socio-economic development, whether it takes place at the local, regional, or national level, occurs in the context of diverse spaces. In the literature on the subject, there are classic works devoted to the unevenness of spatial development, which constitute the foundation of the theory of regional development. Differences in development between the city and its surroundings were studied by Perroux (1955). The concept of growth poles was developed by Boudeville (1966) who identified them as groupings of dynamically developing and strongly interconnected activities. In the works of Hirschmann (1985) one can find statements about the inevitability of uneven development processes, and the concept of cumulative causality, proposed by Myrdal (1957), emphasized this unevenness, explaining them with an initial change in one of the factors, which led to increasing interregional differences. Friedman (1972), the creator of the theory of polarized development, dealt with asymmetric relations between the

central area and the periphery. The literature on the subject provides numerous evidence that development processes differ in centres and peripheries, but are closely related (Gawlikowska-Hueckel, 2002; Szółek, 2006; Domański, 2008; Adamus, 2009; Czyż, 2009; Gaczek, 2009; Kudłacz, 2009).

The European Union's cohesion policy is intended to eliminate development barriers, by the principles of solidarity and social cohesion. Less developed areas should receive additional support under the income redistribution mechanism (Dorożyński, 2013). The allocation of funds supporting development comes down to the issue of dividing funds into different areas of activity and decisions regarding the spatial orientation of the intervention (Hausner, 2001; Gorzelak, 2004). EU funds are distributed by a place-based policy approach, which adapts financial instruments to the specific needs and opportunities of regions and promotes the involvement of local communities, authorities, enterprises and non-governmental organizations (Kaźmierska, 2017).

There are two main development strategies: the equalizing strategy, which assumes that excessive socio-economic differences constitute the main barrier to development, and only support concentrated on the least developed areas will allow for equalizing the level of socio-economic development, and the polarization-diffusion strategy, which focuses on removing barriers hindering the competitiveness and growth potential of all territorial units, with priority for the areas of large cities (Churski, 2009).

The first full financial perspective in which Poland participated covered the years 2007-2013. The key document defining the conditions of support and the system for implementing financial resources from the EU budget was the National Cohesion Strategy - National Strategic Reference Framework for 2007-2013 (NSRF). In this perspective, instruments for managing EU funds were separated at the national and regional levels, introducing Regional Operational Programs (RPO) for each of the 16 voivodeships, managed by voivodeship local government authorities. In the next financial perspective for 2014-2020, this division of financial instruments was continued and support for individual areas was maintained.

The effective use of EU funds, referred to as absorption capacity, depends on many interrelated factors, such as the conditions for making funds available, the level of socio-economic development and the ability to effectively obtain and use the allocated funds (Słodowa-Helpa, 2005). Proper preparation of documents at all levels, efficient project identification, compliance with EU requirements and effective functioning of institutional structures are of key importance. These activities are aimed at stimulating the development of regions, activating multiplier mechanisms and supporting structural changes and economic development in Poland.

The EU financial perspectives differed in the size of the allocation. In the period 2014-2020, Polish beneficiaries will receive funds for EUR 77 billion, i.e. 14.5% more than in the previous period (Table 1). The areas covered by individual operational programs were not 100% identical

in both perspectives, which can be noticed when analyzing the program assumptions of individual financial tools.

Table 1.

Allocation of EU funds divided into operational programs in the 2007-2013 and 2014-2020 perspectives.

Instrument name 2007-2013	Allocation in billion euros		Instrument name 2014-2020	Allocation in billion euros	
Operational Programme Innovative Economy (OPIE)	8,7	13%	Operational Programme Smart Growth (OPSG)	8,6	11%
			Operational Programme Digital Poland (OPDP)	2,3	3%
Operational Programme Infrastructure and Environment (OPIE)	28,3	42%	Operational Programme Infrastructure and Environment (OPIE)	27,4	36%
Operational Programme Eastern Poland (OPEP)	2,4	4%	Operational Programme Eastern Poland (OPEP)	2	3%
Operational Programme Human Capital (OPHC)	10	15%	Operational Programme Knowledge Education Development (OPKED)	4,7	6%
Operational Programme Technical Assistance (OPTA)	0,5	1%	Operational Programme Technical Assistance (OPTA)	0,7	1%
Regional Operational Programme (ROP)	17,3	26%	Regional Operational Programme (ROP)	31,3	41%
Sum:	67,2	100%	Sum:	77,0	100%

Source: <https://www.gov.pl/web/fundusze-regiony/dowiedz-sie-wiecej-o-funduszach-europejskich> (as of June 30, 2024).

The number of operational programs has changed. Two new programs have emerged from the previous Innovative Economy Operational Program: OPSG and OPDP. Operational Programme Human Capital (OPHC) changed its name to Operational Programme Knowledge Education Development (OPKED). Development and, what is worth noting, the pool of funds was reduced compared to the previous period. The name was also changed in the operational programme concerning the area of Eastern Poland (OPEP). The financial structure of the allocation changed later, mainly due to an almost twofold increase in the value of funds allocated for intervention in the regions, which accounted for 41% of all funds.

3. Research methodology and assumptions

The subject of the study was the structure and effectiveness of obtaining EU funds in two financial perspectives: 2007-2013 and 2014-2020. The structure of EU funds was determined according to the type of tool, i.e. the operational program from which funds were obtained. In both perspectives, we dealt with similar areas for which it was possible to obtain funds, but with a different number of operational programs, which is why the structure had a different number of elements in both financing periods. Data were collected for the years 2015 and 2023, and the numerical values for these years express the cumulative values for the entire programming periods, for the 2007-2013 and 2014-2020 perspectives, respectively.

The subject of the study was voivodeship cities, i.e. 16 voivodeship capitals understood as the seats of voivodes, as well as two additional cities in which the assemblies of the Lubuskie and Kujawsko-Pomorskie voivodeships are located, i.e. Zielona Góra and Toruń, respectively. To make it more precise - the entities that obtained financial resources for the implementation of projects were both local government units and entities from the public and private finance sectors, as well as any other entities authorized to apply for funds and located in each city.

The study assessed the structure of the following characteristics regarding applying for EU funds:

- the number of submitted applications for co-financing that were verified positively in formal terms, i.e. they met all the requirements to have the status of a submitted application,
- the number of signed contracts, i.e. those applications for funding that passed the substantive assessment and were eligible for financing,
- value of signed contracts, which included general eligible project costs,
- effectiveness of obtaining funds, understood as the ratio of the number of signed contracts to the number of submitted applications for funding.

4. The structure of EU funds obtained in voivodeship cities

Interest in EU funds can be assessed based on the number of submitted applications for funding. It can certainly be assumed that an entity that can implement EU projects is also able to submit a funding application that will pass a formal assessment. While in the 2007-2013 perspective, entities from voivodeship cities most often applied for funds from three programs dominating the structure: IEOP, OPHC and ROP, in the next perspective only two operational programs enjoyed above-average popularity, and these were: OPSG and ROP (Table 2). In the 2014-2020 perspective, the share of applications submitted under the ROP increased significantly and the percentage of applications submitted under OPIE increased slightly.

The most noticeable change concerned OPHC, which was renamed OPKED in the next perspective. In the 2007-2013 perspective, the lowest share of submitted applications under the OPHC program was 12.97% and concerned Kraków, but the highest values reached almost 50% - in Gorzów Wielkopolski (47.66%) and Olsztyn (42.99%). In turn, from a later perspective, not only did the amount of allocation for human capital-related projects decrease twice, but the interest of entities in this program decreased significantly. It dropped in provincial cities to just a few percent. The highest recorded values are 6.03% in Gorzów Wielkopolski (also 4.12% in Zielona Góra) and 4.45% in Olsztyn, i.e. almost the same cities that were characterized by high shares of applications for funding under OPHC. Looking at the table,

it can be said that the interest of entities from voivodship cities was largely redirected from OPHC to ROP.

Compared to the 2007-2013 perspective, there was also a noticeable increase in the number of applications for funding from OPEP. This could be related to the fact that the level of effectiveness of obtaining funds in the previous perspective in this case was quite high, and entities encouraged by the vision of success were more willing to apply for funds from this program. Previously, in the structure of submitted applications, only Lublin exceeded 1% of the share of applications for the development of Eastern Poland in the total number of applications. The later programming period brought a dramatic change. Almost every third application from Rzeszów and every fifth application from Lublin and Białystok concerned competition from OPEP, and in the remaining cities - Kielce and Olsztyn, the share of applications from OPEP amounted to several percent.

Table 2.

Structure of the number of submitted applications for funding in large cities in the 2007-2013 and 2014-2020 perspectives

City	Applications for funding 2015 [%]						Applications for funding 2023 [%]						
	total	OPIE	IEOP	OPHC	OPEP	ROP	total	OPIE	OPSG	OPPC	OPEP	OPKED	ROP
Wrocław	100	1,5	56,8	16,9		24,8	100	2,2	46,8	0,1		1,3	49,6
Bydgoszcz	100	1,8	37,9	22,9		37,4	100	4,0	55,9	0,4		1,8	37,9
Toruń	100	1,4	32,1	25,7		40,8	100	4,6	41,1	0,6		2,8	50,9
Lublin	100	1,2	23,9	19,6	1,2	54,3	100	1,2	21,8	0,1	17,6	1,4	57,9
Gorzów Wlkp.	100	1,2	22,2	47,7		28,9	100	10,3	24,7	1,4		6,0	57,5
Zielona Góra	100	0,9	29,7	35,4		34,0	100	4,3	38,8	0,7		4,1	52,1
Łódź	100	1,1	28,9	35,3		34,7	100	1,7	26,9	0,2		1,2	70,0
Kraków	100	1,1	62,8	13,0		23,1	100	2,3	60,5	0,2		2,0	35,0
Warszawa	100	1,3	70,1	16,7		11,9	100	2,8	55,5	0,1		1,8	39,9
Opole	100	1,7	29,7	24,3		44,3	100	5,5	24,1	0,8		2,8	66,8
Rzeszów	100	1,1	47,1	25,8	0,7	25,3	100	1,8	36,5	0,2	28,6	1,7	31,2
Białystok	100	1,1	23,5	36,4	0,9	38,2	100	1,3	15,6	0,1	16,2	2,3	64,6
Gdańsk	100	2,5	37,6	32,8		27,1	100	3,2	59,5	0,8		4,4	32,2
Katowice	100	1,2	37,5	22,9		38,4	100	3,3	31,7	0,4		3,3	61,3
Kielce	100	1,0	35,3	29,9	0,6	33,2	100	1,7	13,4	0,2	13,2	1,7	69,8
Olsztyn	100	0,8	14,4	43,0	0,4	41,4	100	1,4	13,6	0,1	11,7	4,5	68,7
Poznań	100	1,3	62,9	14,7		21,1	100	3,5	61,7	0,3		1,4	33,2
Szczecin	100	2,3	29,7	31,5		36,4	100	6,0	37,6	0,5		4,0	51,8

Source: Local Data Bank of the Central Statistical Office.

Signing the co-financing agreement indicates that the submitted co-financing application has been positively verified in the substantive assessment and the applicant has decided to start implementing the project. This means that the submitted project has received funding and can be implemented. Looking at the structure of the number of submitted applications and the number of signed contracts, one can see a similarity in the distribution of shares among individual operational programs. The largest part of the contracts signed in the 2007-2013 perspective were agreements concluded under the ROP, IEOP, where possible, and also under OPEP. Similarly to the structure of submitted applications for funding, the share of signed contracts under OPHC was lower in all cities than in the previous perspective. This situation is

not surprising because the allocation under OPHC in the older perspective was twice as large as the funds allocated for OPKED in the newer perspective.

Table 3.

Structure of the number of co-financing agreements in large cities in the 2007-2013 and 2014-2020 perspectives

City	Number of co-financing agreements 2015						Number of co-financing agreements 2023						
		[%]						[%]					
	total	OPIE	IEOP	OPHC	OPEP	ROP	total	OPIE	OPSG	OPPC	OPEP	OPKED	ROP
Wrocław	100	3,6	45,3	10,5		40,6	100	3,1	29,2	0,1		1,3	66,2
Bydgoszcz	100	3,2	30,0	16,2		50,6	100	6,3	40,3	0,1		2,2	51,0
Toruń	100	2,1	22,9	17,9		57,1	100	4,9	22,5	0,5		3,8	68,4
Lublin	100	1,9	17,0	10,6	2,2	68,2	100	1,5	10,5	0,0	13,9	0,7	73,3
Gorzów Wlkp.	100	2,9	20,7	33,9		42,6	100	13,5	15,5	2,5		5,0	63,5
Zielona Góra	100	1,7	25,9	22,9		49,5	100	6,9	23,5	0,6		6,3	62,8
Łódź	100	2,1	23,1	23,4		51,3	100	2,3	19,2	0,1		1,0	77,4
Kraków	100	2,1	52,7	9,7		35,4	100	3,7	51,1	0,1		1,9	43,2
Warszawa	100	3,0	73,7	10,2		13,1	100	4,8	38,1	0,0		1,8	55,2
Opole	100	3,2	23,5	13,9		59,3	100	5,7	14,9	0,2		2,9	76,4
Rzeszów	100	2,1	39,1	14,6	1,5	42,7	100	3,2	21,7	0,2	30,3	1,3	43,3
Białystok	100	2,5	21,0	25,9	2,2	48,5	100	1,7	7,7	0,1	13,7	1,8	75,0
Gdańsk	100	7,0	37,5	23,0		32,5	100	6,9	50,5	0,3		3,0	39,3
Katowice	100	2,4	37,2	14,1		46,3	100	7,0	23,3	0,2		2,9	66,6
Kielce	100	2,2	27,5	18,5	1,2	50,5	100	2,3	7,1	0,2	9,7	1,7	79,0
Olsztyn	100	1,5	5,8	25,5	0,9	66,4	100	2,3	6,3	0,3	9,0	2,3	79,7
Poznań	100	2,3	58,2	9,8		29,7	100	6,4	54,2	0,2		1,8	37,4
Szczecin	100	5,5	23,0	19,6		51,9	100	8,3	21,4	0,5		3,1	66,7

Source: Local Data Bank of the Central Statistical Office.

The redirection of funds for the implementation of human capital projects to regional programs resulted in a higher share of contracts financed from provincial programs than in the previous perspective. Some cities have significantly increased the percentage of contracts under RPO. The largest increase in the percentage was recorded in Warsaw, from 13 to 55%, i.e. by 42 percentage points. This fact may be due to Warsaw's function as the capital. An increase above 20 percentage points was also observed in Kielce, Białystok, Łódź, Wrocław, Gorzów Wielkopolski and Katowice. Differences between the financial perspectives are also visible in the analysis of the percentage of contracts concluded under programs that were intended to support the development of Eastern Poland. In the 2014-2020 perspective, in Lublin, Rzeszów and Białystok as well as in Kielce and Olsztyn, the share of contracts under OPEP increased significantly, e.g. in Rzeszów from 1.54 to 30.29%, in Lublin from over 2% to 13.86%, and in Białystok from 2.22% to 11.44%.

Information on the number of submitted applications and co-financing agreements has been supplemented with data on the value of co-financing agreements. Their value was determined as the amount of eligible expenditure of all projects. It is worth mentioning that entities from the surveyed cities implemented projects for a total amount of over PLN 46 billion in the 2007-2013 period. In the next programming period, the amount was over PLN 98 billion, i.e. over 105% higher. In both perspectives, projects worth the highest amount were implemented by entities from Warsaw, and their value - over PLN 18 billion in the period 2014-2020 - accounted for over 18% of the value of projects implemented in large Polish cities.

The value structure of the implemented projects in both perspectives was similar. It is worth noting that the largest financial resources came from the Infrastructure and Environment Operational Program and regional operational programs (Table 4). The OPIE, under which large infrastructure projects were implemented, was less popular (fewer applications for funding were submitted and fewer contracts were signed than in other programs), but at the same time, the projects were of high value. In both analyzed periods, entities from Warsaw are a great example, where the largest part of project financing came from the OPIE, with a small share of funds from regional programs. In the period 2007-2013, Gdańsk was also in a similar situation. When analyzing the structure of project values according to financing tools, what is also normal is the negligible share of project financing from the program intended for the development of "soft skills" - OPHC in the period 2007-2013 and OPKED 2014-2020. In the case of the latter, it did not even exceed 1.5% in any of the cities.

Table 4.

The structure of the value of co-financing agreements in large cities in the 2007-2013 and 2014-2020 perspectives

City	Value of Co-financing Agreements 2015 [%]						Value of Co-financing Agreements 2023 [%]						
	total	OPIE	IEOP	OPHC	OPEP	ROP	total	OPIE	OPSG	OPPC	OPEP	OPKED	ROP
Wrocław	100	53,8	9,9	2,5		33,8	100	28,2	40,0	0,1		0,9	30,8
Bydgoszcz	100	7,6	29,8	7,3		55,3	100	34,3	33,2	0,2		0,9	31,4
Toruń	100	40,2	16,8	5,0		38,0	100	21,8	11,0	0,2		1,2	65,7
Lublin	100	22,6	7,7	4,4	22,3	43,0	100	13,6	23,9	1,0	22,4	1,3	37,9
Gorzów Wlkp.	100	50,0	7,5	5,6		36,9	100	49,7	12,8	0,9		1,0	35,5
Zielona Góra	100	14,8	8,2	9,1		67,9	100	35,8	10,8	0,4		1,3	51,7
Łódź	100	28,4	18,5	15,1		38,1	100	39,3	18,7	0,1		1,6	40,4
Kraków	100	10,9	37,3	5,8		46,0	100	37,5	33,8	0,0		0,8	27,8
Warszawa	100	40,5	37,4	6,5		15,7	100	75,4	12,3	0,0		1,4	10,9
Opole	100	20,5	5,1	4,2		70,2	100	29,6	11,0	0,4		1,2	57,7
Rzeszów	100	13,9	16,0	5,2	18,4	46,5	100	13,5	11,9	0,2	22,8	1,2	50,5
Białystok	100	12,6	11,9	5,7	31,1	38,7	100	9,1	22,2	0,5	31,7	1,3	35,3
Gdańsk	100	76,5	8,5	3,4		11,6	100	59,5	13,9	0,3		0,5	25,8
Katowice	100	28,7	27,1	8,3		35,9	100	40,3	17,1	0,1		1,2	41,4
Kielce	100	23,9	9,9	5,9	24,3	36,0	100	9,4	11,3	1,3	19,9	2,4	55,8
Olsztyn	100	11,4	1,7	6,8	18,7	61,4	100	25,0	7,7	0,2	25,6	0,7	40,8
Poznań	100	23,2	29,6	4,9		42,3	100	27,9	33,6	0,1		0,5	37,7
Szczecin	100	36,4	8,3	7,9		47,4	100	42,9	9,9	0,4		1,1	45,7

Source: Local Data Bank of the Central Statistical Office.

5. Effectiveness of obtaining EU funds in provincial cities

The effectiveness of obtaining EU funds, defined as the quotient of the number of signed financing agreements and the number of submitted applications for financing, is an indicator that allows us to find out what percentage of projects submitted by entities from individual cities were successful. The entities from Opole, Toruń, Lublin and Kielce were characterized by the highest effectiveness in both analyzed periods (Table 5). Comparing both financial

perspectives, it is evident that effectiveness has increased in almost all cities. The exception was Poznań, where a drop in effectiveness was recorded by just over 2 percentage points (from 42.09% to 39.71%). The largest increase in the success rate was observed in Gorzów Wielkopolski - a change of 22 percentage points (from 35.38% to 57.47%), in Białystok – an increase of 17.08 p.p. (from 40.23% to 57.31%) and in Szczecin – an increase of 16.51 p.p. (from 38.13% to 54.64%).

Table 5.

Effectiveness of obtaining EU funds in large cities in the 2007-2013 and 2014-2020 perspectives

City	Effectiveness 2015						Effectiveness 2023						
	total	OPIE	IEOP	OPHC	OPEP	ROP	total	OPIE	OPSG	OPPC	OPEP	OPKED	ROP
Wrocław	36	84	29	22		59	49	68	30	50		50	65
Bydgoszcz	42	72	33	30		56	49	76	35	17		59	66
Toruń	50	73	36	35		70	56	60	31	50		77	76
Lublin	49	82	35	27	94	61	60	76	29	25	47	30	75
Gorzów Wlkp.	35	88	33	25		52	57	75	36	100		48	64
Zielona Góra	40	75	34	26		58	51	83	31	40		79	62
Łódź	40	75	32	26		59	53	73	38	22		46	59
Kraków	35	64	29	26		53	43	69	36	22		40	53
Warszawa	33	79	35	20		37	43	73	30	20		45	60
Opole	50	94	39	28		67	64	67	40	14		65	73
Rzeszów	43	79	35	24	100	72	46	82	27	50	49	33	64
Białystok	40	91	36	29	100	51	57	77	28	50	48	45	67
Gdańsk	33	90	32	23		39	43	93	37	14		30	53
Katowice	38	79	37	23		46	41	87	30	22		35	44
Kielce	46	100	36	28	100	70	55	76	29	60	40	54	62
Olsztyn	42	72	17	25	100	67	52	82	24	133	40	26	60
Poznań	42	73	39	28		59	40	74	35	29		53	45
Szczecin	38	91	29	24		54	55	76	31	50		43	70

Source: Local Data Bank of the Central Statistical Office.

The trend indicating an increase in the effectiveness of entities from large cities in obtaining EU funds for the implementation of projects may indicate that these entities are increasingly better prepared to apply for European funds. Many entities have gained organizational skills and experience in project implementation. There are business environment entities on the market that specialize in advising when applying for EU funds. It is also important to reduce the complexity of the procedures accompanying the process of applying for funding.

Analyzing the effectiveness from the point of view of the tool used to apply for financial resources, it can be noticed that the effectiveness increased when applying for funds from OPKED. In the period 2007-2013, on average every fifth application for funding received funding. However, the effectiveness of obtaining funds from the OPEP decreased. In the period 2007-2013, entities from Rzeszów, Białystok, Kielce and Olsztyn obtained funding for each submitted application. In the 2014-2020 perspective, only half of the projects received financing under OPEP. In the period 2014-2020, the effectiveness of entities from these large cities in applying to OPIE and regional operational programs decreased to a small extent.

The structures of interest in and obtaining funds for EU projects were essentially similar in both perspectives, which was probably influenced by the structure and allocation of EU funds. Nevertheless, there were noticeable differences that are worth mentioning. The most important similarities and differences between the two financial perspectives according to the categories analyzed in the article are included in Table No. 6.

Table 6.

Similarities and differences according to the categories examined in the 2007-2013 and 2014-2020 perspectives

Category	Similarities	Differences
Number of applications for funding	The greatest interest is in OPSG/ICOP and ROP.	Decreased interest in OPKED (compared to OPHC). A slight increase in interest in OPIE. Increasing interest (OPEP, ROP).
Number of contracts		Reducing the share of OPKED (compared to OPHC). Increasing the share of ROP and OPEP.
Value of contracts	A large share of OPIE - with a relatively small number of projects, but of high value. A large share of the ROP. A small share of OPHC/OPKED.	Reducing the share of OPKED compared to OPHC.
Effectiveness		Overall, increasing the effectiveness of fundraising. Increasing the effectiveness of cities in obtaining funds from OPKED (compared to OPHC), and to a small extent from OPIE (compared to EIOP). Decreased effectiveness of obtaining funds from OPEP.

Source: own study.

In the case of OPKED (formerly OPHC), there was a decrease in interest in the program, a decrease in the share in the number of signed contracts, but also a decrease in the value of signed contracts. However, the effectiveness of entities in applying for EU funds has increased. In the case of OPEP, opposite processes could be observed than in the case of the previously described OPHC/OPKED - the effectiveness of applying for financial resources decreased, but at the same time, the interest in the program increased. OPIE and ROP also enjoyed increased interest. In this last category of programs, there was also an increase in the number of signed contracts while their value decreased.

Conclusion

Acquiring resources to maintain and develop operations is one of the key aspects of the organization's operation. The European Union's cohesion policy enables public and private entities to implement projects in various areas under national and regional financial instruments. State and local government authorities at the regional level can conduct development policy by organizing and supervising the allocation of financial resources under individual support

instruments. While maintaining the principle of subsidiarity and the assumptions of public policies based on the concept of place-based policy, the structure of the use of financial resources under operational programs may be changed to optimally support the development of organizations, regions and the entire country. The article aimed to compare the structure and effectiveness of obtaining EU funds for projects implemented in provincial cities from two financial perspectives: 2007-2013 and 2014-2020.

By reading the article you can see that the process of organizing the process of obtaining funds, as well as the allocation of funds in the 2014-2020 financial perspective, took local conditions into account more than in the previous period. The assumptions of the place-based policy concept influenced the increase in available financing under regional instruments already at the stage of planning the division of the financial resources. In both perspectives examined, there were both national and regional operational programs. It should be noted that in the period 2014-2020, the number of national programs changed. The Operational Program Human Capital changed its name to the Operational Program Knowledge Education Development while reducing the target group and the amount of financing. Some activities related to human capital development have been moved to regional programs. The Innovative Economy Operational Program was replaced by the Smart Growth Operational Program and the Digital Poland Operational Program.

When analyzing the structure of obtaining EU funds, the focus was on the following categories: the number of submitted applications for funding, which indicated the entities' interest in obtaining funds, the number of signed funding agreements and their value, which characterized the implemented initiatives, and the effectiveness of entities in obtaining EU funds. The most important similarities between both financial perspectives include the greatest interest in competitions under OPSG, OPIE and ROP, as well as the fact that the most expensive projects were implemented under OPIE. The latter conclusion is not surprising, because this financial instrument was dedicated to large investments in technical infrastructure. In both periods, a relatively small share of soft projects in the structure of the value of contracts was also observed, i.e. under OPHC and OPKED, as well as a relatively high share in the structure of the value of contracts of those projects that were implemented regionally.

Isolating the differences between the perspectives, attention should be paid to the reduced interest, reduction in the number and value of contracts, but at the same time increasing the effectiveness of obtaining funds in the field of soft projects (OPKED). The opposite situation - an increase in the structure of operational programs in the interest and number of contracts and a decrease in effectiveness - was recorded in OPEP. A similar nature of changes in the interest, number and value of contracts was observed in regional programs, but in this case, the effectiveness of obtaining funds increased slightly and remained at a high level. Based on previous observations, it can also be concluded that the reduction in the allocation of financial resources under operational programs resulted in a reduction in the number of potential beneficiaries, a reduction in the group of interested entities, a reduction in the number and value

of contracts, but improved the effectiveness of applying for EU funds. However, maintaining a similar amount allocated to the operational program and the group of potential beneficiaries (as was the case in OPEP) increased interest and increased the share in the structure of signed contracts, but resulted in a reduction in the effectiveness of entities.

The conclusions drawn from the analysis are as follows. Purposeful relocation of financial resources based on observations from previous periods, dictated by the records of regional demand analyses, improved the effectiveness of applying for funding both when the pool of available funds decreased (OPKED) and increased (ROP). The effectiveness of obtaining funds for EU projects was probably influenced by the experience of entities from earlier perspectives, the simplification of procedures for submitting applications for funding and the general increase in knowledge about the possibilities of obtaining external financing under the broadly understood cohesion policy in the European Union. The presented issue does not exhaust the topic but only signals the need for further consideration. Particularly interesting may seem to be issues related to observing the effectiveness of entities in obtaining financial resources under the current financial perspective or institutional solutions that are intended to direct financial support to entities operating within specific fields and in specific areas.

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ANALYSIS OF THE EMPLOYEE SENTIMENT AS THE TOOL TO BUILD POSITIVE WORKING ENVIRONMENT

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Purpose: The purpose of this paper is to identify the possibilities to use Employment Sentiment Analysis (ESA) to build positive working environment.

Design/methodology/approach: The paper is an attempt to identify the awareness of managers and specialists in big companies about the possibility to use ESA and Employee Sentiment Analysis Tools (ESAT). The answers to the research questions were helpful to meet the paper objectives. The data from own empirical research conducted with the use of CAWI (Computer-Assisted Web Interview) were used in the research. The analysis of available source materials – scientific papers, Internet platforms with the inbuilt AI tools to ESA was performed in the paper.

Findings: The analyses presented in the paper show that the awareness level of managers and specialists in big companies about the existence of ESAT is rather low. The younger the generation the more they notice the positive influence of using ESAT by employers on their engagement as well as they declare the readiness to take up work in an organization which uses such tools. Nevertheless, the condition is that the employers inform workers about using ESAT. Fears referring to the data privacy and security arising from using ESAT depend on the respondents' belonging to the specific generation. The younger the generation, the lower the fears are.

Research limitations/implications: Examining the level of awareness of managers and specialists in big companies about the existence of ESAT is the introduction to research connected with building positive working environment. The authors claim that further research should be focused on using other modern information technologies – among others Internet platforms with built-in AI tools shaping employees' well-being.

Practical implications: In the business culture oriented on the employee's well-being ESA makes it possible to track employees' emotions, moods and reviews about a given subject. Thanks to ESA, the employers may identify positive, negative or neutral employees' attitude, which makes it possible to react to the potential problems quickly and to improve working conditions.

Originality/value: The results of the conducted survey research should be regarded as an attempt to present a new opinion in the scientific discussion about the possibility to use ESA and ESAT. As this issue is widely recognized in the subject literature, the issue of identification

the awareness of managers and specialists in big companies about the possibility to use ESAT is recognized weakly.

Keywords: Employee sentiment analysis (ESA), employee sentiment analysis tools (ESAT), working environment.

Category of the paper: research paper.

1. Introduction

In the era of widely-spread digitalization and access to the Internet the number of data generated and shared in a digital form is increasing exponentially. The number of generated data was about 19% higher for the last three consecutive years (2020-2023) than all the data from before 2020 (Raghunathan, Kandasamy, 2023). The phenomenon of expressing and sharing opinions, comments to the entries in the Internet blogs and posts in social media is common. The effective use of social data in the context of competition causes the dynamic development of multidisciplinary approach such as sentiment analysis. This approach covers psychology, sociology, management and economics as well as natural language processing and machine learning (Ligthart et al., 2021).

This paper is an attempt to analyse the awareness of managers and specialists in big companies concerning the possibilities to use employee sentiment analysis and information tools supporting the performance of such an analysis¹. It was planned to conduct the survey research the purpose of which is to identify the opinions of managers and specialists in big companies concerning their attitude to possible use of employee sentiment analysis tools (ESAT) by their employers. The trial to answer the following research questions may be helpful to meet the paper objective:

- RQ1. In which rate are managers and specialists in big companies aware of the existence of employee sentiment analysis tools and how does this awareness affect their approach to the potential use of these tools by their employers?
- RQ2. How does the perception of managers and specialists in big companies concerning the impact of employee sentiment analysis tools on the working environment influence their readiness to take up work in the organization which uses such tools?
- RQ3. In which rate do the fears regarding the data privacy and security affect the acceptance of managers and specialists in big companies to use employee sentiment analysis tools by employers?

The exploration of the above research questions will enable to identify the possibilities to use sentiment analysing to build the positive working environment.

¹ The dynamic development of this research area has started since 2004, presented in a significant increase in scientific papers in the field of sentiment analysis and opinion exploration (Birjali et al., 2021).

2. Sentiment analysis and employee sentiment analysis tools

Sentiment analysis² is the set of activities consisting in detecting the review polarity qualified as phrases which present positive, negative or neutral emotions (Baj-Rogowska, 2019). As for sentiment analysis³ and monitoring employees' moods, HR departments use various Internet platforms with built-in AI tools which analyse internal communication (e.g. e-mails or messages on the communication platforms) concerning their sentiment to identify the changes in employees' moods and early signals of potential problems connected with well-being. The sentiment analysis in the assessment of employees' well-being allows to recognize and classify emotions expressed in the communications connected with the workplace automatically, which facilitates the comprehension of the general mood among employees. Thanks to such solutions, the employers may identify positive, negative or neutral employees' attitude, which enables to react on potential problems quickly and to improve working conditions⁴. The examples of such Internet platforms with AI tools are presented in Table 1.

Table 1.

Examples of Internet platforms with the built-in AI tools for employee sentiment analysis

	Name of the Internet platform with built-in AI tools	Characteristics
1.	Culture Amp ⁵	<ul style="list-style-type: none"> – Enables the performance of employees' surveys with the advanced sentiment analysis, allowing the organisations to understand what their employees really feel. – Uses AI algorithms to analyse open responses in surveys, identifying employees' moods.
2.	Microsoft Viva Glint ⁶	<ul style="list-style-type: none"> – Uses the advanced analytics and AI to analyse the feedback from employees helping the organisations to improve employees' wellbeing. – Analyses employee sentiment in the real time, enabling to identify and solve problems quickly.

² In the literature the terms sentiment analysis or opinion mining appeared in the beginning of 21st century in the works of Nasukawa, Yi (2003); Pang, Lee, Vaithyanathan (2002) in the context of identifying the subjective polarity together with determining the strength of such polarity (strong, weak) of a given text which was the opinion of its author. Sentiment analysis is based on the methods and tools of Natural Language Processing (NLP), computational linguistics, big data and text mining and is part of business analyses and machine learning (Chaturvedi et al., 2018).

³ Sentiment analysis may be performed on three consecutive levels and namely: document, sentence, aspect (Dhanalakshmi, Sri Devi, 2020; Ligthart et al., 2021). Whereas the classification of sentiment is done with the use of such approaches as: machine learning (supervised learning methods and unsupervised learning methods); word methods, hybrid methods (Yusof et al., 2015, Al-Qablan et al., 2023).

⁴ The efficient analysis of reviews, moods, attitudes, notifications concerning selected area of company operating (products, services, processes) requires to include the existence of sarcasm, spelling mistakes, idiomatic expressions, abbreviations, which constitutes a big challenge in the area of affective computing and emotion recognitions (emotion recognition) (Valdivia et al., 2018).

⁵ <https://www.cultureamp.com/>

⁶ <https://www.microsoft.com/en-us/microsoft-viva/glint?ocid=cmmort1cgin>

Cont. table 1.

3.	Lattice ⁷	<ul style="list-style-type: none"> – Enables to conduct surveys referring to employees' engagement and efficiency which cover sentiment analysis. – Allows the HR managers to monitor changes in the employees' moods and fast reaction to possible problems. AI is used to analyse the survey data.
4.	Officevibe ⁸	<ul style="list-style-type: none"> – Specialises in gathering feedback from employees with the use of short, weekly surveys. – Uses sentiment analysis based on AI to help managers understand how the employees feel at work, showing potential problems with wellbeing.
5.	TINYpulse ⁹	<ul style="list-style-type: none"> – Enables the organisations to conduct anonymous work surveys and gather feedback. – Uses AI to analyse data, identify trends in employees' moods and to give insight into potential areas of dissatisfaction.

Source: own study.

The requirements, which sustainable human resources management faces concerning effective use of big data, social data, contribute to the increased interest in practical use of sentiment analysis to understand the emotional state which business employee experience in a better way (Raghunathan, Kandasamy, 2023).

3. Research method

The research was conducted with the use of CAWI method (Computer-Assisted Web Interview) in the period January 2024 – April 2024. The survey questionnaire was sent to big Polish companies situated in the Lodz and Silesia Provinces. The return from 117 companies was received in response. The research was voluntary and it is assumed to be a pilot observation. The respondents representing managers and specialists of big companies from two main sectors of economy: industry and services (with the exclusion of financial companies) participated in the research.

The suggested survey questionnaire consisted of 6 questions – 2 single-choice questions and 4 questions to which the even 4-grade Likert scale (without neutral option) was used. The even scale was chosen to encourage the respondents to take a more decisive approach, eliminating the possibility to select the “safe” middle response which does not present a clear opinion. The questions in the survey questionnaire were preceded with the definitions of employee sentiment analysis (ESA) and employee sentiment analysis tools (ESAT). They were as follows:

⁷ <https://lattice.com/>

⁸ <https://www.officevibe.com/>

⁹ <https://www.tinypulse.com/>

- ESA – is a process using the techniques of natural language processing (NLP), statistics and algorithms of machine learning to identify, analyse and interpret emotions, opinions and attitudes expressed by employees. It is aimed to understand the general atmosphere among employees, to identify the areas on which the attention should be paid and to monitor the changes in perceiving various work and organizational environment aspects. This analysis may refer to both unstructured text data such as employees' opinions gathered by surveys, emails, social media as well as more structured forms of feedback.
- ESAT – means software or Internet platforms using advanced technologies including Artificial Intelligence (AI) and Natural Language Processing (NLP) to automate the process of employee sentiment analysis. Taking advantage of the deep machine learning algorithms, the software classifies the gathered data to the emotional categories such as positive, neutral or negative sentiments. It may also identify more complex emotions such as satisfaction, frustration, joy or sadness as well as assess the intensiveness of these emotions. These tools allow to process big amounts of data in an effective way in order to get important information concerning employees' moods, emotions and opinions. They enable organisations to identify trends, problems and possibilities in a fast way to improve employees' engagement, satisfaction and general wellbeing. These tools may offer such functions as: engagement surveys, feedback analysis, management dashboards with data visualization and recommendations of actions.

4. Employee sentiment analysis in the light of empirical research results

In the research sample 57.5% of respondents (65 persons) represented the companies of the industry and 42.5% (48 persons) came from the service sector (non-financial service companies). Whereas, when it comes to the age, it was noticed that the representants of three generations participated in the research. Their relation was as follows: 36.6% generation X (41) persons, 50.4% generation Y (57 persons) and 13.3% generation Z (15 persons) (Figure 1). This paper presents the analysis of the respondents' answers concerning their belonging to generations X, Y and Z. Whereas, the analysis of the research results concerning the economic sectors (industry and non-financial services) will be continued, as the authors intend, within further research connected with the use of information tools to ESA.

The first question of the survey was to identify the respondents' awareness about the existence of the employee sentiment analysis tools in the market. The received data were presented in Table 2. Unfortunately, it turned out that while analysing the percentage number of indications, the answer to the question "Have you ever met the issue of using employee sentiment analysing tools?" was "No. I have also never met with the issue of employee sentiment analysis" the most often (40.7% of all respondents). However, the second most often

selected response – “Yes, but I have only heard about them and I do not know examples of such tools” should be assessed positively.

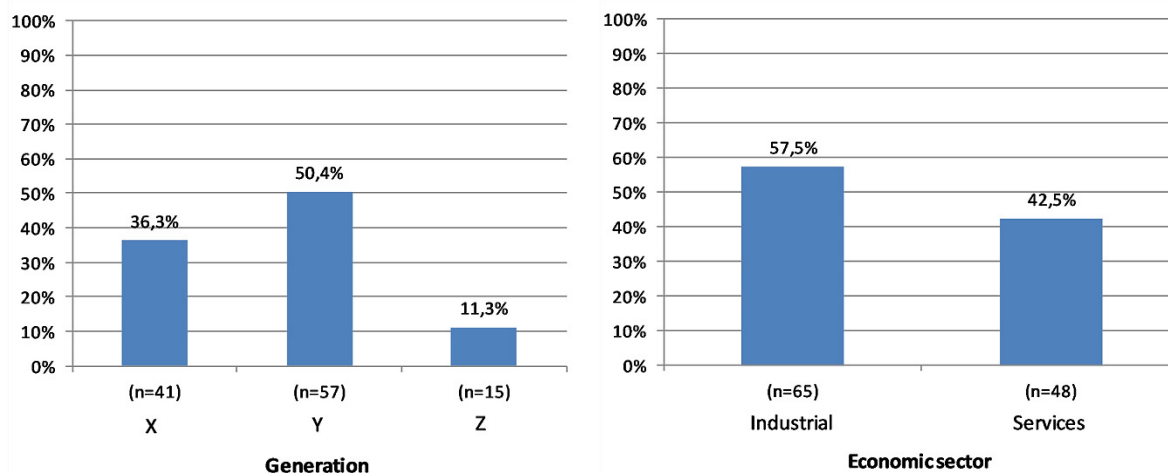


Figure 1. Characteristics of the research group – from the left: division according to the generation, division according to the economic sector.

Source: own study.

Thus, it turns out that 37.2% of all respondents heard about the ESA. Nevertheless, this group of respondents does not know the examples of employee sentiment analysis tools.

Table 2.

Awareness of the existence of employee sentiment analysis tools

Have you ever met the issue of using the employee sentiment analysing tools?	Generation (number of indications)			Total (number of indications %)
	X (n=41)	Y (n=57)	Z (n=15)	
Yes. I also know the examples of such tools.	-	5	-	4,4
Yes, but I have only heard about them and I do not know examples of such tools.	21	16	5	37,2
No, but I know the issue of the employee sentiment analysis.	15	5	-	17,7
No. I have also not met the issue of the employee sentiment analysis.	5	31	10	40,7

Source: own study.

In the next questions the respondents were asked to present their opinion concerning the following statement “I think that using the employee sentiment analysis tools by employers is beneficial to build good psycho-social working conditions” (Figure 2). The 4-grade Likert scale in the range from 1 (‘I strongly disagree’) to 4 (‘I strongly agree’) was used in the question. The response “I rather agree” was selected the most often – 51% of respondents from X generation, 63% of respondents from Y generation and 67% of respondents from Z generation, respectively. Analysing this response, the tendency may be noticed that the younger the generation, the stronger the opinion about the beneficial influence of using the employee sentiment analysis tools by employers on building the good psycho-social working conditions.

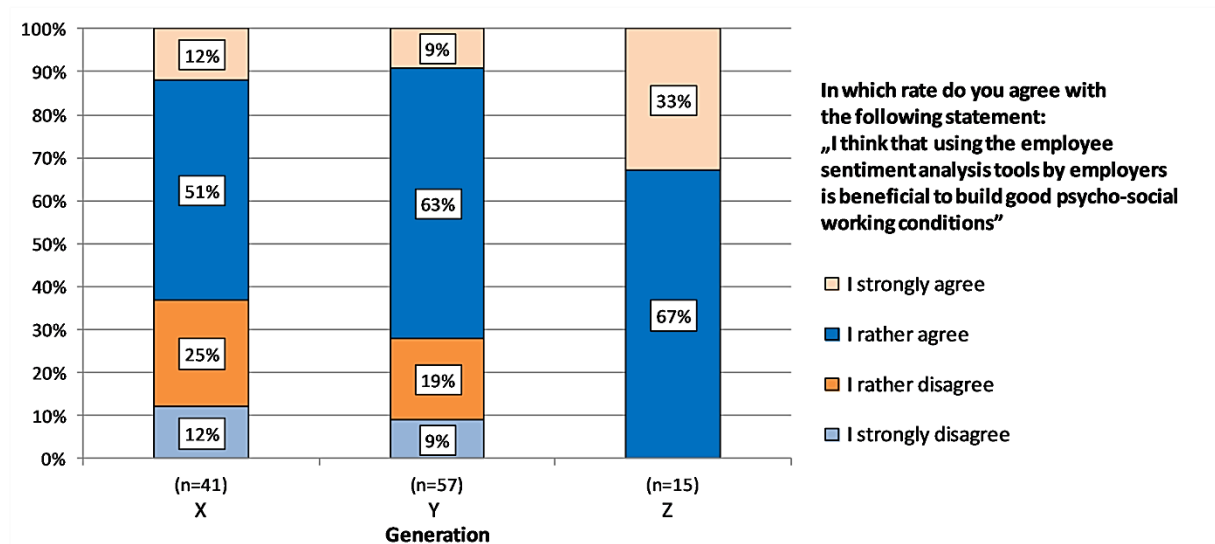


Figure 2. General approach to “Employee Sentiment Analysis Tools”.

Source: own study.

Referring to the formulated research question RQ1, it is possible to state that the awareness level of managers and specialists in big companies about the existence of information tools to employee sentiment analysis is rather low. However, their attitude to the potential use of these tools by their employers should be assessed as positive, accepting their use.

The next questions regarded the existence of possible respondents’ fears connected with the privacy and data security in the context of potential use of employee sentiment analysis tools by the employer. The question was as follows: “In which rate would you have fears connected with your data privacy and security if your employer used the employee sentiment analysis tools?” Possible responses: “No fears”, “Slight fears”, “Some fears” and “Great fears”. As many as 67% of respondents from Z generation selected the response “No fears”. The respondents from generations X and Y selected the answer “Some fears” the most often – 51% for generation X and 54% for generation Y, respectively. The fact should be emphasized that the respondents representing generation Z gave only extreme responses – “No fears” and “Great fears”. Moreover, the response “Great fears” constituted the biggest percentage of indications among generations X, Y and Z – 33% for Z generation, 25% for X generation and 9% for Y generation.

Whereas, referring to the research question RQ3, fears regarding data privacy and security arising from the use of employee sentiment analysis tools depend on the respondents’ belonging to the particular generation. The younger the generation, the lower the declared fears are.

The fourth question referred to the opinion of tested managers and specialists to the statement: “Using the employee sentiment analysis tools by employers affects the employees’ engagement in a positive way” (Figure 3).

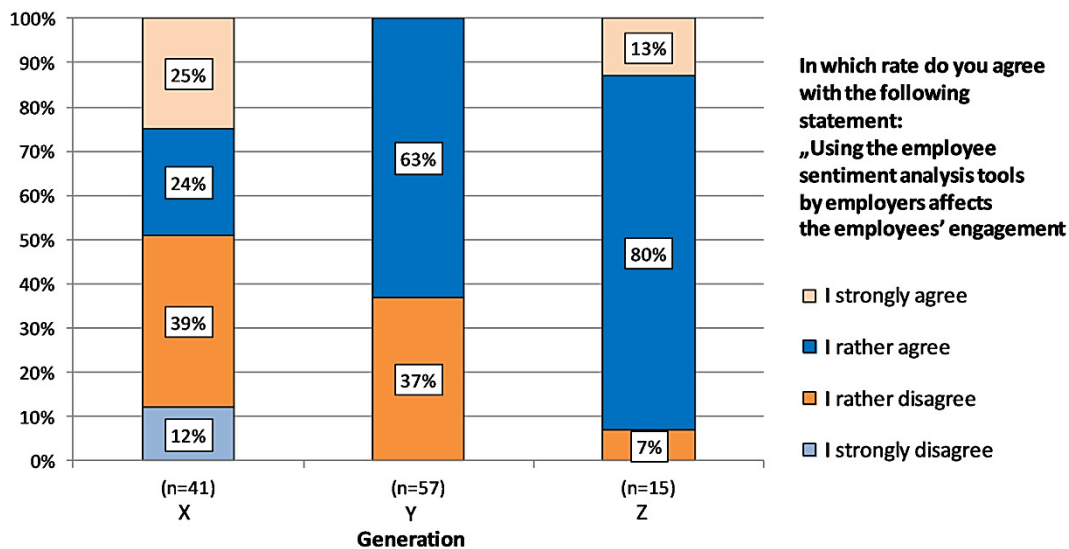


Figure 3. Influence on the employees' engagement.

Source: own study.

The 4-grade Likert scale in the range from 1 ('I strongly disagree') to 4 ('I strongly agree') was used in the question. The response "I rather disagree" was selected the most often among the respondents from X generation (39%), "I rather disagree" – generation Y (63%) and "I rather agree" – generation Z at the level of 80%. Summing up the indications "I strongly agree" and "I rather agree" in the particular generations, it can be noticed that the younger the generation, the more they agree with the statement presented in the survey.

The respondents were also asked to present their opinion about the following statement: "I accept the possibility of giving feedback (e.g. from the employees' surveys, notes from interviews, internal emails, social media) to the employer with the use of the employee sentiment analysis tools". The 4-grade Likert scale in the range from 1 ('I strongly disagree') to 4 ('I strongly agree') was also used in the question. The most often indicated response by the respondents from generation Y and Z was "I rather agree" – 63% and 67%, respectively. Whereas, the respondents belonging to generation X indicated the answer "I strongly disagree" the most often (Figure 4).

In the last, sixth question, the respondents were to express their opinion concerning the question: In which rate do you agree with the following statement: "I think that the employers should inform employees about using the employee sentiment analysis tools". The possible answers were: "I strongly agree", "I rather agree", "I rather disagree" and "I strongly disagree". The managers and specialists of big companies representing the particular generations had the same opinion. The most often indicated response was "I strongly agree" (generation X – 63%, generation Y – 83% and generation Z – 66%) and "I rather agree" (generation Z – 25%, generation Y – 17% and generation X – 33%).

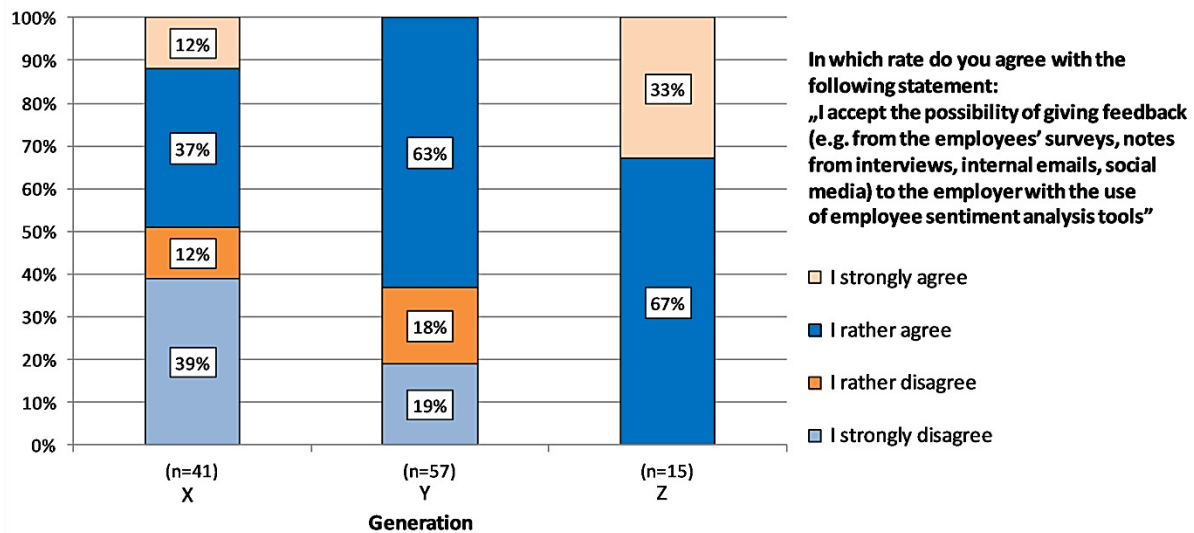


Figure 4. Openness on feedback and communication.

Source: own study.

Referring to the formulated research question RQ2, it turns out that the younger the generation, the more they see the positive influence of the use of employee sentiment analysis tools by employers on their engagement as well as they declare the readiness to take up work in the organisation which uses such tools. However, there is a condition that the employers inform their employees about using sentiment analysis tools.

The results of the conducted survey research presented above should be treated as an attempt to take new voice in the scientific discussion about the possibility to use employee sentiment analysis and employee sentiment analysis tools. As this subject is widely recognised in the literature, the issue of the awareness identification of managers and specialists in big companies concerning the possibilities of the sentiment analysis tools use is recognised poorly.

Maximising the wellbeing of employees in modern companies constitutes the priority of good practices of the sustainable human resources management. The organisations are obliged to possess the set of current information and data from internal interested parties about the employees' experience in their professional lives to shape friendly conditions of the working environment in a proper way. Work satisfaction and the employee's effort in the work process may cause positive feeling of satisfaction or be a source of disappointment (negative emotions). High level of employees' satisfaction contributes to the growth of motivation, performance and wellbeing, whereas dissatisfaction leads to the growth of the level of rotation and disturbances in the company functioning (Wijngaards, 2020).

By matching review data concerning the influence of employee sentiment analysis with firm level financial data, the analyses find that an 1% increase in positive ratings increases market value by approximately 0.68-0.73% and the company revenue by about 0.62-1.01%. It confirms the enormous meaning which has the employee sentiment analysis which in consequence contributes to the financial results in the real world (Feng, 2023).

ESA provides HR departments¹⁰ with incredibly useful and current information about the employee feelings about the company, examining how they communicate in their workplace (Dhanalakshmi, Sri Devi, 2020).

ESA provides the insight into positive and negative emotions, feelings thus into employee attitudes and approaches concerning the human resources policy, organisational culture, conditions of the working environment (Costa, Veloso, 2015). It contributes to the level of work satisfaction (Putra et al., 2023) of this group of interested parties and their loyalty towards the employer, determines the level of staff rotation (Dhanalaski, Seri Devi, 2023) or unwanted rate of human resources shortage (Xie, 2022), which in consequence indicates the level of future company profits (Moniz, Jong, 2014). Measuring the employee experience, the organisations may react to the needs, expectations or fears of employees proactively by tracking and detecting positive or negative trends in sentiments among the staff (Ramendran et al., 2024). According to Saxena et al. (2023), the general sentiment results and general productivity results are correlated positively, which means that the employee having a positive attitude to the work process is at the same time the more productive employee.

5. Conclusion

The key factor of firm competitive advantage is becoming the implemented modern IT and AI technologies which stimulate and positively influence on the increase in competences of firm human resources. The proper assessment of expectations, preferences, reviews as well as sentiments of organization participants is significant for the efficient management of employee life cycle starting from the recruitment and selection process to keeping the employee with high morale and career and achievement management.

Providing each employee with the work satisfaction and high level of wellbeing in an organization, which promotes supporting environment of cooperation, oriented on productivity is a challenge included in the objectives of sustainable human resource management.

ESA may help the organization determine their strengths and weaknesses presenting at the same time the ranking of so-called employer's brand value. It can also help the candidates looking for a job to optimize decisions by providing the information if the jobs offered at the

¹⁰ The example of the use of employee feedback sentiment analysis system which gathers and processes employee opinion from the websites is Glasdoor.com, Indeed.com that builds the picture of employee attitude and moods – providing monthly report to the HR workers. It includes the total number of positive or negative comments informing about the assessment of the level of remuneration, opinions, referring to the pressure phenomenon in the work process, work life balance, promotion prospects, work culture. The companies may then use this knowledge to reflect and understand social moods of various employee groups in a better way concerning the company brand, possessing the full awareness of requirements and preferences of work process participants. Such knowledge may be useful for both solving particular problems and introducing repair actions at the operational level as well as for introducing changes in the whole organization (Dhanalakshmi, Sri Devi, 2020).

labour market correspond to the future employees' expectations and possibilities (Dina, Juniarta 2020).

Examining the awareness level of managers and specialist in big companies about the existence of ESAT is a preliminary stage of research connected with building positive working environment. The authors think that further research should focus on the use of other modern information technologies – among others Internet platforms with built-in AI tools shaping employees' wellbeing.

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LONG-TERM SOLVENCY AND SUSTAINABLE DEVELOPMENT OF LOGISTICS SECTOR – EVIDENCE FROM POLAND

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Purpose: The paper's primary goal is to assess the impact of long-term solvency on the logistics sector's sustainable development in Poland from 2008 to 2022.

Design/methodology/approach: To verify the research hypothesis, we created the synthetic indicators of sustainable logistics development and developed models using the Classical Least Squares Method (OLS), Vector Autoregression (VAR) and Seemingly Unrelated Regression (SUR).

Findings: The research results show that compliance with the golden financial rule is statistically significant for the sustainable development of the logistics sector. Moreover, it has a direct impact on the economic and social pillars.

Research limitations/implications: The selection of indicators for the research sample and the estimation methods limit the analysis.

Practical implications: Maintaining an appropriate financing structure for logistics sector companies is crucial, and ensuring compliance with the golden financial rule is important for the sustainable development of companies.

Social implications: The research results are important from the point of view of the development of the logistics sector in the social and ecological aspects, and reducing the sector's emissions should lead to improved conditions and quality of life for communities.

Originality/value: The paper's novelty is determining the impact of the golden rule of financing on the sustainable development of logistics.

Keywords: financial analysis, long-term solvency, sustainable development, logistics sector.

Category of the paper: research paper.

1. Introduction

Sustainable development is determined by improving the current generation's quality of life without losing future generations' ability to function freely and well. It requires the involvement of states, state entities, organizations and institutions, enterprises and ordinary people.

It is especially important to engage in green and social activities of enterprises. Companies are extremely important for economic growth, employment rates, and improving the quality of life of citizens and on the other hand, they are one of the main entities that cause pollution of the natural environment through their activities.

Logistics, recognized as a pivotal driver of economic development, has emerged as a dynamic force propelling the rapid growth of both national and regional economies (An et al., 2024; Mačiulis et al., 2009). At the same time, the future of logistics companies and their capacities (development opportunities) faces major economic, social and environmental challenges (Verma, 2024).

The logistics industry's current main task is to develop green logistics and adhere to the main energy-saving principles, emission reduction, green environmental protection, and efficiency improvement. Logistics companies should be oriented towards the protection of resources and care for the environment (Klimecka-Tatar, Ingaldi, 2021; Huang, Wang, 2022).

To achieve these goals, logistics companies should invest in fixed assets while managing their financial condition, including long-term solvency. In assessing this area, the golden balance sheet rule is useful. This rule presents recommendations for managing balance and stability in the financing of the enterprise (Nosková et al., 2022). These issues are important because there is a relationship between companies' sustainable behaviour and their financial performance (Martinez-Ferrero, Frias-Aceituno, 2013).

The article's main aim is to assess the impact of long-term solvency on the sustainable development of logistics enterprises (SD, section H of PKD 2007) in Poland from 2008 to 2022. We have chosen a section important for shaping GDP, stable development of society and other economic sectors.

The paper's novelty is treating long-term solvency (LTS) as one of the determinants of sustainable development. The golden balance sheet rule, which indicates that fixed assets should be financed entirely with fixed capital, limits the probability of a company losing financial liquidity and reduces its financial risk.

The research data was taken from the Central Statistical Office Database. They are annual. The central research hypothesis is as follows: Long-term solvency positively impacts the sustainable development of logistics enterprises in Poland from 2008 to 2022. To verify the research hypothesis, the Ordinary Least Square Method (OLS), the Vector Regression Analysis (VAR) and the Seemingly Unrelated Regression (SUR) were used.

2. Theoretical background

The rapid development of industry, urbanization and globalization have led to several changes in socio-economic life and have hurt the condition of the natural environment (Kichigin

et al., 2023). Significant environmental degradation and climate change have become challenging and require taking steps and initiatives to protect the natural environment (Roseland, 2000; Peng et al., 2020).

In economic theory and practice, various concepts have arisen related to the functioning and development of enterprises and their impact on the external environment. The most popular ideas are sustainable development (Teng et al., 2021; Misztal et al., 2024), corporate social responsibility (Aguinis et al., 2024), ecological and social responsibility (Chatterji, 2024), or eco-development (Asumah et al., 2024).

Sustainable enterprise development means the actions undertaken by enterprises in the economic, social and environmental spheres (Zuzek, Mickiewicz, 2014; Comporek et al., 2022). In the most straightforward sense, it means development that enables the development of the present generation without wasting opportunities and conditions for future generations (Matinaro et al., 2019).

Another approach shows that sustainable development of enterprises is a development that provides good conditions for current and does not exclude the interests of future stakeholders of the enterprise (Lorenc, Kustra, 2021).

Business practice is about making profits, sharing them, taking care of the development of local communities, and implementing environmentally friendly technologies. The goal is to create sustainable business strategies and a holistic approach to business in a changing and complex environment (Kaletnik, Lutkovska, 2020) (Figure 1).

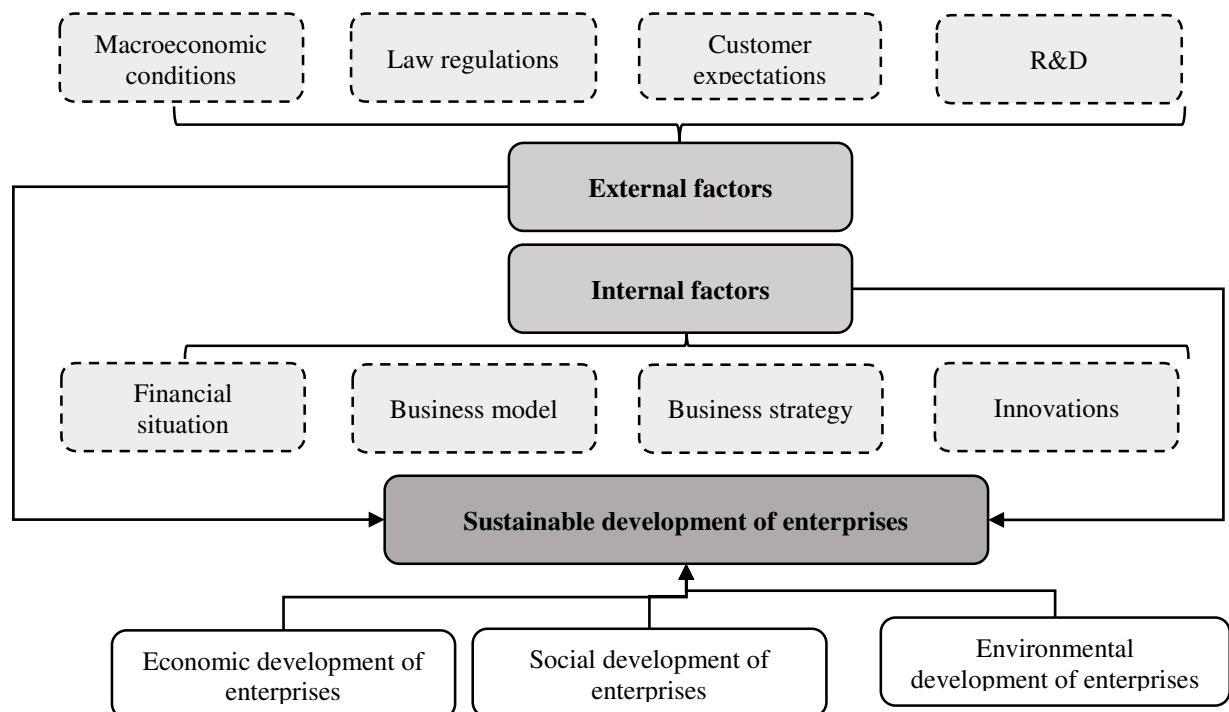


Figure 1. Determinants of enterprises sustainable development.

Source: own elaboration.

The effectiveness of implementing the goals and tasks of sustainable development requires the involvement of various institutions and organizations, including enterprises, which have significantly and negatively contributed to negative climate changes (Misztal, 2018).

External and internal factors determine the sustainable development of enterprises (Stoenoiu, Jäntschi, 2024). The first group includes issues related to economic development, scientific research development, economies' innovativeness, and regulations in employee rights and environmental protection. The second group includes issues related to the adopted business model and strategy, assets, financial and property situation, management style, and knowledge (Middermann et al., 2020; Diallo et al., 2024).

One of the factors important for sustainable development is a good financial situation. An important issue is the high level of permanent capital (Zhou et al., 2022). The financial golden rule index is the constant capital and fixed assets quotient. Fixed capital is a stable, long-term source of financing the company's operations. The value of constant capital includes the enterprise's capital and foreign capital at its long-term disposal. The constant capital use ratio is often called the ratio checking the fulfilment of the golden financial rule, a milder version of the golden balance sheet rule. The golden financial rule states that the company's fixed assets should be financed with stable sources of financing in the form of permanent capital, which is the sum of the company's equity and long-term external capital (Soda, Al-Shyyab, 2024; van den Hurk, 2024).

The golden financial rule is important because it allows for appropriate liquidity risk management and increases financial stability and cost efficiency.

3. Research methodology

The research's primary aim is to assess the impact of long-term solvency on the logistics sector's sustainable development in Poland from 2008 to 2022. The data for the analysis come from the resources of the Central Statistical Office. They are annual. The research sample includes logistics companies registered in Poland (Section H: Transportation and Storage).

The central research hypothesis is as follows: Long-term solvency positively impacts the sustainable development of logistics enterprises in Poland from 2008 to 2022.

In addition, we asked the following research questions:

- What is the dynamics of sustainable development of the logistics sector in Poland?
- What is the long-term solvency of the logistics sector in Poland?
- Does long-term solvency have a statistically significant impact on the pillars of sustainable development?

We conducted our research in stages. First, we form the indicator of sustainable development of logistics sector (SD). We use the formula:

$$SD_i = \frac{1}{n} \sum_{j=1}^n E_i + \frac{1}{n} \sum_{j=1}^n S_i + \frac{1}{n} \sum_{j=1}^n Env_i ; (i = 1, 2, \dots, n) \tag{1}$$

where:

SD_i stands for the synthetic indicator in the *i*-year;

n is the number of metrics;

E_u – economic development in the *i*-year;

S_i – social development in the *i*-year;

Env_i – environmental development in the *i*-year.

Then, we transform the explanatory variables to unify their measuring scales using the following formulas:

- for the stimulants:

$$z_{ij} = \frac{x_{ij} - \min_i\{x_{ij}\}}{\max_i\{x_{ij}\} - \min_i\{x_{ij}\}}, z_{ij} \in [0; 1]; \tag{2}$$

- for the destimulants:

$$z_{ij} = \frac{\max_i\{x_{ij}\} - x_{ij}}{\max_i\{x_{ij}\} - \min_i\{x_{ij}\}}, z_{ij} \in [0; 1]. \tag{3}$$

where:

z_{ij} stands for the normalized value of the *j*-th variable in the *i*-th year;

x_{ij} is the value of the *j*-th variable in the *i*-th year;

$\min_i\{x_{ij}\}$ is the lowest value of the *j*-th variable in the *i*-th year;

$\max_i\{x_{ij}\}$ is the highest value of the *j*-th variable in the *i*-th year.

Evaluating the relationship between the SD and LTS required using certain simplifying assumptions and developing proprietary indicators. We normalised the SD and its pillars (E, S, Env) based on diagnostic variables divided into stimulants and destimulants (Table 1).

Table 1.

Diagnostic variables used in the SD and its pillars (E, S, Env)

Pillars of SD	Diagnostic variable	Description of the variable	Stimulants	Destimulants
Economic development (E)	x1	Total number of companies in a country	+	
	x2	Turnover or gross premiums [million euro]	+	
	x3	Production value [million euro]	+	
	x4	Value added at factor cost [million euro]	+	
	x5	Gross operating surplus [million euro]	+	
	x6	Total purchases of goods and services [million euro]	+	
	x7	Gross investment in tangible goods [million euro]	+	
	x8	Investment rate (investment/value added at factors cost) [%]	+	
	x9	Share of personnel costs in production [%]		+
	x10	Average personnel costs [thousand euro]		+

Cont. table 1.

Social development (S)	X11	Wages and Salaries [million euro]	+	
	X12	Social security costs [million euro]	+	
	X13	Total number of employees in a country	+	
	X14	Turnover per person employed [thousand euro]	+	
	X15	Apparent labour productivity [thousand euro]	+	
	X16	Gross value added per employee [thousand euro]	+	
	X17	Growth rate of employment [%]	+	
	X18	Number of persons employed per enterprise	+	
	X19	Investment per person employed [thousands euro]	+	
	X20	Personnel costs [million euro]		+
Environmental development (Env)	X21	Carbon dioxide emission [tons]		+
	X22	Methane emission [tons]		+
	X23	Nitrous oxide emission [tons]		+
	X24	Sulphur oxides emission [tons]		+
	X25	Ammonia emission [tons]		+
	X26	Carbon monoxide emission [tons]		+
	X27	Nitrogen oxides emission [tons]		+
	X28	Generation of total waste [tons]		+

Source: own study on the basis of Eurostat [<https://ec.europa.eu/Eurostat>], 16.08.2024.

In the next step, we use the OLS method to assess the impact of long-term solvency (LTS) on the SD (4):

$$SD_i = \beta_0 + \beta_1 LTS_i + \varepsilon_i; \quad LTS = \text{fixed capital} / \text{fixed assets} \quad (4)$$

where:

β_0 is the intercept;

β_1 is the slope;

ε_i denotes the i -th residual;

I is an observation index.

The estimated models are given by the equations:

$$SD = \hat{\beta}_0 + \hat{\beta}_1 LTS_i + e_i = \widehat{SD}_i + e_i \quad (5)$$

so the residual for each observation is as follows:

$$e_i = SD_i - \widehat{SD}_i = SD_i - (\hat{\beta}_0 + \hat{\beta}_1 LTS_i) \quad (6)$$

The OLS procedure minimizes the sum of squared residuals:

$$s(\hat{\beta}_0, \hat{\beta}_1) = \sum_{i=1}^n e_i^2 = \sum_{i=1}^n (SD_i - \widehat{SD}_i)^2 = \sum_{i=1}^n (SD_i - \hat{\beta}_0 - \hat{\beta}_1 LTS_i)^2 \rightarrow \min \quad (7)$$

To assess the impact of LTS on the E, S and Env pillars we built three structural equations based on the following formulas:

$$\begin{aligned} E_i &= \alpha_0 + \alpha_1 LTS_i + \alpha_3 S_i + \alpha_4 Env_i + \varepsilon_i \\ S_i &= \alpha_0 + \alpha_1 LTS_i + \alpha_3 E_i + \alpha_4 Env_i + \varepsilon_i \\ Env_i &= \alpha_0 + \alpha_1 LTS_i + \alpha_3 E_i + \alpha_4 S_i + \varepsilon_i \end{aligned} \quad (8)$$

We use feasible generalized least squares (FGLS) to estimate the SUR model. The residuals from our regression are used to estimate the elements of matrix:

$$\hat{\sigma}_{ij} = \frac{1}{R} \hat{\varepsilon}_i^T \hat{\varepsilon}_j \quad (9)$$

Then, we run generalized least squares regression for using the variance matrix:

$$\Omega \equiv E[(\varepsilon\varepsilon^T|X)] = \sum \Omega \otimes I_R \tag{10}$$

$$\hat{\beta} = (X^T(\hat{\Sigma}^{-1} \otimes I_R)X)^{-1} X^T(\hat{\Sigma}^{-1} \otimes I_R)y$$

The formula for the SUR estimator is as follows:

$$\sqrt{R}(\hat{\beta} - \beta) \xrightarrow{d} N(0, (\frac{1}{R}X^T(\Sigma^{-1} \otimes I_R)X)^{-1}) \tag{11}$$

To verify the autoregression of the SD we use the VAR model:

$$SD_t = c + A_1SD_{t-1} + \varepsilon_t \tag{12}$$

where:

SD_{t-i} indicate that variable's value i time periods earlier and are called the "i-th lag" of y_t ;
 c is a k -vector of constants serving as the intercept of the model;
 A_i is a time-invariant ($k \times k$)-matrix and ε_t is a k -vector of error terms.

4. Research results

Table 2 presents the sustainable development indicators and their pillars. The economic indicator is increasing from 2008 to 2022, and the social development indicator of the logistics sector has similarly high positive dynamics. The increase in the environmental development index is positive, although less dynamic. The dynamics of sustainable development are positive; the indicator's highest level was in 2020, the first year of the pandemic; this is largely due to the temporary limitation of activities and, therefore, the lower emission intensity of the sector.

Table 2.
Sustainable development of logistics sector and its pillars in Poland from 2008 to 2022

Indicator	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
E	0,25	0,01	0,13	0,3	0,27	0,31	0,44	0,52	0,41	0,54	0,87	0,92	0,93	0,95	0,99
S	0,38	0,13	0,29	0,42	0,41	0,42	0,54	0,55	0,52	0,6	0,8	0,81	0,83	0,86	0,91
Env	0,41	0,61	0,44	0,51	0,58	0,65	0,67	0,57	0,39	0,27	0,18	0,71	0,96	0,6	0,61
SD	0,35	0,25	0,29	0,41	0,42	0,46	0,55	0,55	0,44	0,47	0,62	0,81	0,91	0,8	0,83

Source: own study on the basis of Eurostat [<https://ec.europa.eu/Eurostat>], 16.08.2024.

Figure 2 shows the dynamics of sustainability indicators and their pillars. The dynamics of economic development are the highest, while the dynamics of environmental development are the lowest. The dynamics of sustainable development are positive.

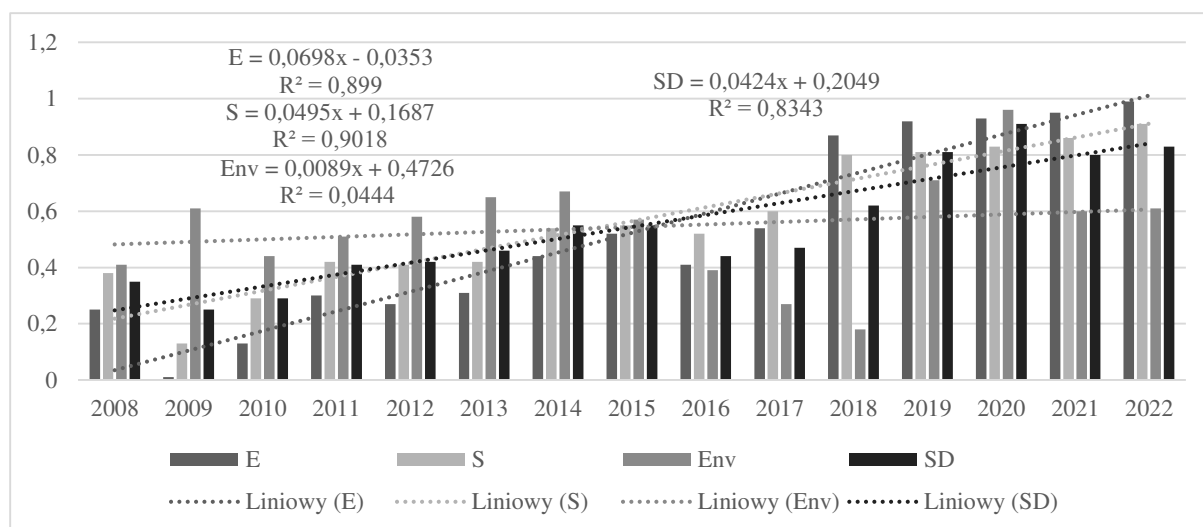


Figure 2. Sustainable development and its pillars from 2008 to 2022.

Source: own study on the basis of Eurostat [<https://ec.europa.eu/Eurostat>], 16.08.2024.

Figure 3 presents the long-term solvency (LTS) indicator of the logistics sector in Poland from 2008 to 2022. The dynamics of the indicator is positive, the value of the indicator exceeds 1 in the entire period.

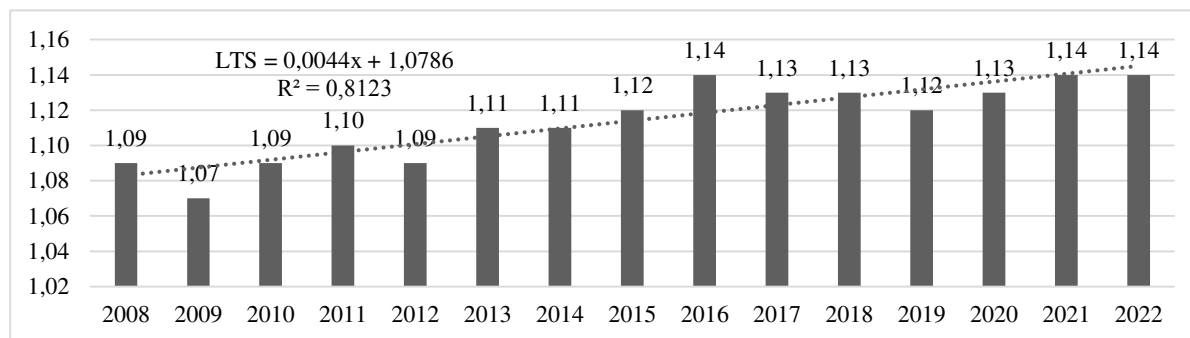


Figure 3. Long-term solvency of the logistics sector in Poland from 2008 to 2022.

Source: own study on the basis of Eurostat [<https://ec.europa.eu/Eurostat>], 16.08.2024.

The results of the OLS estimation are presented in Table 3. The impact of LTS is positive on the sustainable development of the logistics sector in Poland in the years 2008 to 2022. The results of statistical tests indicate that the estimation method can be used. Statistical significance was determined at $p < 0.05$.

Table 3.

The OLS, using observations 2008-2022 ($T = 15$); dependent variable: SD

	Coefficient	Std. Error	t-ratio	p-value	
const	-7.32651	1.93749	-3.781	0.0023	***
LTS	7.06509	1.73891	4.063	0.0013	***

Mean dependent var	0.544000	S.D. dependent var	0.207564
Sum squared resid	0.265731	S.E. of regression	0.142972
R-squared	0.559435	Adjusted R-squared	0.525545
F(1, 13)	16.50754	P-value(F)	0.001343
Log-likelihood	8.965819	Akaike criterion	-13.93164

Schwarz criterion	-12.51554	Hannan-Quinn	-13.94672
rho	0.544571	Durbin-Watson	0.912123

Non-linearity test (squares): LM = 0.112541 with p-value = P(Chi-square(1) > 0.112541) = 0.73727
White's test for heteroskedasticity: Test statistic: LM = 4.06437 with p-value = P(Chi-square(2) > 4.06437) = 0.131049
Test for normality of residual: Test statistic: Chi-square(2) = 2.57339 with p-value = 0.276182
Source: own study on the basis of Eurostat [https://ec.europa.eu/Eurostat], 16.08.2024.

The results of the autoregression are presented in Table 4. The impact of sustainable development from the previous period on the indicator level in the current period was recorded. Sustainable development is self-reinforcing, so decisions made in earlier periods bring results later.

Table 4.

The VAR system, lag order 1; OLS estimates, observations 2009-2022 (T = 14)

Log-likelihood = 13.946194					
Determinant of covariance matrix = 0.0079850003					
AIC = -1.7066					
BIC = -1.6153					
HQC = -1.7151					
Portmanteau test: LB(3) = 5.13242, df = 2 [0.0768]					
	Coefficient	Std. Error	t-ratio	p-value	
const	0.0681202	0.0749606	0.9087	0.3814	
SD_1	0.935377	0.134427	6.958	<0.0001	***
Mean dependent var	0.557857	S.D. dependent var	0.208075		
Sum squared resid	0.111790	S.E. of regression	0.096519		
R-squared	0.801381	Adjusted R-squared	0.784829		
F(1, 12)	48.41711	P-value(F)	0.000015		
rho	0.197569	Durbin-Watson	1.414483		
F-tests of zero restrictions:					
All lags of SD F(1, 12) = 48.417 [0.0000]					
All vars, lag 1 F(1, 12) = 48.417 [0.0000]					

Source: own study on the basis of Eurostat [<https://ec.europa.eu/Eurostat>], 16.08.2024.

Table 5 presents the SUR estimation results. The analysis results indicate that long-term solvency statistically impacts economic, social and environmental development. It should be noted that this impact varied in strength and direction of impact.

Table 5.

The SUR, using observations 2008-2022 (T = 15)

Dependent variable: E					
	coefficient	std. error	t-ratio	p-value	
const	1.50237	0.708055	2.122	0.0574	*
Long	-1.70018	0.652000	-2.608	0.0244	**
S	1.53890	0.0572028	26.90	2.18e-011	***
Env	0.0833371	0.0470972	1.769	0.1045	
R-squared 0.988282 Adjusted R-squared 0.985086					

Cont. table 5.			
Dependent variable: S			
	coefficient	std. error	t-ratio p-value
const	-1.01004	0.434169	-2.326 0.0401 **
Long	1.13331	0.393921	2.877 0.0151 **
E	0.647478	0.0241487	26.81 2.26e-011 ***
Env	-0.0481905	0.0310751	-1.551 0.1492
R-squared		0.990296	Adjusted R-squared 0.987650
Dependent variable: Env			
	coefficient	std. error	t-ratio p-value
const	1.13811	0.312875	3.638 0.0034 ***
E	2.47824	1.07343	2.309 0.0396 **
S	-3.34604	1.51924	-2.202 0.0479 **
R-squared		0.135299	Adjusted R-squared -0.008817

Source: own study on the basis of Eurostat [<https://ec.europa.eu/Eurostat>], 16.08.2024.

5. Discussion

The research results show that the dynamics of sustainable development of the logistics sector in Poland from 2008 to 2022 is positive, although its level varies in individual years. It should be assumed, like other researchers (Comporek et al., 2022), that the sector makes important investments, introduces ecological innovations, although on a limited scale, and supports the development of employees (Middermann, 2020; Aguinis et al., 2024). It should be noted that the general economic situation in Poland in the period under review was good; there is a particular shortage of drivers in the labor market regarding to logistics, and the financial and non-financial expectations of employees are increasing.

Our research confirms previous results in which researchers emphasize that financial factors are important for the sustainable development of enterprises (Matinaro et al., 2019; Misztal et al., 2024).

The OLS estimation results indicate that long-term solvency positively impacts the sustainable development of logistics enterprises in Poland from 2008 to 2022. Therefore, the main research hypothesis is true; therefore, maintaining the appropriate financial and property situation is important from the point of view of the credit position of enterprises.

The answer to the first research question is yes because the trend line of the sustainability index has a positive trend. It is a positive phenomenon, although it should be emphasized that a positive economic and social indicator determines the level of the synthetic indicator.

Long-term solvency fluctuates in the analyzed period (second research question), but it should be noted that the indicator has a positive trend, which should be assessed well from the point of view of corporate financial management.

Long-term solvency influences to varying degrees, both in terms of strength and direction of impact on the economic, social and environmental pillars. Moreover, company managers still focus on the economic and social development of the sector.

Theoretical implications are related to introducing a model written in an equation and a multi-equation model, allowing for assessing the impact of long-term solvency on the sustainable development of the logistics sector.

The empirical implications are that managers should consider the issues of managing the enterprise's financial and asset structure when making social and ecological investment decisions.

The research has limitations related to the availability of data, their selection, estimation methods, and the choice of the research period. Our study's boundary is assessing the impact of only long-term solvency on the sustainable development of the logistics sector; this is also an added value of the article because it needs an assessment of one of the most important factors. The choice of the exogenous variable is not accidental because long-term solvency is important for enterprises' stable operation and development.

6. Conclusion

Sustainable development of logistics from 2008 to 2022 has a positive trend, although the indicator values in individual years vary. The highest levels concern economic and social development, environmental development is at a lower level.

The VAR estimation results show that the level of the sustainability index from the previous period influences its current value. Therefore, decisions made in previous periods are important for the effects obtained in the future.

In turn, the OLS and SUR estimates show that long-term solvency positively impacts the sustainable development of the logistics sector and, in a diverse way, positively or negatively, on its economic, social and environmental pillars.

We will devote further research to analyzing the impact of financial security on the sustainable development of the logistics sector in selected European Union countries.

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INSURANCE CRIME AS A DYSFUNCTION OF THE INSURANCE MARKET – IN THE LIGHT OF THE RESULTS OF AN EXPERT INTERVIEW

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Purpose: The main objective of the article is to analyse the phenomenon of insurance crime as a dysfunction of the insurance market in the light of surveys conducted among experts. In addition, the article formulates additional auxiliary objectives: 1. To determine the directions of actions in counteracting insurance crime; 2. To analyse the attitudes of the surveyed respondents towards the phenomenon of insurance crime.

Design/methodology/approach: A free-text interview (also known as an in-depth ethnographic interview) was used as the main research method used to realise the objectives set. In addition, a critical analysis of the source literature and a comparative analysis were carried out to realise the set objectives. Between February and March 2024, five individual expert interviews were conducted with employees of insurance companies involved in the prevention of insurance crime.

Findings: In presenting the most important results, it should be pointed out that there is a conviction among experts that the most important instruments for crime prevention are cooperation between insurance companies and the involvement of insurance market institutions. Experts in the fight against insurance crime mainly pointed out the difficulties in data exchange related, among other things, to data protection regulations or budget constraints, as well as the need for insurance crime education at the level of the police and prosecutor's office.

Research limitations/implications: In the course of the research, it was only possible to reach a few experts involved in the prevention of insurance crime. This was related to the difficulty in reaching people who would agree to be interviewed as experts. Therefore, it should be noted that the results obtained represent only the subjective views of those who were interviewed as experts.

Originality/value: The prepared article fills a research gap on insurance crime prevention. While conducting a literature review, the authors did not find a publication on research among experts dealing with insurance crime prevention. The results obtained may become the basis for further research attempts among a wider range of experts dealing with the issue under study.

Keywords: insurance, insurance market, crime, insurance crime.

Category of the paper: research paper.

1. Introduction

Insurance crimes are among the most serious problems facing insurance companies around the world. The extent of insurance crimes committed varies from country to country, but nevertheless the consequences of insurance crime are very similar for each market. It is estimated that insurance fraud in Europe accounts for up to 10% of all insurance claims expenses (Nikolaienko, 2019). Moreover, insurance crimes affect all types of insurance (PIU, 2021). Thus, the common assumption that crimes are related to motor insurance has been outdated for more than two decades. Every case of fraud implies an undue compensation or benefit, the cost of which is borne by customers - the insured in the premiums paid for subsequent insurance. Insurance fraud also affects the trust on which the entire insurance sector operates (Salleh et al., 2018, pp. 586-598). Insurance crime also repeatedly discourages honest customers from taking insurance. Hence, insurers as well as insurance market institutions are engaged in combating and preventing insurance crime. An important aspect of activity in the field of insurance crime prevention is expert knowledge and attitudes towards this negative phenomenon occurring in the insurance market. The article refers to the results of an expert survey.

The main purpose of the article is to *analyze and evaluate the phenomenon of insurance crime as a dysfunction of the insurance market in light of surveys conducted among experts.*

In addition, the article formulates additional auxiliary objectives:

1. To determine the directions of action in countering insurance crime.
2. to analyze the attitudes of the surveyed respondents toward the phenomenon of insurance crime.

The realization of the set objectives was carried out on the basis of a critical analysis of the source literature, a comparative analysis, as well as the analysis and evaluation of the primary data obtained (expert interview).

In carrying out the analysis, attention should be drawn to the limitations of the research conducted. The analysis carried out concerned only a certain research group and, therefore, the results obtained should not be applied to a larger or entire community. On the other hand, the results obtained may become a contribution to further research.

2. Literature review

Insurance crime is presented in the literature not only on an economic level, but also on a legal and social level. Insurance crime finds legitimacy in the mutual agreement of the parties and constitutes a promise by the insurer to pay an amount or to give something of value to the insured upon the occurrence of a fortuitous or accidental event that is beyond the control of the contracting parties and in which the promise has an interest beyond the contract (Smith, Roberson, 1971, p. 1166). M. Gill, A. Woolley and M. Gill explain insurance crime as knowingly submitting a fictitious claim, inflating the value of the compensation or adding additional elements to the claim, and being dishonest in any way with the intent to obtain more than a legitimate benefit (Gill et al., 2005, pp. 73-82).

An insurance crime occurs when an insurer, insurance intermediary, appraiser or consumer commits intentional fraud in order to gain illegal profit (Tomaš, Todorović, 2016, pp. 76-87). Within the insurance system itself, criminality can be determined by a variety of phenomena or behaviors that mainly include:

- overinsurance - determining the sum insured above the value of the insured property,
- multiple insurance - manifested by simultaneous insurance, in several insurance companies in order to collect compensation for the same damage,
- concealment of information - both to pay a lower premium and to take out insurance,
- conversion of an uninsured loss into an insurance claim,
- false claims - making a claim for a loss that did not occur at all,
- intentional causing of damage - by the insured himself following the use of third parties.

Insurance crimes cover a wide range of illegal activities, but some types are more common than others. One common type is insurance fraud, which involves making false claims or providing misleading information in order to obtain benefits from an insurance policy. Another common type is premium diversion, in which an insurance agent or broker collects premiums from customers but does not pass them on to the insurer, thus keeping the money for their own use. In addition, there are also staged accidents and arson for profit, in which individuals intentionally cause accidents or set fire to property in order to obtain insurance compensation. Such crimes not only result in financial losses for insurers, but also increase premiums for honest policyholders.

The motivation for committing an insurance crime can come from a variety of factors. One of the main motivations is financial gain, as individuals may try to fraudulently obtain insurance payouts. This may be due to economic hardship, which leads them to resort to illegal means of obtaining money. Another motivation is the desire for revenge or retaliation against the insurance company or other parties involved in the claims process, which may prompt individuals to commit fraud. In addition, some individuals may view insurance fraud as a victimless crime and rationalize their actions based on this misconception.

Insurance fraud not only creates additional costs for insurance companies, but also negatively affects the attitudes of consumers – participants in the insurance market (Schrijver et al., 2024). Insurance crimes may initially cause direct damage to insurance companies, but this damage is ultimately passed on to future policyholders through increased premiums. Second, insurance fraud cases are mostly complex and diverse Automobile insurance fraud detection using data mining: A systematic literature review Automobile insurance fraud detection using data mining: A systematic literature review (Jung, Kim, 2021). So, the risk of fraud not being identified in time can cause significant financial losses but also negatively affect the reputation of the insurer and the trust of stakeholders (Bera, Pauch, 2022).

Preventive measures, as well as learning about the attitudes of the public including those of the so-called younger generation, can save insurers from failure, and not only financially, but also socially.

In addition, insurance fraud has become customary to such an extent that it is no longer the exception, but rather the standard in the insurance market. Hence, insurers should systematically protect themselves from insurance crimes by using active tools to counteract the activity of insurance criminals (Bera et al., 2019). Implementing a process of active prevention in this regard will increase the confidence of investors, shareholders, board members, as well as the audit and the public itself. It is important that information on perceptions of insurance fraud not be ignored, but subjected to periodic analysis and evaluation.

3. Research results

A free-form interview (also known as an in-depth ethnographic interview) was used as the research method used to achieve the stated goals. According to the typology of interviews, i.e. the degree of their standardization (Przybyłowska, 1978), a free-form interview with a standardized list of information sought was used. Five individual expert interviews were conducted between February and March 2024. Experts, employees of insurance companies dealing with insurance crime prevention in life insurance – Division I (Insurance and Reinsurance Business Act, 2015) and other personal insurance and property insurance – Division II (Insurance and Reinsurance Business Act, 2015), participated in the study. The survey made it possible to obtain a reliable and credible opinion on the phenomenon under study.

Among the limitations of the survey, the number of interviews conducted should be noted. A request for interviews was made to 25 people involved in insurance crime prevention. Only 5 people agreed to be interviewed. Those who did not consent as the most common reasons indicated the duty of secrecy in connection with their profession, the lack of permission from superiors to take part in any research conducted by an external entity. The specific subject

matter of insurance crime makes it very difficult to conduct surveys among experts who deal directly with crime prevention. This is confirmed by the literature, which lacks any research directed at those directly involved in this aspect. Certainly, the authors of the article were not able to find such publications.

High ethical standards were maintained, ensuring the confidentiality of the data collected. The selection of experts was purposeful, from a single designated professional group, in order to obtain comprehensive and complementary responses. The interviews provided rich, qualitative data, allowing for a more thorough understanding of various aspects of insurance security in the Polish and global context.

The experts surveyed were characterized by varying degrees of seniority in insurance crime prevention. Three respondents had seniority of 6-15 years, while two experts indicated more than 15 years. Consequently, they were experienced and possessed a wealth of knowledge regarding the research problem under study. All the respondents stated that the actual scale of insurance crime is several times higher than the data published in the reports of insurance market institutions and organizations, e.g. Insurance Europe, European Insurance and Occupational Pensions Authority (EIOPA), Polish Insurance Association (PIU).

Also unanimously, all experts indicated that the biggest threat to insurance companies are professional/professional offenders, who consider criminal activity as their main source of income. According to the traditional criminological typology and classification of economic offenders proposed by Tiedemann (Bera, Pauch, 2022; Górnio, 1994; Tiedemann, 1972), situational and occasional offenders are also distinguished.

Another issue that was surveyed was the classification of factors that experts believe affect the commission of insurance crimes (fig. 1). Respondents ranked the ease of committing the act as the most important factor. They ranked social acceptance regarding insurance crime next.

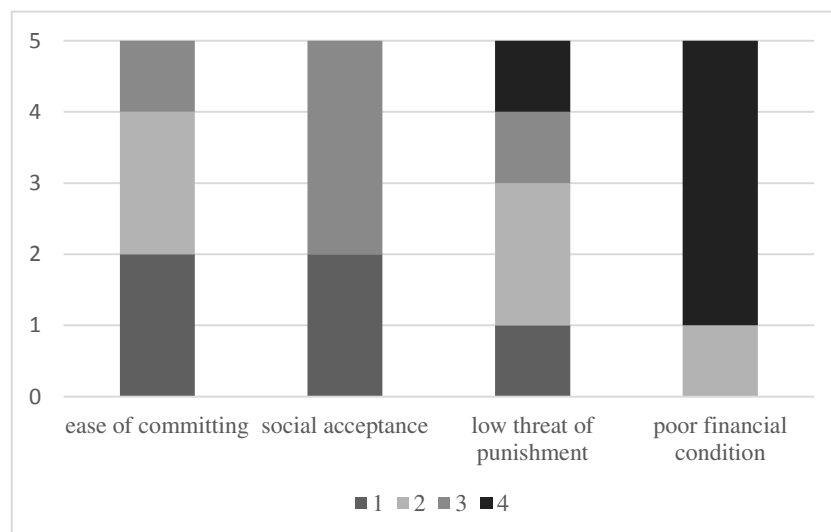


Figure 1. Classification of factors that affect the commission of insurance crimes (1 - most important, 4 - least important).

Source: developed by the authors.

In the next question, respondents were asked to classify the phenomena that hinder the fight against insurance crime (fig. 2). The tardiness of the collection authorities (police, prosecutors, courts) was considered as the greatest impediment to counteraction. In this case, three experts ranked this as the greatest impediment. The use of modern technology in criminal activity was ranked next.

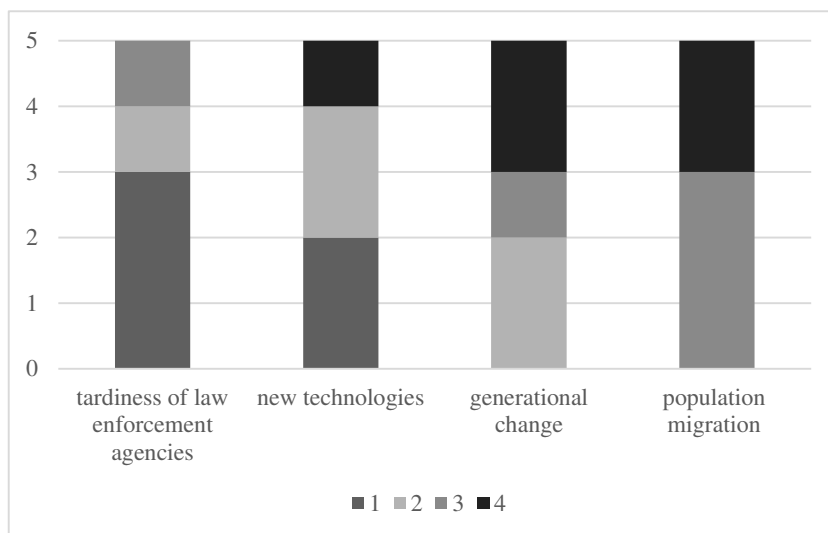


Figure 2. Classification of phenomena that hinder the fight against insurance crime (1 - most difficult, 4 - least difficult).

Source: developed by the authors.

In the next question, experts were asked to identify the most effective instruments for preventing insurance crime in the future (Table 1). Experts mostly pointed to systemic instruments, i.e. cooperation between insurance companies and greater involvement of insurance market institutions in preventing insurance crime.

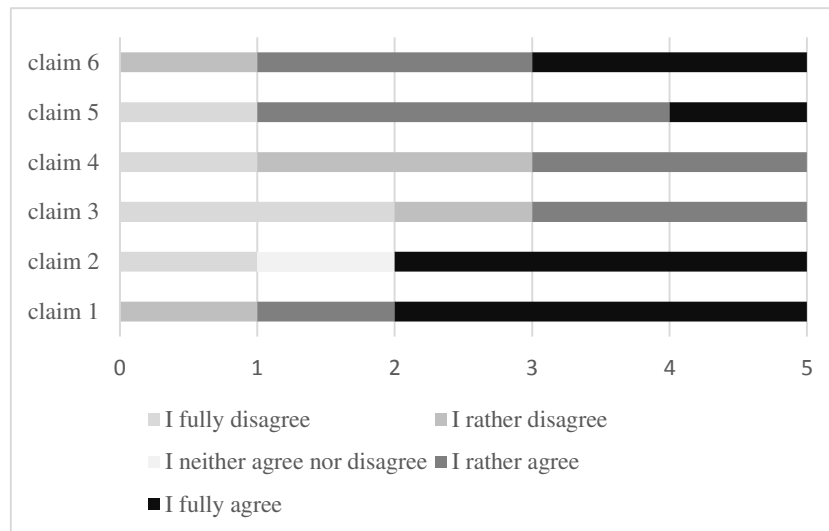
Table 1.

Perspectives on the use of insurance crime prevention instruments

Type of instrument	Number of indications
Systemic	3
Legal	1
Digital	1
Preventive	0

Source: developed by the authors.

In the next part of the survey, experts were asked to respond to six statements (Fig. 3). The respondents were most in agreement on two statements: the scale of insurance crime will increase in the future (claim 1) and that penalties for insurance crimes are too low (claim 2). In both cases, three of the five experts indicated that they fully agreed with the above statements. Two experts indicated that they fully agreed with the statement that: insurance companies' activities in the aspect of insurance crime prevention require better cooperation with insurance market institutions and insurance companies (claim 6).



- Claim 1: The scale of insurance crime will increase in the future.
- Claim 2: Penalties for insurance crimes are too low.
- Claim 3: Insurance companies' insurance crime prevention activities are sufficient.
- Claim 4: The Covid-19 pandemic has contributed to the increase in insurance crime.
- Claim 5: People who have committed insurance crime and have not been punished will commit the act again.
- Claim 6: The activities of insurance companies in terms of preventing insurance crime require better cooperation with insurance market institutions and insurance companies.

Figure 3. Experts' opinion on the statements made.

Source: developed by the authors.

The next question that was asked was to assess the challenges of insurance crime prevention (Fig. 4). Among the two biggest problems and constraints facing the insurance sector in preventing insurance crime, respondents pointed to: the lack of specialists and the growing need for experts in insurance crime prevention, and low public awareness of the risk of insurance crime.

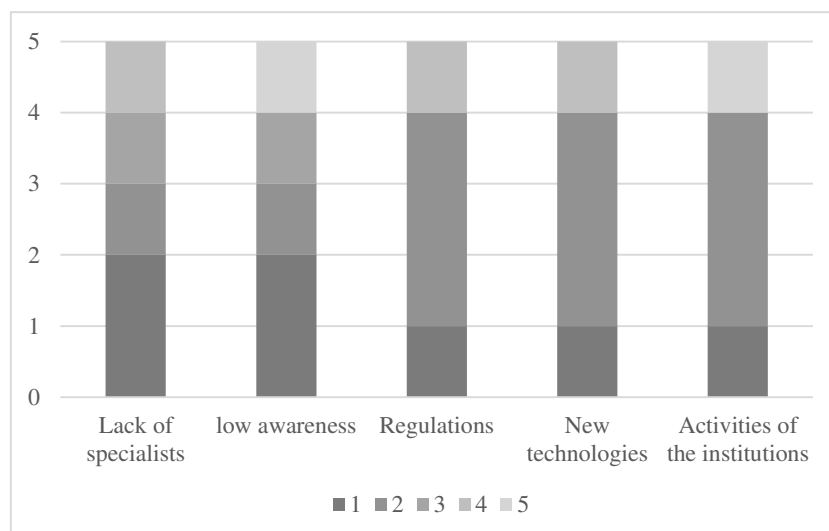


Figure 4. Experts' opinion on the statements made.

Source: developed by the authors.

Experts were asked to assess the threat level of the most common types of insurance crimes in terms of current and future scenarios (Table 2). The opinions of the respondents are very divided. The biggest types of threats coming from insurance criminals cannot be clearly identified. The largest number of respondents indicated as the greatest threat the extension of the rental time of a replacement vehicle (three experts indicated in first place) and the reporting of fictitious personal damage (two experts indicated in first place). At the same time, one expert each considered the above events as “no opinion.” The lack of unanimity among respondents may confirm the fact that insurance crime is a very complex phenomenon that cannot be clearly assessed and classified. Any type of criminal activity can be fraught with a high level of danger.

Table 2.

Threat level of insurance companies with the most common types of insurance crimes (1 - high threat, 5 - no opinion)

Type of threat	1	2	3	4	5
Use of car seller's policy to defraud compensation claims	0	3	0	1	1
Forcing an admission of guilt	1	1	1	2	0
Crimes related to the purchase of a vehicle imported from abroad	1	3	1	0	0
Reporting fictitious personal injury	2	1	1	0	1
Extending the rental time of a replacement vehicle	3	1	0	0	1
Illegal use of personal data	0	2	1	1	1
Intentionally causing traffic collisions	0	1	1	3	0
Deliberately increasing the extent of the damage	0	2	2	1	0

Source: developed by the authors.

As part of the interview, the experts were also given the opportunity to speak freely about the current situation and prospects for preventing insurance crime. As part of their statements, the experts highlighted the following issues:

- *not the amount of punishment, but its absolute application and inevitability is the key to prosecuting insurance offenders,*
- *cooperation with law enforcement is also a challenge: according to most prosecutors' offices, insurance crime is a civil matter, not a crime,*
- *combating insurance crime has no priority, it is not even in the catalog of crimes,*
- *unfortunately, the activities of insurance companies in countering insurance crime are mostly limited to refusing to pay claims. In the end, it is the financial result that counts, not the system of fighting insurance crime,*
- *there is a lack of legal conditions that allow insurance companies to effectively exchange information between financial sectors (banks, leasing companies),*
- *It is important to note the low effectiveness of law enforcement agencies. Most of the notifications about the possibility of a crime are discontinued, causing the perpetrators to feel unpunished by which they attempt further criminal actions.*

In analyzing the collected material, it is important to note the limitations of the research conducted. The analysis carried out concerned only a certain research group, so the results obtained should not be applied to a larger or entire community. On the other hand, the results obtained can become a contribution to further research.

4. Discussion

Insurance plays a key role in today's society (Schrijver et al., 2024). Insurance crime encompasses a range of criminal activities that affect the insurance industry and society as a whole (Baştürk, 2020; Belias et al., 2019; Ribeiro et al., 2020). Leading to significant financial impacts for insurance companies and policyholders (Hanafy, Ming, 2021).

In 2022, insurers operating in the Polish market reported nearly 32,000 cases of insurance crime. All of these cases represent an estimated annual total of PLN 357 million in detected insurance fraud in Poland (PIU, 2023), contributing to the detection of fraudulent claims worth €2.5 billion across Europe in 2017 alone (Insurance Europe, 2019). It should be noted that the data presented only relates to detected fraud cases. The fraud detection practices used are difficult both in terms of adopting appropriate presentation metrics and precision (Powers, 2011).

Insurance companies use in-house teams, outsourcing companies and sophisticated intelligence systems to investigate and detect fraudulent claims (Phillips, 2016). Insurance fraud is a serious problem for insurance companies, and failure to engage in countermeasure strategies can lead to loss of income for insurance companies and market dysfunction (Picard, 1996). Insurance fraud is a complex issue that affects insurance policies and requires cooperation among insurance companies. He notes that combating insurance fraud is a major concern for insurance companies (Picard, 2000).

W.C. Lesch and J. Brinkmann emphasize the importance of insurance fraud committed by customers. And they also highlight the aspect of morality and the need to create a new paradigm regarding the shared responsibility of insurance companies and customers to prevent insurance crime (Lesch, Brinkmann, 2011). S. Tennyson takes a similar view, pointing out that consumer attitudes toward insurance fraud depend on ethical and social factors. People who have a negative perception of insurance companies are characterized by greater tolerance of insurance crime (Tennyson, 1997).

When analyzing modern countermeasures, it is important to cite the considerations of M. Óskarsdóttir et al. who point to a novel approach to detecting insurance fraud by using social network analysis to extract additional information in compensation cases and claimants. In doing so, they show improved fraud detection performance compared to models using only the classic symptoms indicative of an attempt to defraud a claimant (Óskarsdóttir et al., 2022). A similar view is held by Bangchang et al. and Simmachan et al. who point out that traditional approaches to detecting insurance fraud are ineffective, leading to the need for data mining techniques and machine learning algorithms to predict and identify fraudulent claims (Na Bangchang et al., 2023; Simmachan et al., 2023).

Timofeyev and Busalaeva note that there are gaps in legislation and difficulties in cooperation with the police have been identified as sources of ineffectiveness in fraud prevention strategies, and recommendations have been proposed to increase effectiveness (Timofeyev, Busalaeva, 2021).

5. Summary

Insurance crime is now an entrenched social problem in most countries. There is a belief among experts that the most important instruments for preventing crime are cooperation between insurance companies and the involvement of insurance market institutions. Insurance companies should increase their cooperation in this regard, as they cannot counter insurance crime alone.

It notes the need for a national insurance crime database and a national-level organization to coordinate anti-fraud activities.

Experts in combating insurance crime pointed out the difficulties in exchanging data related to, among others, with regulations regarding the protection of personal data, or budget restrictions, as well as the needs of education in the field of insurance crime at the level of the police and prosecutor's offices.

The lack of research and government policy regarding insurance fraud is most likely related to the public's lack of awareness of the extent of insurance fraud. Hence, educating the public on this issue remains a challenge. Developing fraud detection capabilities with technological support is also an important forward-looking challenge. Many industries and sectors are now aggressively using big data technologies in ways that suit their needs.

The issues covered in this study may prove particularly useful for practitioners, those dealing with insurance crime prevention, employees of insurance companies as well as supervisory authorities and insurance market institutions. The results obtained may become the basis for further research attempts among a broader group of experts dealing with the studied issue.

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HUMAN CAPITAL AS A MANAGER'S CHALLENGE. GENERATION Z ON THE LABOR MARKET

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Purpose: The reason for writing this article is the still existing gap in research on the attitudes of Generation Z. In particular, on attitudes related to work, including cooperation between managers, bosses and subordinates. In the context of contemporary socio-demographic changes in the labor market, the issue of generational diversity and the challenges it presents for employers, as well as for human resource management within organizations, has become increasingly important. Members of Generation Z are ambitious and independent.

Project/methodology/approach: The objectives of the article were achieved through the analysis of available texts. This method was used to research the described issue. The approach to the topic results from the specificity of the studied group, which is amorphous and, despite similar activities, does not have a developed strategy for its activity on the labor market. **Findings:** The research results showed that for representatives of Generation Z, professional satisfaction, although important, is less important than personal life, interests, and self-fulfillment. Very often, Generation Z representatives are ready to change jobs if they see their self-development as incompatible.

Practical implications: Generation Z clearly differs in its attitudes from previous generations. For employers, this means new challenges; they will have to learn the values of Generation Z employees and try to find a model of cooperation between managers and their subordinates that will allow for the development of organizations in which the youngest generations have found employment.

Social implications: The article may be a signal to management staff that Generation Z, increasingly represented on the labor market, poses new, previously unknown challenges to managers. It also shows that they can be applied in practice.

Originality/value: The article discusses a problem that has so far been poorly researched in Poland. Research conducted in other countries shows that it is important for management staff. In theory, this is the first article in a series analyzing the attitudes of Generation Z on the Polish and Central European labor markets. It also shows that automatic implementation of Western European or Far Eastern solutions will not always be a solution on the Polish labor market.

Keywords: management, human capital, generation Z.

1. Modern Human Resource Management

Human Resource Management (HRM) refers to the strategic approach to the effective management of people within an organization, aimed at maximizing employee performance in service of the employer's strategic objectives. HRM encompasses a range of functions, including recruiting, selecting, training, evaluating, and compensating employees. It also involves managing labor relations, employee welfare, and fostering a productive work environment. Modern HRM focuses on aligning human capital with organizational goals, creating a culture of continuous learning, and emphasizing employee engagement, diversity, and inclusion to drive overall business success (Brzezińska, Appelt, Ziółkowska, 2008).

Human Resource Management (HRM) is a critical function within organizations that focuses on the strategic and effective management of people. It plays a vital role in ensuring that an organization's workforce is capable, motivated, and aligned with the company's strategic goals. In today's competitive business environment, HRM goes beyond traditional administrative functions such as hiring, payroll, and employee relations. It encompasses a broader approach, aimed at fostering talent, enhancing employee engagement, and promoting a positive workplace culture (Wrzesień, 2005).

The core activities of HRM include recruiting and selecting the right candidates, training and developing employees, performance management, and compensation. These activities ensure that organizations attract, retain, and develop talent that is critical for their long-term success. The recruitment process involves identifying the right individuals whose skills, experiences, and values align with the company's needs and culture. Training and development focus on improving employee skills and preparing them for future challenges, while performance management ensures that employees' contributions are aligned with organizational objectives (Zawadzki, 2015).

Another key aspect of HRM is employee welfare and labor relations. Creating a safe, inclusive, and supportive work environment is essential for employee well-being and productivity. This also includes ensuring that the organization complies with labor laws and regulations, managing employee benefits, and addressing issues such as workplace conflicts and employee grievances (Permenter, 2007).

Modern HRM also emphasizes diversity and inclusion, recognizing the value of a diverse workforce and fostering an environment where all employees feel valued and respected. Employee engagement has become a major focus area as well, with organizations seeking to create conditions that motivate employees to give their best performance and remain committed to the organization (Oblój, 1999).

2. Methodology

In order to achieve the research objectives of this article, the study used techniques such as literature review to collect, analyze, and synthesize relevant information from a wide range of sources. Databases were searched using the following keywords: management, Generation Z, attitudes toward challenges. The literature review was conducted using Google Scholar and Scopus browsers. The aim was to conduct a theoretical review based on an extensive literature search and qualitative content analysis of relevant articles in order to develop and expand the knowledge on ethical management of human capital in Generation Z. The article attempts to answer the question about the main issues faced by managers working with Generation Z.

2.1. Globalization, technology and HRM

In the context of globalization and technological advancements, HRM has evolved to include the use of digital tools and data analytics for managing human capital. HR professionals now utilize technology to streamline HR processes, track employee performance, and gather data to inform decision-making. As the workforce becomes more diverse and dynamic, HRM is critical in helping organizations adapt to these changes and maintain a competitive Edge (Masłyk-Musiał, 2011).

However, it soon became apparent that managing large plants by common sense, intuition and personal experience alone was insufficient. In particular, it does not lead to a corresponding increase in the productivity of direct production workers, according to the possibilities of technology (Pujer, 2016). It was precisely the low individual productivity that was considered by the organizational classics to be the main impediment to economic development. This is because, on the one hand, it prevented the raising of wages and thus the creation of a mass market for industrial consumer goods (demand barrier), while on the other hand, it impeded the growth of production (supply barrier), because, as a result of high unit costs, the payback time of capital invested in expensive equipment was too slow (Brigham, Houston, 2015). Taylor recognized this: "...the slow performance of labor is the most serious problem we have to deal with in the United States. It is also certainly the most serious problem that the English also have to deal with at the present time", he wrote in 1911.1 low current these words unfortunately sound in many countries in the last decade of the 20th century (Taylor, 1998).

On the basis of his research. F.W. Taylor identified the basic factors causing low productivity of workers. He included among them (Dumay, Garanina, 2014):

- a defective system of remuneration for workers, which made it in their interest to hide their true productive capacity,
- irrational work methods used in industry,

- the incompatibility between the characteristics of workers (physical strength, mental level, qualifications, etc.) and the demands of the work,
- workers' belief that increased production inevitably leads to increased unemployment.

Taylor focused his attention and research interests on the work of the individual worker and the work brigade in a production plant. He was prompted to do so by personal experience (Falencikowski, Lis, 2018).

F.W. Taylor began working at the age of twenty-two in the mechanical plants of the Midvale Steel Company, in one of the offices. Being a clerk did not suit him, so he moved on to work as a loader, shoveling. Then he finessed that he was put at the machine. He became a lathe helper. He did a great job, working ten hours a day, and in the evenings he rewrote the engineering course at Stevens Institute (Sułkowski, 2005). In 1883, he earned a degree in mechanical engineering. During his six years at the Midvale Steel Co. he was promoted successively from lathe helper to toolmaker, foreman, foreman, repair crew leader, chief designer, study office manager and finally chief engineer. Here he conducted his first research both in purely technical fields (metalworking, the operation of transmission belts, etc.) and in the scientific organization of labor (measuring work time, ways of remuneration, etc.) (Sudoł, 2012).

In 1890. Taylor became general manager of the large Manufacturing Investment Company (paper industry). After three years, however, he decided to return to research. He began working as an independent organizational consultant, reorganizing the Northern Electrical Manufacturing Co., the Johnson Company, the Lorain Steel Co. In 1898, one of the largest steel producers in the US. the Bethlehem Steel Company, engaged him as a permanent consultant (Griffin, 2017). He was awarded a gold medal at the Paris World Exposition in 1900 for the improvements he made in steel production here (he invented the so-called high-speed steel). At Bethlehem Steel Co. he applied almost the full set of undertakings that make up the system of scientific work organization. In 1901. after a change of ownership of the company he was unceremoniously fired from his job. From then on. he devoted himself wholeheartedly to promoting scientific management, devoting part of his fortune to this activity. He was first and foremost a “man of industry” who influenced management theory and practice around the world (Gołemski, 2019).

It is also significant that in Poland Taylor's works were published as early as the early 1920s (Sułkowski, 2011).

Scientific management according to Taylor, should be based on four basic principles (Gordon, 2020):

- the principle of scientific elaboration of every element of human work in place of common-sense methods of the “more or less” type,
- the principle of cooperation between management and workers to implement scientific management and workers to implement scientific management principles,

- the principle of almost equal division of labor and responsibility between managers and workers in place of the existing “total” burden on executive workers.
- the principle of scientific selection and gradual training and improvement of workers.

Every person belongs to a specific generation. They are part of a particular age cohort. A set of characteristics shared by several age groups leads to cohorts being defined as a generation. Typically, dominant trends in social life at a given place and time are perceived as characteristic by the members of that generation. A generation is a collective entity with the traits of a peer group (Szymczak, 2017).

In the cultural context represented by the West, adulthood is the longest stage of life, spanning from the ages of 20 to 85, and it is divided into three periods: early adulthood, middle adulthood, and late adulthood. Adulthood is regarded as a life stage where intense human development occurs across biological, psychological, spiritual, social, and cultural dimensions. This developmental perspective allows us to view adulthood as a structure that changes and continuously updates itself (Bławat, 2014). The concept of adulthood and the tasks associated with this life period pertain to both generations: Generation Y is currently experiencing early adulthood, while Generation X is in middle adulthood. It is natural to discuss generations in chronological order, from oldest to youngest (first Generation X, then Generation Y), and to address human development stages from youngest to oldest (first early adulthood, then middle adulthood) (Ambroziak, 2013).

The word "generation" appears in everyday conversations. The term has a wide range of meanings. Besides its use in colloquial language, it serves to describe social changes, literary classifications, philosophical concepts, and the analysis of political shifts. The concept of a generation functions as a way of organizing chronological, substantive, and ideological categorization of groups of people who are of similar age. Dobrochna Hildebrand-Wypych, referencing Charles Berg, who stated that "pedagogy for some is the science of generational relations", situates the concept of generation in the field of education as a constitutive term (Hildebrand-Wypych, 2009).

The term "generation" operates in the realm of social sciences, humanities, colloquial language, literature, worldview discussions, and advertising. The category of "generation" requires an interdisciplinary approach due to its ambiguity and complexity. Jose Ortega y Gasset argues that "generation is a fundamental concept for history" because the world "changes with every generation; each has somehow influenced it, leaving the world more or less different from the one it encountered" (Ortega y Gasset, 2005).

2.2. Generation X

"Generally speaking, one could say that 'Xers' are the children of the so-called baby boomers, the generation that sparked the revolution of the 1960s, only to later abandon its ideals for lucrative positions and a comfortable, consumer-oriented lifestyle". Generation X refers to

people who came of age toward the end of the 20th century, a period marked by significant societal changes and the weakening of traditional institutions (Brzozowska, 2005).

Generation X, which followed the baby boom generation in Western countries (USA, Canada, the UK), grew up during a time of crisis for traditional institutions, shifts in social structures, and an increasing focus on consumption and media in everyday life. In Poland, the shared generational experience for Xers is the memory of the Polish People's Republic (PRL) and the transition period that accompanied the major political and economic transformation. Living through the PRL era and the socio-political transition meant learning life skills and developing pragmatic creativity, particularly in dealing with everyday challenges. Generation X in Poland witnessed a shift from a world of scarcity to one of abundance in terms of consumer goods. The labor market, after the 1989 transformations, presented them with new opportunities (Couplan, 2005).

Education in Polish schools and universities during this time focused on developing a broad perspective on issues, identifying core problems, and nurturing analytical thinking. The verification of knowledge and skills was not done through tests but rather through essays that required justification of opinions, beliefs, and reflections. Xers did not have their after-school time pre-planned by their parents. Their choices in this regard were based on their own interests. Children and adolescents often organized their own free time and were not surrounded by excessive parental supervision (Zawadzki, 2017). The term "latchkey kids" became synonymous with children of working parents (with women entering the workforce on a larger scale than in the past), parents who were trying to quickly improve their financial situation or survive in the emerging free-market world. During this period, the media, particularly television, began to play a more significant role in people's lives. Generation X forms a diverse and broader collective that lacks a defined elite responsible for creating or imposing a generational myth on others (Consumerlab, 2017).

In this context, the experience of Generation X is deeply shaped by their upbringing in an era of political and economic transformation, the rise of media influence, and a growing sense of individual responsibility in an increasingly consumer-driven world (Dubas, 2009).

2.3. Characterization of Generation Y

At the end of the 20th century, the process of generational change gained momentum. The last cohorts of Generation X no longer identified with their generational "label," signaling the emergence of a new generational group—Generation Y. In Western countries, three primary characteristics of Generation Y can be distinguished (two of which also apply to Generation Y in Poland) (Cewinska, Stryker, 2009):

- Racial and ethnic diversity.
- Independence resulting from the unique nature of primary socialization and the technological changes that have occurred.
- A strong sense of security and optimism stemming from their relationships with their parents.

About Generation Y: “They were born into a world completely different from the one their parents knew in their youth, a world their parents could not even imagine, and when it finally arrived, they greeted it with a mix of bewilderment and disbelief. It is a world full of exciting job opportunities, seemingly unlimited choices, and countless attractions and pleasures worth tasting, each appearing more tempting than the previous ones, hastily sent to early retirement and destined for ultimate oblivion”. Millennials have definitively broken with tradition, rejecting hierarchies, institutions, and authorities, and replacing the need for organizational structures with a belief in partnerships and the omnipotence of networks” (Bartczak, Marszał, Stachowska, 2018).

Generation Y members are more alike than any previous generation. As Generation Y forms, the geographical context is becoming less significant, while technological factors are gaining increasing importance. Millennials are the first generation that did not require an authority figure to access information (Lewandowski, 2018).

Generation Y was born during the "child decade", when new trends in child-rearing emerged—support and care for the child took center stage. The parents of Generation Y, in addition to spending time with their children at home, offered them various extracurricular activities to ensure their start in life was as advanced as possible. The result of this shift in child-rearing, ensuring their needs were met, is a generation whose members have high self-esteem and confidence, are aware of their rights, and know what they deserve (Duda, 2009).

Some of the characteristics of Generation Y, as presented by Neil Howe and William Strauss, include (Walkowiak, Mietlewski, 2017):

- Uniqueness—stemming from the significant attention given to children.
- Protection—never before have so many regulations concerning health and safety been implemented.
- Confidence.
- Team orientation.
- Conventionality.
- Ambition.
- Living under pressure.

The conditions in which Generation Y grew up were different from those of previous generations. They were raised in smaller, nuclear families. Their parents actively engaged in their children’s lives, focusing much of their attention on shaping their children's careers (Masłyk-Musiał, 2011).

Witold Wrzesień highlights the commercial aspect of Generation Y's existence: the social identity of this generation is largely defined by patterns of consumer culture (consumerism is also a defining trait of Generation X). Moreover, the sense of generational belonging—internally speaking—is often the result of acquiring products that appear in the generational marketplace. Generation Y was "born to consume". The symbol of this consumption-oriented generation is the triad: fast food, fast sex, fast cars (symbolized by the phrase "leather jacket, car, and cell phone") (Walkowiak, Mietlewski, 2017).

2.4. Characteristics of Generation Z

In the context of contemporary socio-demographic changes in the labor market, the issue of generational diversity and the challenges it presents for employers, as well as for human resource management within organizations, has become increasingly important. From this perspective, a particularly significant group is the Generation Z cohort, who are at the beginning of their professional careers and exhibit attitudes, expectations, and preferences towards work that differ significantly from those of their predecessors (Zawadzki, 2017).

Different generations are characterized by varying attitudes towards work, value systems, and expectations or preferences related to employment and career paths. These differences become particularly evident when comparing younger generations (Y and Z) with older cohorts. Among the primary factors that distinguish younger people from older age groups are greater individualism, flexibility, and a strong proficiency with new technologies. Generation Z also exhibits a markedly different approach to work compared to Generation X. For young people, work is not one of the top priorities in life, and they are not inclined to sacrifice their personal lives for work or to commit to long-term relationships with an organization. However, they can be highly engaged in work that meets their expectations and fulfills their needs. They seek employment in companies that offer a positive atmosphere and opportunities for self-fulfillment. The more focused a company is on these aspects, the more likely it is to earn their loyalty (Masłyk-Musiał, 2011).

Members of Generation Z are ambitious and independent. However, personal life satisfaction is more important to them than career success. They place a strong emphasis on maintaining a balance between work and personal life. What distinguishes them from previous generations is their heightened focus on themselves, their needs, and their benefits. They hold high expectations not only for themselves but also for their leadership and employers. They expect excellent leadership and value interpersonal relationships with their supervisors. From their employers, they anticipate investment in their personal development and satisfactory compensation. They are eager to invest in themselves, pursue their passions, and continuously learn. They prefer engaging work over hard work (Zawadzki, 2017).

Young people from Generation Z are often described as skilled multitaskers who easily adapt to change. They can quickly access information, build communities, and enjoy frequent communication, primarily through digital platforms. They favor informal interpersonal

relationships, including casual dress codes. Many of these traits are considered strengths in a professional context. However, some weaknesses are also notable, such as lower work ethics, impatience, a lack of self-discipline, weaker decision-making skills, a sense of entitlement, and challenges with face-to-face interactions (Stosik, Leśniewska, 2015).

Generation Z, also known as Generation C (referring to "connected", "communicating", and "computerized"), represents the next generation after Millennials. This cohort, raised amidst the advancements of modern technology, is often referred to as "the children of the Internet". There is a general belief that Generation Z shares many traits with Generation Y, while demonstrating even greater proficiency in certain areas (Stosik, Leśniewska, 2015).

As a generation deeply intertwined with technology, Generation Z has been shaped by the rapid evolution of digital tools, which has influenced their communication styles, learning habits, and work expectations. Their ability to navigate digital environments and adapt to technological shifts has made them highly competitive in the modern workforce. However, these strengths are counterbalanced by challenges in traditional work structures, including a tendency toward impatience and a need for instant gratification, which can sometimes hinder their long-term commitment to organizations or projects. Despite these challenges, their innovative mindset and ability to quickly acquire new skills make them valuable contributors in an ever-evolving work environment.

2.5. The Profession of a Manager

The role of a manager is pivotal in any organization, serving as the bridge between the strategic objectives of the company and the day-to-day operations that drive its success. Managers are responsible for planning, organizing, leading, and controlling resources to achieve specific goals efficiently and effectively. Their responsibilities span across various functions, including human resources, finance, marketing, operations, and more, depending on the organizational structure and industry (Masłyk-Musiał, 2011).

Key Responsibilities

1. **Planning and Strategy Development:** Managers are tasked with setting short-term and long-term goals aligned with the organization's vision. This involves strategic planning, forecasting, and the allocation of resources to ensure that objectives are met. Effective planning requires an understanding of market trends, competitive landscape, and internal capabilities.
2. **Organizing Resources:** Organizing involves structuring the workforce, delegating tasks, and ensuring that the necessary resources—such as finances, equipment, and information—are available to achieve the desired outcomes. Managers must design efficient workflows and establish clear roles and responsibilities within their teams.

3. **Leadership and Motivation:** Leadership is a critical component of management. Managers must inspire and motivate their teams, fostering a positive work environment that encourages productivity and innovation. This involves effective communication, conflict resolution, and the ability to recognize and reward employee achievements.
4. **Decision-Making and Problem-Solving:** Managers are often faced with complex decisions that require analytical thinking and sound judgment. They must assess situations, weigh alternatives, and implement solutions that benefit the organization while mitigating risks.
5. **Performance Management:** Monitoring and evaluating employee performance is essential to ensure that goals are being met. Managers conduct performance reviews, provide constructive feedback, and identify opportunities for professional development. Effective performance management helps in maintaining high standards and achieving continuous improvement.
6. **Financial Oversight:** Budgeting, financial planning, and cost control are integral parts of a manager's role. They must ensure that their departments operate within financial constraints while maximizing efficiency and profitability.

Essential Skills and Competencies (Melnik, Bititci, Platts, Tobias, Anderson, 2013):

1. **Communication Skills:** Clear and effective communication is fundamental for managers to convey expectations, provide feedback, and collaborate with various stakeholders. This includes both verbal and written communication, as well as active listening.
2. **Leadership and Interpersonal Skills:** Strong leadership involves the ability to inspire and guide teams, build trust, and manage diverse personalities. Interpersonal skills are crucial for fostering teamwork and resolving conflicts.
3. **Analytical and Critical Thinking:** Managers must analyze data, interpret trends, and make informed decisions. Critical thinking enables them to evaluate situations objectively and develop strategic solutions.
4. **Time Management and Organization:** Effective managers prioritize tasks, manage their time efficiently, and maintain organized workflows to ensure that projects are completed on schedule.
5. **Adaptability and Flexibility:** The business environment is constantly changing, and managers must be able to adapt to new challenges, technologies, and market conditions. Flexibility allows them to pivot strategies when necessary.
6. **Emotional Intelligence:** Understanding and managing one's own emotions, as well as empathizing with others, is essential for building strong relationships and maintaining a positive workplace culture.

Educational and Professional Requirements

Typically, a manager holds at least a bachelor's degree in a relevant field such as business administration, management, or a specific industry-related discipline. Many organizations prefer candidates with advanced degrees, such as an MBA, especially for higher-level management positions. Additionally, practical experience in leadership roles and a proven track record of achieving results are highly valued (Szaban, 2003).

Challenges Faced by Managers

1. **Balancing Multiple Responsibilities:** Managers often juggle various tasks simultaneously, from strategic planning to handling daily operational issues, which can be demanding and stressful.
2. **Managing Change:** Implementing and managing change initiatives, whether technological, structural, or cultural, requires careful planning and the ability to guide teams through transitions.
3. **Employee Retention and Engagement:** Keeping employees motivated and reducing turnover rates are ongoing challenges. Managers must continuously find ways to engage their teams and address their needs and concerns.
4. **Navigating Organizational Politics:** Understanding and effectively navigating the political landscape within an organization is essential for gaining support for initiatives and fostering collaboration across departments.

Importance in Organizations

Managers play a crucial role in translating the strategic vision of the organization into actionable plans. They ensure that resources are utilized efficiently, foster a productive and positive work environment, and drive their teams towards achieving both individual and organizational goals. Effective management leads to increased productivity, higher employee satisfaction, and ultimately, the sustained success and growth of the organization (Kowalewski, 2014).

In conclusion, the profession of a manager is multifaceted, requiring a blend of technical knowledge, interpersonal skills, and strategic thinking. As organizations continue to evolve in response to global trends and technological advancements, the role of managers remains indispensable in steering their teams and businesses towards success (Koontz, 1980).

2.6. Generation Z in the Workforce

Generation Z, often referred to as "Gen Z," encompasses individuals born between 1997 and the early 2010s. This generation is the first to grow up with digital technology from a very young age, making them highly tech-savvy and adaptable to rapid technological changes. As they begin to enter the workforce, Gen Z is redefining workplace norms and expectations with their distinct attitudes, values, and approaches to work (Masłyk-Musiał, 2011).

Key Characteristics of Generation Z in the Workforce (Bartczak, Marszał, Stachowska, 2018):

1. **Tech-Savvy and Digitally Native:** Gen Z has grown up in a world where the internet, smartphones, and social media are ubiquitous. They are comfortable using digital tools and expect technology to play a significant role in their work environment. This generation is proficient in multitasking across various digital platforms and can quickly adapt to new software or tools introduced in the workplace.
2. **Desire for Work-Life Balance:** Unlike previous generations that often prioritized career advancement over personal life, Gen Z places a high value on work-life balance. They seek flexibility in their work schedules and are more inclined towards remote or hybrid work models. For Gen Z, the ability to maintain a healthy balance between professional and personal life is essential for job satisfaction.
3. **Focus on Purpose and Meaning:** Gen Z employees are driven by a strong sense of purpose. They prefer working for organizations that align with their values, especially in terms of social responsibility, environmental sustainability, and diversity and inclusion. For this generation, a job is not just about earning a paycheck, but also about contributing to a greater cause.
4. **Entrepreneurial Mindset:** Many members of Gen Z are entrepreneurial and value independence. This is reflected in their preference for freelance or gig work, as it allows them greater control over their schedules and projects. Additionally, Gen Z is not afraid to pursue unconventional career paths, and many of them are interested in starting their own businesses.
5. **Continuous Learning and Development:** Gen Z values personal and professional development. They seek opportunities for continuous learning and are eager to acquire new skills that will help them advance in their careers. Organizations that offer career growth opportunities, mentorship, and training programs are likely to attract and retain Gen Z talent.
6. **Diversity and Inclusion:** Diversity and inclusion are non-negotiable for Gen Z. They expect workplaces to be inclusive, diverse, and equitable, and they are more likely to be loyal to employers who actively promote and practice these values. Gen Z is also more likely to speak out against discrimination and advocate for fairness and equality in the workplace.
7. **Preference for Collaboration and Teamwork:** Gen Z values collaboration and teamwork but in a different way from previous generations. While they are comfortable working in teams, they also appreciate autonomy and the ability to work independently when needed. They thrive in environments where they can contribute to projects in meaningful ways and receive constructive feedback.

Expectations and Preferences of Gen Z in the Workplace

1. **Flexible Work Arrangements:** Gen Z employees expect flexible work environments that allow them to manage their time effectively. Remote work options, flexible hours, and work-from-home policies are attractive to this generation. They prioritize the ability to choose how, when, and where they work.
2. **Innovative and Dynamic Work Culture:** Gen Z is drawn to workplaces that foster creativity and innovation. They prefer dynamic work cultures that encourage experimentation, fresh ideas, and out-of-the-box thinking. Organizations that are open to new approaches and embrace change will be more appealing to this generation.
3. **Regular Feedback and Communication:** Regular feedback is critical for Gen Z employees. They prefer frequent check-ins with managers and constructive feedback that helps them improve and grow. Open communication is key, as Gen Z values transparency and appreciates managers who provide clear guidance and mentorship.
4. **Career Advancement Opportunities:** Gen Z is ambitious and eager to progress in their careers. They seek clear paths for advancement and are likely to leave organizations that do not offer opportunities for growth. Employers who invest in their professional development through training, mentorship, and promotion opportunities will have an easier time retaining Gen Z talent.
5. **Focus on Mental Health and Well-Being:** Gen Z places a strong emphasis on mental health and well-being. They expect employers to provide resources that support their mental and emotional health, such as wellness programs, counseling services, and flexible work arrangements to prevent burnout.

Challenges and Opportunities for Employers (Hildebrandt-Wypych, 2006)

1. **Retention and Loyalty:** Retaining Gen Z employees can be a challenge for employers, as this generation tends to be more willing to switch jobs in pursuit of better opportunities or work environments that align with their values. Employers must focus on creating a supportive and inclusive work culture, offering growth opportunities, and maintaining open lines of communication to retain Gen Z talent.
2. **Integration of Technology:** Employers need to keep up with technological advancements to meet the expectations of Gen Z workers. This generation is used to working with cutting-edge technologies and may become frustrated with outdated systems or processes. Organizations must invest in modern technologies and tools to attract and retain tech-savvy Gen Z employees.
3. **Adapting Management Styles:** Traditional hierarchical management styles may not resonate with Gen Z, who prefer a more collaborative and inclusive approach. Managers need to adapt their leadership styles to be more supportive, approachable, and flexible. Providing regular feedback and creating a culture of mentorship will help foster positive relationships with Gen Z employees.

4. **Diversity and Inclusion Initiatives:** To attract Gen Z talent, organizations must prioritize diversity and inclusion. Employers should actively promote initiatives that create equitable opportunities for all employees, regardless of their background. This can include mentorship programs, diversity training, and inclusive hiring practices.

3. Conclusions

Generation Z, born between 1997 and the early 2010s, represents a unique cohort entering the workforce with distinct characteristics shaped by digital technology. As the first true digital natives, they are highly proficient with technology, expecting it to play a central role in their work. Gen Z values work-life balance, flexibility, and the opportunity to work remotely, differing from previous generations that prioritized career over personal life (Fatyga, 2005).

They seek purpose and meaning in their work, favoring organizations that align with their values, particularly in social responsibility and diversity. Many also possess an entrepreneurial mindset, preferring freelance work and non-traditional career paths. Continuous learning and personal development are important to them, as they seek career growth opportunities (Bartczak, Marszał, Stachowska, 2018).

Diversity and inclusion are essential values for Gen Z, and they expect workplaces to reflect these principles. While they appreciate collaboration, they also value independence and thrive in environments that encourage innovation and creativity (Dyczkowska, 2015).

Employers face challenges in retaining Gen Z employees, who are willing to leave organizations that don't meet their expectations. To attract and retain this generation, companies must offer flexible work arrangements, embrace modern technology, and foster inclusive, dynamic work cultures with clear opportunities for growth and mental health support (Drucker, 2005).

Managers need to adapt their styles to be more collaborative, providing regular feedback and mentorship to resonate with Gen Z's values. Successful organizations will prioritize diversity and inclusion, innovative work environments, and continuous development to meet the needs of this new generation in the workforce (Bartczak, Marszał, Stachowska, 2018).

The problem of generation Z remains open, in the processes of managing human capital, as well as in various other areas of life. The key to solving the problem here is the vision of future intergenerational relations. It seems that the ideal solution to this relationship would be a model integrating the fresh perspectives of generation Z with the experience of mature managers. In light of the interdisciplinary nature of research on the existing situation, analysis and solving the challenges brought by the emergence of a new type of employee becomes one of its most important elements.

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IMPLEMENTING CIRCULAR ECONOMY IN HEALTHCARE – CHALLENGES AND STRATEGIC SOLUTIONS

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Purpose: The study aims to identify and address the key challenges that are faced during the implementation of Circular Economy (CE) for sustainable healthcare.

Design/methodology/approach: This scoping review follows Levac et al.'s (2010) methodological framework, enhanced by Pham (2014) and Tricco (2016), to identify and address relevant literature on challenges and solutions of implementing CE in healthcare. A comprehensive search of SCOPUS, EBSCO, ProQuest, and Web of Science yielded 112 articles (2010 onwards), with 73 meeting inclusion criteria focused on CE challenges and solutions in healthcare. The extracted data were synthesized using a narrative approach to identify key themes and research gaps.

Findings: The study finds key challenges in implementing CE principles in healthcare, including resource depletion, medical waste, energy consumption, emissions, and healthcare inequity. Healthcare's high use of resources and energy results in environmental threats and costs, while significant medical waste contributes to pollution. CE strategies can enhance efficiency, reduce waste, and lower emissions. Overcoming these challenges requires improving resource management, promoting recycling, and ensuring equitable access to sustainable healthcare.

Research limitations/implications: Findings may not be universally applicable due to regional variations in healthcare systems and regulations. Rapid advancements in CE and healthcare technologies may have emerged since the review, affecting the relevance. Practical challenges like regulatory hurdles and financial constraints were identified but not exhaustively explored.

Practical implications: By identifying the main challenges in the implementation of CE principles in healthcare, the study provides valuable guidance for policymakers to develop targeted policies addressing resource depletion, waste management, energy consumption and emissions, and equitable access to sustainable healthcare. For healthcare practitioners, the study offers actionable insights for implementing solutions like recycling programs, energy-saving measures, and sustainable procurement practices within their facilities.

Social implications: Promoting CE practices can reduce pollution, minimize healthcare facilities' environmental footprint, and ensure equitable access to sustainable healthcare.

Originality/value. The originality of this study lies in its comprehensive examination of challenges and solutions for implementing CE principles in healthcare. Focusing on the interconnectedness of sustainability, public health, and social equity, this scoping review offers actionable strategies for promoting sustainability in healthcare systems.

Category of the paper: Scoping Review.

Keywords: sustainability, green economy, CE.

1. Introduction

The healthcare industry, despite its essential role in public health, often remains overlooked in research about environmental sustainability and carbon emissions. Healthcare activities contribute significantly to the global carbon footprint, which accounts for up to 5% of total emissions (Leiva, 2023). 25% of the total amount of medical waste - a quantity expected to rise with the world population aging - is hazardous for human beings and for the environment, containing radiological, biological, or chemical threats (Wei et al., 2021). This impact is driven by energy-intensive operations, pharmaceutical production, medical waste disposal, and resource-intensive supply chains (Stadhouders et al., 2019). This is a huge environmental footprint, making it urgent to adopt Circular Economy (CE) principles within the healthcare system.

Implementing CE practices in healthcare is crucial for several compelling reasons. First, it aims to bring down medical waste, which includes vast amounts of single-use plastics and hazardous materials (Chew et al., 2023). By redesigning products to prioritize durability, recyclability, and reuse, healthcare facilities can significantly diminish waste generation and alleviate the burden on landfills (Ramos et al., 2023). Secondly, CE strategies promote efficient resource use by optimizing processes, adopting responsible procurement practices, and managing supply chains sustainably (Moraga et al., 2019). This can lead to reduced resource consumption, lower operational costs, and decreased overall environmental impact.

Furthermore, addressing healthcare's carbon footprint is paramount in combating climate change. Embracing CE principles can help mitigate these impacts by promoting energy efficiency, renewable energy adoption, and sustainable practices throughout healthcare systems (Yaryhina et al., 2021). Additionally, implementing CE initiatives fosters resilience within healthcare by encouraging local sourcing, reducing reliance on single-use materials, and driving innovation towards sustainable healthcare solutions (Dumée, 2022).

Boerdonk et al. (2021) view the CE in healthcare as an economic strategy that proposes innovative ways to transition from the current linear system of consumption to a circular one. By transforming the predominantly linear model into a circular system, the CE offers opportunities for resource optimization and long-term sustainability (Van Boerdonk et al.,

2021a). According to Moreau et al. (2017) the CE is restorative and regenerative by design with an emphasis on always preserving materials products, and components at their maximum usefulness (Moreau et al., 2017). They highlight the concept as a continuous positive development cycle, and this can be applied to healthcare as well – by recycling and reusing more.

Additionally, Haupt et al. (2019) have envisioned CE as a system of production and consumption with low material and energy losses (Haupt et al., 2019). Their definition emphasizes extensive reuse, recycling, and recovery practices to minimize resource depletion and environmental impact.

CE in healthcare is an economic system that aims to eliminate and reduce waste for the reduction of pollution (D'Adamo et al., 2024). CE in healthcare ensures the circulation of products and materials at their highest value, so they do not turn into waste (UNDP, 2023). It involves strategies like smarter product design, longer use, recycling, and regenerating nature, and can be applied at various scales from individual medical products to medical instruments and devices (Molero et al., 2020) The concept of CE in healthcare is the same as that in other industries - the exact opposite of the prevailing linear economy model, which considers that the available resources are abundant and produced goods can be disposed of after being used once. CE in contrast to that, establishes that products can be kept in a cyclic usage to gain maximal utilization – thus preventing excessive waste (Pacheco et al., 2024).

In implementing CE principles in healthcare, several challenges have been highlighted by different researchers. Mehtsun, Hyland, Offodile (2023) have discussed the emissions generated by healthcare energy consumption. The authors state that supply chains in healthcare, including the food and transportation sector, account for up to 80% of total healthcare-associated emissions in the US. It is a challenge to reduce these emissions without compromising the quality of healthcare. Huttin (2023) and Teymourian (2021) have highlighted the effects of healthcare inequity and inequality The authors argue that achieving equal healthcare access under a CE presents significant challenges. This includes affecting the pricing dynamics across primary markets (e.g., with repurposed products), secondary markets (with reused or recycled products), and the interplay between supply and demand.

Regulatory changes from authorities and major tech players, alongside traditional stakeholders in healthcare, could further complicate this landscape. Another challenge is that repurposing medical equipment or drugs for underserved populations via secondary markets can lower prices but also result in price discrimination. D'Alessandro et al. (2024) focuses on challenges including resource depletion in healthcare. The authors conclude that the challenge is attaining sustainability through a CE model, striving for a profitable and sustainable system that advances the economy without resource depletion. This can only be achieved by minimizing resource use and maximizing recycling.

Kandasamy (2022), has pinpointed that medical waste management has followed a linear economy approach for a long time, but it now needs to transition to a CE due to ecological and economic issues associated with the linear model. Overproduction and waste dumping are causing environmental pollution while dwindling raw materials and rising demand are driving up prices and impacting global markets. These challenges are umbrella terms that carry the other challenges that are found during the application of CE in healthcare systems especially post-pandemic (Wuyts et al., 2020).

These challenges were selected in these studies because of their significant impact on sustainability as found by previous research carried out. They have a significant impact on the healthcare sector and the potential for CE principles to address them effectively.

The worldwide medical devices market reached an astounding value of \$432 billion in 2020 and is expected to grow to \$628 billion by 2028. This has happened with an annual growth rate of 5.4% from 2021 to 2028. This sector of healthcare demands significant resources in terms of mining and energy, typically has a relatively short lifespan, and poses challenges for recycling, leading to a substantial carbon footprint and waste generation (Ivan Idso, 2022). Healthcare facilities use up a large amount of these resources, and their depletion poses environmental threats while leading to increased costs and inefficiencies within the system (Brown, Buettner, Canyon, 2012). Embracing CE strategies can help reduce resource consumption and promote efficiency, mitigating the impact of resource depletion (Tong et al., 2022).

Medical waste generation is another crucial challenge, as healthcare facilities produce large volumes of waste, especially from disposable equipment, medications, and protective gear. This is one of the biggest ways the healthcare sector contributes to the waste pile of the earth (Ekins, Zenghelis, 2021). Consequently, improper disposal methods cause pollution and greenhouse gas emissions on a large scale (Abubakar et al., 2022; D'Alessandro et al., 2024).

CE principles offer solutions by reducing waste generation and encouraging recycling and reuse practices, which can lessen the environmental impact of medical waste (Ranjbari et al., 2022).

Energy consumption and emissions are also major concerns for healthcare facilities, which have high energy usage and resulting emissions. These emissions pose multiple hazards to the environment and the health of humans (Vishwakarma et al., 2023). Application of CE into healthcare can help decrease energy usage which in turn reduces emissions. This aligns with global climate targets and promotes overall sustainability in the sector (Yousefi, Avak Rostami, 2017).

Even though various challenges have been addressed by researchers in the field, none of these research works have presented the challenges all at once. Moreover, there is a need for a solid plan to address and prioritize the various challenges in the healthcare sector, considering how they impact each other. Each healthcare system and region have its unique problems, so we need novel ideas to deal with them effectively. Getting all the key players involved and working together is crucial for moving towards a CE, but there's not enough research on how

to carry this out. Also, there is a lack of good methods to measure and monitor progress, which makes it hard to make informed decisions and compare different CE strategies. By filling these research gaps through teamwork across different fields, we can get a better grasp of the challenges and come up with effective ways to apply CE principles in healthcare. This will help make the sector more sustainable and efficient with resources.

This study aims to find the key challenges in implementing CE principles in the healthcare sector to promote sustainability. Further, the aim is to suggest solutions to all these challenges in this study. The research question that will be addressed is what are the key challenges in implementing CE principles in the healthcare sector, and what strategic solutions can be adopted to overcome these challenges to promote sustainability? These challenges and their solutions will be pinpointed in this paper because they represent crucial areas where efforts to promote sustainability through the implementation of CE. The paper explores the critical barriers to CE adoption in healthcare, as well as proposes corresponding solutions to overcome them and drive sustainable practices in the sector.

2. Methodology

This scoping review follows the methodological framework proposed by Levac et al. (2010) and is further enhanced by Pham (2014) and Tricco (2016). The key steps in the review process are:

1. Identifying the research question.
2. Identifying relevant studies.
3. Study selection.
4. Charting the data.
5. Collating, summarizing, and reporting the results.

A comprehensive search strategy was developed to identify relevant literature from multiple databases, including SCOPUS, EBSCO, ProQuest, and Web of Science. The search terms used a combination of keywords including CE, circular economy, healthcare, healthcare management, sustainability, and their combinations. The search was limited to articles published in English from 2010 onwards. Titles and abstracts of the identified records were screened against the inclusion criteria. Articles that were full-text articles and the author could have access to were then retrieved and assessed for eligibility.

For this analysis, a total of 112 articles were initially scanned from various academic databases and online sources. After a thorough review process, 39 articles were excluded due to reasons such as lack of relevance, not falling into the inclusion criteria, or being conference proceedings. The remaining 73 articles formed the core literature used to identify the key challenges and research gaps in implementing CE principles in healthcare.

The inclusion criteria were:

1. Studies focusing on the challenges faced in implementation of CE principles in the healthcare sector 2010 onwards.
2. Studies examining the challenges and/or solutions for adopting CE practices in healthcare.
3. Peer-reviewed journal articles, and grey literature.

The extracted information was synthesized using a narrative scoping review approach to identify and summarize key themes, patterns, and gaps related to the research question. The synthesis focused on categorizing and describing the various challenges and potential solutions for implementing CE principles in the healthcare sector. All steps in the literature selection process, from initial search to final synthesis, were conducted transparently to ensure the reliability and validity of the findings. The synthesis focused on categorizing and describing the various challenges and potential solutions for implementing CE principles in the healthcare sector.

3. Theoretical Background

The adoption of a CE approach in healthcare entails the repair, reuse, reprocessing, and recycling of resources, requiring effective alignment between healthcare and regulatory bodies to ensure the safety and efficacy of reusable devices. Implementing CE strategies in healthcare can significantly reduce environmental impacts, promoting a more sustainable system. The financial savings generated from these practices can be reinvested in improving staff well-being, patient care, and community outreach programs, ultimately enhancing overall healthcare quality (Al-Alawy et al., 2021).

The development of CE in healthcare revolves around two key strategies: transitioning from a linear to a circular system and designing products with their entire life cycle in mind. This approach prioritizes recycling, reusing, and optimizing resources, aiming to preserve materials and components at their maximum utility (Ellen et al., 2012). However, integrating CE principles into healthcare is complex due to challenges such as ensuring medical product safety, navigating regulatory compliance, and managing costs. Overcoming these challenges requires innovative engineering, stringent testing, and regulatory adjustments to balance sustainability with patient safety (Leiva, 2023).

The intersection of CE and healthcare presents a set of complex problems due to the unique characteristics and demands of the sectors. The design and safety considerations of medical products pose substantial threats. When medical devices are designed, only one aspect is kept in mind - the efficacy and efficiency of patient care that they can provide (Altayyar, 2020; Miclăuș et al., 2020). Transitioning towards reusable or recyclable designs must ensure that

these products remain safe and effective for medical use, complying with regulatory requirements that prioritize patient safety above all else (Guzzo et al., 2020). Finding the right equilibrium between sustainability and safety demands inventive engineering, stringent testing procedures, and continuous monitoring to uphold the durability and reliability of medical devices across their lifespan (Haber et al., 2021).

Navigating regulatory compliance is a multifaceted problem when integrating CE practices into healthcare. This makes it very complex. The healthcare sector is governed by stringent regulations aimed at ensuring patient safety (Kwon et al., 2013). Implementing changes to product design, waste management, or supply chain practices must adhere to current regulatory frameworks or involve the development of new standards that support sustainable practices while maintaining patient care and regulatory compliance standards (Al-Alawy et al., 2021).

Cost considerations also make it harder to adopt CE principles within healthcare (WHO, 2017). Healthcare is known for its high financial costs, and any shifts towards sustainable practices must be economically viable. Implementing reusable or recyclable solutions should not significantly increase financial burdens on healthcare providers or patients, necessitating careful cost-benefit analyses and financial planning (Politecnico et al., 2013; Almodhen et al., 2023). Balancing sustainability with affordability requires strategic investments in technology and infrastructure that demonstrate long-term cost savings and environmental benefits, fostering a sustainable healthcare ecosystem without compromising financial stability (Tambor et al., 2015). Although complex, adopting CE principles in healthcare can significantly reduce waste, enhance resource efficiency, and promote sustainability, ultimately benefiting patients and the environment.

4. Results

The healthcare sector, despite its essential role in public health, has a notable impact on global carbon emissions and environmental health. Accounting for up to 5% of total global emissions, healthcare activities contribute significantly to environmental degradation, particularly through the generation of hazardous medical waste, including radiological, biological, and chemical threats. This environmental footprint is exacerbated by energy-intensive operations, pharmaceutical production, medical waste disposal, and resource-intensive supply chains. Consequently, there is an urgent need for the adoption of CE principles within the healthcare sector.

Comprehensive studies related to the challenges of implementing CE in Healthcare are rare. Researchers tend to focus on single challenges such as waste management (Jafarzadeh Ghouschi et al., 2022; Kandasamy et al., 2022b; Mahjoob et al., 2023), energy consumption (Mehtsun et al., 2023), emissions (Pecchia et al., 2021; Abubakar et al., 2022), and healthcare

inequity and inequality (Huttin, 2023; Teymourian et al., 2021). These all are papers addressing individual healthcare challenges when it comes to the implementation of CE into healthcare but none of them address all of these challenges in one paper. Many studies also focus on other challenges to implementing CE in healthcare supply chains, such as policy, financial, management, social, cultural, and technological barriers (Alfina et al., 2022). Some have also explored challenges to implementing CE in healthcare as analysed from a systems perspective, including infection prevention, behaviours of device consumers and manufacturers, and regulatory structures that encourage the proliferation of disposable medical devices (Basu et al., 2019). Complementary policy- and market-driven solutions are required to encourage systemic transformation in the implementation of CE in healthcare to foster sustainability. (Macneill et al., 2020) However, there is a lack of comprehensive research related to the challenges of implementing CE in healthcare from the individual's perspective. This scoping review addressed all these challenges in one paper.

While implementing CE principles in healthcare, four main challenges have been pinpointed for investigation: resource depletion in healthcare, medical waste generation, energy consumption and emissions, and healthcare inequity and inequality (Samenjo et al., 2023a). These challenges were selected because there is significant research done on them in terms of their impact on sustainability within the healthcare sector and the potential for CE principles to address them effectively. These challenges represent crucial areas where efforts to promote sustainability can have a big impact on CE implementation in healthcare.

There are many challenges found in the implementation of CE principles in healthcare to attain sustainability, during the scoping review. However, four key challenges were pinpointed i.e. resource depletion, medical waste generation, energy consumption, and healthcare inequity as seen in (Figure 1).



Figure 1. CE in Healthcare Challenges – a Visual Depiction.

Source: Own work.

These were found to be the most significant barriers to CE adoption. To overcome these challenges, it is required that regulatory investments are carried out, along with innovating green solutions and strategic investments to create a sustainable healthcare ecosystem post-pandemic. Following are the results of the scoping review describing each of the challenge in detail and discussing possible solutions to address them.

4.1. Resource Depletion

Resource depletion in healthcare, covering energy, water, medicines, and medical equipment, highlights the need for smart resource use to reduce waste and improve efficiency (EU, 2020). The worldwide medical devices market reached an astounding value of \$432 billion in 2020 and is expected to grow to \$628 billion by 2028. This has happened with an annual growth rate of 5.4% from 2021 to 2028. This sector of healthcare demands significant resources in terms of mining and energy, typically has a relatively short lifespan, and poses challenges for recycling, leading to a substantial carbon footprint and waste generation (IvanIdso, 2022). Healthcare facilities use up a large amount of these resources, and their depletion poses environmental threats while leading to increased costs and inefficiencies within the system (Brown et al., 2012). Embracing CE strategies can help reduce resource consumption and promote efficiency, mitigating the impact of resource depletion (Tong et al., 2022).

To mitigate resource depletion, regulatory investments are crucial to enforce sustainable practices and provide incentives for resource optimization (Aithal, Aithal, 2023). This can include the implementation of policies that encourage people to practice responsible procurement, The promotion of the use of renewable resources must be also practiced along with a focus on the regulation of healthcare resource extraction in a way that the environmental impact is reduced (Pecchia et al., no date). Other ideas include the development of ecologically friendly materials, thus reducing resource consumption while maintaining quality standards in healthcare (Kondratenko et al., 2023).

4.2. Medical Waste Generation

Medical waste generation is another crucial challenge, as healthcare facilities produce large volumes of waste, especially from disposable equipment, medications, and protective gear. This is one of the biggest ways the healthcare sector contributes to the waste pile of the earth (Ekins et al., 2021). Healthcare facilities are known to produce a variety of waste, including single-use equipment and materials, contaminated materials, and pharma by-products (Dixit et al., 2024) Consequently, improper disposal methods cause pollution and greenhouse gas emissions on a large scale (Abubakar et al., 2022; D'Alessandro et al., 2024). CE principles offer solutions by reducing waste generation and encouraging recycling and reuse practices, which can lessen the environmental impact of medical waste (Ranjbari et al., 2022).

To address this issue, it is vital to work towards the creation of a waste management strategy that prioritizes the reduction of waste along with recycling and reusing it (Lee, Lee, 2022). Healthcare regulatory frameworks need to be focused on mandating the segregation of medical waste and healthcare disposal practices (Najafi, Kohli, 1997). The healthcare sector needs to make investments towards innovation in waste treatment technologies - this may include repurposing and recycling in a way that minimizes the environmental impact while promoting CE principles in healthcare (Tabrizi et al., 2018).

4.3. Energy Consumption

Energy consumption and emissions are also major concerns for healthcare facilities, which have high energy usage and resulting emissions. These emissions pose multiple hazards to the environment and the health of humans (Vishwakarma et al., 2023). Healthcare buildings, vital to societal well-being, present a distinct sustainability challenge due to their continuous operation and stringent hygiene standards, which significantly impact emissions management (Silva et al., 2024). Hospitals demand significantly more thermal and electrical energy compared to other commercial buildings due to their constant operation round the clock, every day of the year. Most of the energy in healthcare is primarily utilized for heating, air conditioning, producing sanitary water, sterilization, laundry, and kitchen services; thus increasing the emissions (Chen-Xu et al., 2024). Application of CE into healthcare can help decrease energy usage which in turn reduces emissions. This aligns with global climate targets and promotes overall sustainability in the sector (Yousefi et al., 2017).

To tackle energy consumption in healthcare, strategic investments are needed to promote energy efficiency and renewable energy adoption (Taleb et al., 2022). Regulatory incentives can also encourage the adoption of energy-saving practices, like upgrading to energy-efficient equipment. This can also include optimizing building designs for natural lighting and ventilation (Lipschutz et al., no date). Furthermore, investing in renewable energy infrastructure, like solar panels and wind turbines, can decrease reliance on fossil fuels and mitigate greenhouse gas emissions (Ramos et al., 2021).

4.4. Healthcare Inequity

There is healthcare inequity and inequality come from the complex supply chains within healthcare that involve numerous stakeholders, making it difficult to trace and manage the environmental impact of products and materials used in medical care (Woromogo et al., 2020). Regulatory and policy barriers often do not prioritize sustainability or those trying to gain access to sustainable healthcare, hindering the adoption of eco-friendly technologies and practices (Aboueid et al., 2023). Public awareness and engagement around healthcare sustainability remain important for fostering support and understanding among patients, and healthcare professionals (Calabrese et al., 2023). It also means that healthcare needs to be made more accessible in terms of sustainable healthcare to everyone in society (Molero et al., 2020).

Addressing healthcare inequity requires regulatory interventions to promote equitable access to sustainable healthcare solutions (Hadjiat, 2023). This includes implementing policies that prioritize sustainability in healthcare procurement and resource allocation, ensuring that underserved communities have access to eco-friendly medical products and services (Sheringham et al., 2022; Haggerty et al., 2020). Moreover, targeted investments in community-based healthcare initiatives and public awareness campaigns can foster sustainability and equity in healthcare provision (Gkiouleka et al., 2023).

The solutions to challenges all have a common objective – that is attaining sustainability through a CE model, striving for a profitable and sustainable system that advances the economy without resource depletion. This can only be achieved by minimizing resource use and maximizing recycling (Kandasamy et al., 2022a) These challenges are umbrella terms that carry the other challenges that are found during the application of CE in healthcare systems especially post-pandemic (Wuyts et al., 2020). These challenges were selected in these studies because of their significant impact on sustainability as found by previous research carried out. They have a significant impact on the healthcare sector and the potential for CE principles to address them effectively (Samenjo et al., 2023).

Overcoming these challenges necessitates a collaborative effort from regulatory bodies, healthcare providers, and stakeholders to prioritize sustainability and innovation in healthcare practices. This involves implementing regulatory investments, fostering green solutions, and making strategic investments to establish a sustainable healthcare ecosystem. However, integrating CE principles into established healthcare systems presents challenges due to the multifaceted nature of the industry. Addressing these barriers requires proactive measures and innovative solutions to ensure the effective and sustainable implementation of CE practices in healthcare.

5. Conclusion

The purpose of this scoping review study was to comprehensively identify and address the key challenges and suggest solutions for the challenges faced during the implementation of CE principles for sustainable healthcare. It sought to explore how CE strategies could mitigate environmental impacts caused by healthcare activities, such as resource depletion, medical waste, and high energy consumption, while promoting efficiency, waste reduction, and equitable access to sustainable healthcare. By examining these challenges and proposing strategic solutions, the study aspired to guide policymakers and healthcare practitioners in developing and adopting CE practices that enhance sustainability within the healthcare sector. For this purpose, a comprehensive scoping review was conducted by carrying out a systematic search of existing literature that fulfilled the criteria of this scoping review. These articles were

analysed and synthesized using a narrative approach to identify key themes and research gaps related to CE challenges and solutions in healthcare.

Incorporating CE practices in healthcare holds promise in addressing numerous challenges. By revamping product designs to prioritize durability, recyclability, and reusability, healthcare establishments can effectively mitigate medical waste, encompassing single-use plastics and hazardous materials. This proactive approach not only curbs waste generation but also mitigates environmental hazards linked to improper disposal. CE strategies advocate for efficient resource utilization via process optimization, responsible procurement, and sustainable supply chain management. This translates into reduced resource consumption, diminished operational expenses, and an overall decline in environmental footprint. Moreover, optimizing resource usage contributes to conserving natural resources for future generations.

Addressing energy consumption emerges as another pivotal aspect where CE practices wield significant influence. Purposeful investments in energy efficiency and the adoption of renewable energy sources can reduce the dependence on fossil fuels, helping in a transition toward cleaner energy alternatives. Through initiatives like optimizing building structures, upgrading equipment, and investing in renewable energy infrastructure, healthcare facilities can reduce their carbon footprint, thereby advancing environmental sustainability. CE practices offer avenues to tackle healthcare inequity by ensuring equitable access to sustainable healthcare solutions. Regulatory frameworks play a critical role in prioritizing sustainability in healthcare procurement and resource allocation, especially for marginalized communities. Directed investments in community-based healthcare programs and public awareness initiatives are essential in fostering sustainability and fairness in healthcare provision.

Integrating CE principles into healthcare operations presents a comprehensive approach to addressing various challenges, encompassing medical waste generation, resource depletion, energy consumption, and healthcare inequity. Addressing healthcare's carbon footprint is critical for combating climate change. Embracing CE principles can help achieve this by promoting energy efficiency, renewable energy adoption, and sustainable practices across healthcare systems. Moreover, CE initiatives foster resilience within healthcare by encouraging local sourcing, reducing dependence on single-use materials, and driving innovation towards sustainable solutions.

There are limitations to this article that need to be addressed. First, there is a strong focus on challenges and research gaps from the perspective of Western or developed countries. This overlooks the unique situations and constraints faced by developing nations or resource-limited healthcare systems. The geographical diversity of these challenges is also not adequately considered. The feasibility of CE strategies in different regions can be significantly influenced by factors such as infrastructure, cultural norms, and legal frameworks. Additionally, without quantitative data and metrics, it's challenging to gauge the relative impact or scale of the identified challenges, as well as the possible economic and environmental benefits of implementing CE principles in healthcare.

To overcome these limitations and improve our understanding of implementing CE principles in healthcare, future research should focus on comparative studies across diverse healthcare systems, including both developed and developing countries. Additionally, exploring effective models for stakeholder engagement and collaboration can help identify the incentives, roles, and responsibilities of different stakeholders in moving towards a CE in healthcare. Bringing together experts from healthcare, environmental science, economics, and policy can give us a deeper understanding of the challenges and help find effective solutions. By addressing these research directions, researchers can provide a more actionable understanding of implementing CE principles in the healthcare sector, ultimately promoting sustainability and resource efficiency.

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UTILIZING ARTIFICIAL INTELLIGENCE FOR ENERGY-EFFICIENT ROUTE PLANNING IN HYPERLOOP LOW-PRESSURE CAPSULE TRANSIT: A STUDY IN ALIGNMENT WITH SUSTAINABLE DEVELOPMENT GOALS

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Purpose: The purpose of this paper is to explore the integration of reinforcement learning with simulation software to optimize Hyperloop transportation systems, aiming to enhance operational efficiency, reduce departure timetable variability, and improve station operations through dynamic dispatch prioritization.

Design/methodology/approach: The research utilizes reinforcement learning combined with discrete-event simulation to model and optimize Hyperloop system operations, focusing on departure schedules, delay reduction, and dispatch prioritization.

Findings: The research demonstrates that reinforcement learning significantly enhances Hyperloop system performance by optimizing departure schedules, reducing delays, and improving dispatch prioritization, leading to more efficient and reliable operations.

Research limitations/implications: The study's limitations include the reliance on simulated data and hypothetical scenarios, which may not fully capture real-world complexities, and future research should focus on testing the proposed methods in actual Hyperloop environments and addressing potential scalability issues.

Practical implications: The research identifies enhanced diagnostic methods for Hyperloop systems that could lead to more efficient and reliable operations, potentially reducing maintenance costs and downtime. The adoption of these methods can improve the safety and performance of Hyperloop services, thereby boosting commercial viability and economic benefits for businesses involved in the development and operation of this high-speed transportation technology.

Social implications: This research on Hyperloop diagnostics could significantly influence public attitudes towards the acceptance and adoption of high-speed vacuum transportation, highlighting its safety and efficiency. Improved diagnostic methods will enhance the reliability of Hyperloop systems, promoting sustainable and environmentally friendly transportation alternatives. Additionally, the findings could inform public and industry policy, encouraging investment in advanced transportation infrastructure, ultimately improving quality of life through reduced travel times and lower emissions.

Originality/value: This paper presents novel diagnostic methods tailored for the unique conditions of Hyperloop systems, such as high-speed vacuum environments. It offers valuable insights for engineers, researchers, and policymakers involved in the development and implementation of advanced transportation technologies.

Keywords: Artificial Intelligence, Hyperloop, FlexSim Simulation, Operational Efficiency, Reinforcement Learning.

Category of the paper: Research paper.

1. Introduction

The Hyperloop, initially conceptualized by George Medhurst and re-envisioned by Elon Musk in 2013, epitomizes a sustainable, high-speed transportation system utilizing electromagnetic propulsion within low-pressure tubes. This innovation promises drastic reductions in travel times and environmental impacts, aligning with the goals of the Green Industrial Revolution by decreasing greenhouse gas emissions and energy consumption (Premsagar, Kenworthy, 2022). With global research and development accelerating, Hyperloop technologies are poised to transform the transportation of passengers and freight, marking a shift towards a more efficient and sustainable future (Barbosa, 2020). Simultaneously, Artificial Intelligence (AI) has advanced from its nascent symbolic and rule-based frameworks to sophisticated neural networks and machine learning techniques, enriching problem-solving across various sectors, including education and healthcare (Zerilli et al., 2021). This progression is underscored by the emergence of Reinforcement Learning (RL), which through Markov decision processes, enables agents to learn and optimize behaviours via trial-and-error, thus enhancing decision-making in dynamic environments (Sutton, Barto, 1998). When combined with neural networks, RL—through deep reinforcement learning—has initiated groundbreaking improvements across diverse fields such as queue management and crisis resource allocation (Mnih et al., 2015). In the realm of transportation, AI's integration is further amplified by simulation technologies like FlexSim, which optimize logistics and potentially reduce environmental footprints. However, the deployment of such simulations raises critical concerns regarding overfitting and data privacy, necessitating robust AI governance to ensure fairness and transparency (Marquis et al., 2020). This paper examines the integration of an RL model into FlexSim for optimizing Hyperloop station operations, aiming to enhance operational efficiency and adjust departure schedules in response to fluctuating passenger demands.

2. Literature Review

Introduced by Elon Musk in 2013, the Hyperloop utilizes electromagnetic propulsion to transport passengers and goods at high speeds through low-pressure tubes, offering potential energy efficiency and minimal environmental impact. Despite its transformative promise, the Hyperloop confronts significant challenges including the necessity for full-scale testing facilities to emulate real-world conditions (Mitropoulos et al., 2021), safety concerns like motion sickness from rapid travel (Almujibah et al., 2020), and high capital costs which may limit access primarily to higher-income groups (Premsagar, Kenworthy, 2023). The system also requires the integration of vehicle and infrastructure design, demanding advanced optimization to meet complex parameters and secure stakeholder confidence (Kirschen, Burnell, 2021). Overcoming these technical and social hurdles through focused research and strategic policymaking is essential for successful Hyperloop implementation (Kupriyanovsky et al., 2020).

FlexSim, a discrete-event simulation software, effectively constructs three-dimensional models of systems, enhancing operations across industries by identifying bottlenecks and optimizing processes (Garrido, 2009). In manufacturing, it boosts productivity and efficiency by simplifying complex procedures (Yi-jun, 2011), and in logistics, it improves warehouse operations and system decision-making (Xing-hua, 2009). Moreover, FlexSim's educational applications provide practical operational insights, improving learning outcomes in logistics and industrial engineering (Ru, 2012).

AI revolutionizes transportation management through advanced route scheduling and dynamic response systems. For example in aviation, AI may optimize fleet routing to enhance profitability and service quality (Yan, Tseng, 2002), while in queue management, reinforcement learning (RL) techniques can reduce waiting times and optimize space usage (Sun et al., 2022). AI also refines simulation accuracy in transport logistics, crucial for applications like FlexSim (Marquis et al., 2020), and improves route and energy management through predictive analytics (Pal, 2023; Zhang et al., 2021).

3. Research methodology

The study employed the FlexSim simulation environment to design and evaluate a dynamic-flow process. This involved developing a code environment in Visual Studio, which was divided into four segments: environment, interface, training process and FlexSim process flow code directly related to the objective function adopted.

The environment designed in FlexSim to reflect a hypothetical Hyperloop capsule station is shown in Figure 1.

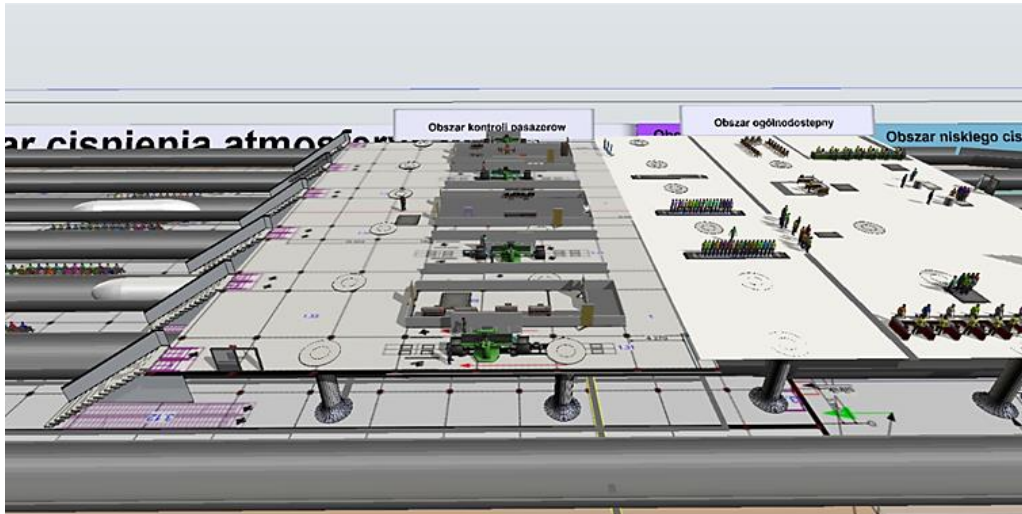


Figure 1. Presented concept of hyperloop station simulation made in Flexsim software.

Source: own elaboration.

Visual and interactive simulations made it possible to visualize the sequence of events, both temporally and spatially, thereby improving the identification of bottlenecks and the optimization of the passenger dispatch process. The adaptability and precision of FlexScript is crucial for testing various scenarios and refining the model to achieve more accurate and relevant outcomes (Nordgren, 2002).

3.1. Reinforcement learning integration

The framework, structured in multiple layers, leverages the Open AI Gym library (currently Gymnasium library) to develop, evaluate, and enhance reinforcement learning algorithms, supporting essential data transformations and complex array management through NumPy for real-time processing (see: Terry et al., 2020). It was then integrated with standard Python libraries such as os, subprocess, and socket to manage system processes and facilitate network communication, ensuring robust infrastructure for continuous data exchange and command operations with FlexSim. The interaction itself is enabled by the Python socket library, allowing real-time communication with the FlexSim application.

```

CODE
flexsim_env.py
flexsim_inference.py
flexsim_training.py
Model90000IterationChangeOverTi...

flexsim_env.py > FlexSimEnv > reset
11 class FlexSimEnv(gym.Env):
36     def step(self, action):
37         self._take_action(action)
38         state, reward, done = self._get_observation()
39         truncated = False
40         info = {}
41         return state, reward, done, truncated, info

```

Figure 2. Code snippet from flexsim_env.py script in Visual Studio.

Source: own elaboration.

The architecture is based on FlexSimEnv (Figure 2), a custom Gym environment designed to interact seamlessly with FlexSim, employing methods like `reset` and `step` to adjust simulation states and manage interactions for consistent control (see: Yao, Chen, Zuo, 2014). In each simulation step, the function performing the step returns the state of the environment and the reward function. In addition, a rendering function is called, visualizing the progress of the simulation in the FlexSim environment.

The integration of the FlexSim environment with the OpenAI Gym API allows for increased productivity and efficiency of the system by employing reinforcement learning algorithms such as Proximal Policy Optimization (PPO), Advantage Actor-Critic (A2C), Deep Q-Network (DQN), and Soft Actor-Critic (SAC), which learn optimal policies through environmental interactions (Figure 3). The implementation of these algorithms is facilitated by Stable Baselines 3, which supports model training and comparison, leveraging PyTorch and TensorFlow to accelerate processing via GPU.

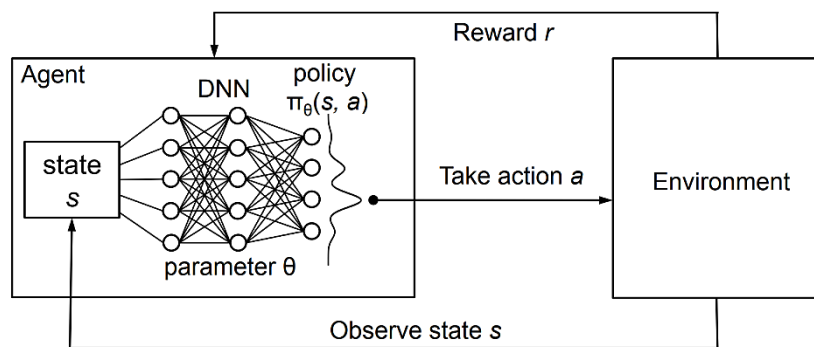


Figure 3. Reinforcement Learning with policy represented via DNN.

Source: Mao, Alizadeh, Menache, Kandula, 2016.

The training progress is monitored through Stable Baselines 3 custom callbacks using dynamically logging rewards. CUDA-enabled GPUs expedite computations through parallel processing, optimizing the handling of large models and datasets. The modularity of the code allows for seamless transitions between different RL algorithms by simply updating parameters in the setup function, significantly streamlining the testing process. Finally, training visualization plots average rewards against steps, providing critical insights into the effectiveness of the chosen algorithms and facilitating ongoing optimization

3.2. Model inference

Once the machine learning model has been trained it can be integrated with a Python-based HTTP server in order to enable dynamic, real-time interactions using data formatted in JSON. These data are then analyzed through Stable Baselines3, ensuring efficient predictions from incoming data streams (see: Seyidova, Shakhayev, 2023). Technically a special FlexSimInferenceServer class adeptly handles HTTP GET and POST requests and convert JSON formatted data into Python's numpy arrays using transformation functions, and subsequently generating predictions with a Stable Baselines3 model, thereby returning the

outcomes back in JSON to support ongoing machine learning processes (Raschka, see: Patterson, Nolet, 2020). The main function initializes the server with a pre-trained PPO model and manages its operations until a shutdown signal is received, ensuring continual system oversight and effective real-time response capabilities (see: Raffin et al., 2021).

3.3. Reward function calculation

This study developed a dynamic reward system through a sequence of steps, each crucial for system functionality. First the system initializes objects representing people in a given colour. Concurrently, passengers are assigned with colours as codes for their destination – red (1), green (2), blue (3), yellow (4), orange (5). The same goes for pallets functioning as pods (Figure 6). This gives quick identification and enables easy tracking of system conditions. The system calculates the number of people linked to a given colour (pallets). Then the capsule capacity difference (places left) is computed by subtracting number of people from the maximum capsule capacity, which in the simulation was 25.

Name	Value
LastItemType	3
People queue	28
Red people	11
Green people	12
Blue people	2
Yellow people	3
Orange people	0
Red pallet	58
Green pallet	69
Blue pallet	69
Yellow pallet	72
Orange pallet	78

Figure 4. Parameters and values in Flexsim Hyperloop Station simulation's observational space.

Source: own elaboration.

The reward function model used in the training phase is defined as follows:

Having:

c – capacity difference ($25 - \text{number of people}$),

a – average number of people in the queue,

n_i – number of people of colour i in the queue, where $i \in \{\text{red, green, blue, yellow, orange}\}$,

n – total number of people,

C – capsule capacity (in the simulation $C = 10$),

v – value of the reward for having more people than the average (in the simulation $v = 5$),

A – the maximum reward function value (in the simulation $A = 10$),

The reward r is calculated as follows:

$$r = \begin{cases} A & \text{if } c = 0 \\ A - c & \text{if } 0 < c \leq 5 \\ \frac{1}{C + 1 - c} & \text{if } c > 5 \end{cases} \quad (1)$$

If the capacity difference c is 0, indicating full capacity, the reward is maximal (equal to $A = 10$). If the capacity difference c ranges from 1 to 5, the reward decreases linearly from A . If the capacity difference exceeds 5, the reward is inversely proportional to the capacity difference c beyond the threshold of the maximum capsule capacity C . The piecewise function plot of reward function calculation is shown in Figure 5.

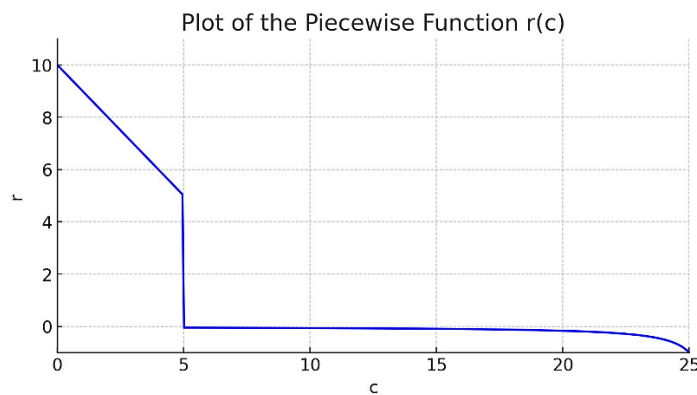


Figure 5. Plot of Piecewise Function $r(c)$ of reward function calculation.

Source: own elaboration.

Reward adjustments are made based on action alignment and whether the combined total of number of people n and those associated with a specific colour n_i is within average number of people a .

For each colour $i \in \{\text{'red'}, \text{'green'}, \text{'blue'}, \text{'yellow'}, \text{'orange'}\}$ the reward function r is adjusted as follows:

$$r = \begin{cases} r - v & \text{if action} = \text{color } i \text{ and } n_i + n \leq a \\ r + v & \text{if action} = \text{color } i \text{ and } n_i + n > a \end{cases}$$

Rewards decrease by $v = 5$ if conditions are met, otherwise, they increase by the same amount. These calculated rewards update the node, influencing the system's overall reward value based on the evaluated parameters.

4. Results

The transition from conventional First In, First Out (FIFO) logistics, which lacked adaptability to variable demand, to the use of the Reinforcement Learning (RL) model represents a significant advancement. The RL model improves system efficiency by dynamically adjusting strategies based on real-time feedback, a necessary adaptation FIFO fails to make. Although initial RL applications demonstrated suboptimal results due to erratic behaviors, adjustments to the gamma parameter, which balances immediate versus future rewards, enhanced stability and performance. Early in the training phase, a sharp increase in average rewards indicates successful learning and performance improvements, despite fluctuations from strategy exploration. As training progresses, rewards continue to increase but at a slower rate, suggesting a stabilization in learning as strategies are refined towards optimal performance.

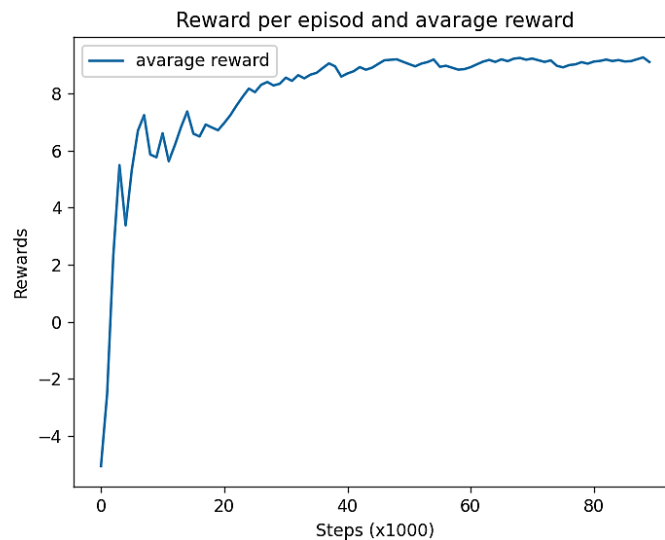


Figure 6. Reinforced Learning Step Count vs. Average Reward.

Source: own elaboration.

In the later stages of training, specifically between 60,000 and 90,000 steps, the agent's performance exhibits minimal reward increases, stabilizing at a high level and suggesting a plateau in learning where further improvements may be negligible. This stabilization, characterized by minor fluctuations, indicates that the model is approaching peak performance, rendering additional training potentially redundant. Through iterative parameter optimization, particularly adjustments to the gamma parameter that significantly influences the discounting of future rewards, the model's performance and stability have improved. This enhancement is evidenced by a consistent rise in capsule fill statistics, reflecting the model's increased efficiency and accuracy in the simulation scenarios and a reduction in variability across iterations, underscoring the necessity of fine-tuning of the reinforcement learning models. The training, conducted over four stages: 2048; 10,000; 40,000 and 90,000 steps, shows that

the designed model, intended for capsules with a 25-passenger capacity, achieves an average fill of 21.26 passengers, markedly surpassing the efficiency of simpler FIFO method applications.

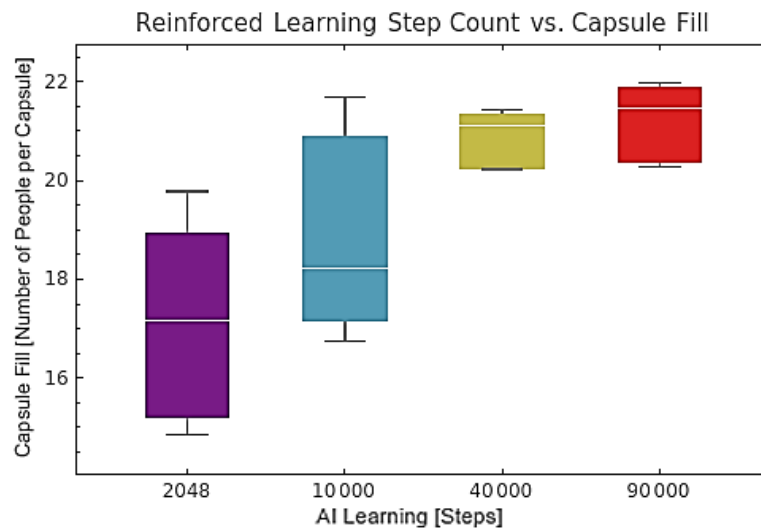


Figure 7. Box and whisker plot of RL Count vs. Capsule Fill.

Source: own elaboration.

In a research study examining reinforcement learning models, initial results showed a wide range in capsule fills with a lower median at 2048 steps. As the model progressed to 10,000 steps, both the median fill and its range increased, indicating improvements. By 40,000 steps, there was a noticeable refinement in prediction accuracy, evidenced by higher median fills and reduced variability. At 90,000 steps, the model's performance stabilized significantly, achieving a median fill close to the target of 25 passengers and minimal variability, suggesting that the learning was nearing a plateau (Figure 10). Throughout the learning process, significant enhancements were observed across various metrics such as minimum, first quartile, median, third quartile, and maximum, with a decrease in the interquartile range indicating a decrease in variability and a stabilization of results. These observations underscore the importance of parameter optimization in enhancing the performance of reinforcement learning models.

5. Discussion

This research explores enhancing Hyperloop station operations using a Reinforcement Learning (RL) model, employing the Stable Baselines3 library and Proximal Policy Optimization algorithm within a FlexSim simulation. The goal is to optimize efficiency and reduce departure timetable variability amid fluctuating passenger flows by programming the RL system to prioritize the dispatch of Hyperloop capsules, tailored to transport up to 25 passengers to five designated destinations based on passengers' shirt colours. Throughout

an 8-hour simulation, the model demonstrated rapid learning gains, achieving peak performance with consistent capsule fill rates and decreased variability. Furthermore, fine-tuning the gamma parameter significantly enhanced the stability and effectiveness of the model, highlighting the potential of RL to improve operational dynamics and environmental sustainability in complex transportation systems.

Proximal Policy Optimization (PPO) navigates the balance between exploration and exploitation within Reinforcement Learning (RL) algorithms, necessitating comparative analyses with other RL techniques like Advantage Actor-Critic and Deep Q-Networks to determine the most effective under varying conditions. Enhanced by automated tuning methods such as Bayesian optimization and genetic algorithms, these models gain robustness by minimizing biases and optimizing performance efficiently. Expanding simulation models to encompass additional destinations, processors, tracks, and capsules enables a deeper evaluation of system capacity and efficiency, particularly vital in high-speed transportation systems where optimizing passenger wait times and capsule utilization is critical for efficiency and satisfaction. Additionally, incorporating variability in passenger arrivals, such as during peak periods, improves the adaptability of these strategies to dynamic demands, increasing the realism and utility of the models. Future research should validate these strategies while exploring cargo logistics optimization using RL, which takes into account operational factors like delivery windows and cargo priorities, ensuring comprehensive improvements in both passenger and cargo transport sectors.

6. Conclusions

This study examines the transformation from a traditional First In, First Out (FIFO) logistics model to a dynamic, adaptive system using Reinforcement Learning (RL), which continually adjusts to fluctuating demands and priorities, thereby enhancing operational efficiency. Implementing RL within the FlexSim environment has markedly increased operational efficiency in hyperloop transportation systems by optimizing time management, reducing costs, and increasing throughput; notably, the average passenger capacity per vehicle has risen significantly. Initial training phases demonstrate rapid learning, with rewards peaking during early stages and stabilizing as the system approaches near-optimal performance. Further refinements in the gamma parameter have improved stability across various training milestones, underlining RL's potential in achieving highly efficient and adaptable transportation solutions.

This research not only contributes to the discourse on the potential applications of artificial intelligence, particularly reinforcement learning in transport systems, but also aims to improve the user experience of transport systems, as in the hyperloop under study, by optimizing operational indicators. Despite promising simulation results, the need for real-world validations

remains, highlighting the importance of further studies that extend these findings through practical applications and broader algorithm comparisons.

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EXPLORING THE ROLE OF BRAND EXPERIENCE IN DRIVING CONSUMER EMOTIONS AND ENGAGEMENT WITH SPORTS BRANDS IN AUSTRALIA

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Purpose: This paper aims to fill the theoretical gap in understanding and practical implementation by examining how sports brands in Australia use brand experience to link emotional response and brand engagement.

Design/methodology/approach: The study fits into the positivist paradigm. The starting point is the stimulus-organism-response theory. A quantitative method, which is an online survey, was used to collect data. Responses from 610 respondents were collected, and after they were cleaned, data from 526 participants were analyzed. The conceptual model of the relationships between variables was verified using the regression method.

Findings: The findings confirmed the hypotheses. Brands investing in comprehensive experiences effectively generate positive emotions among consumers, increasing consumer brand engagement.

Research limitations/implications: The study sample was limited to the Australian population. Further limitations include the relatively small sample size and the participants' demographics skewed towards specific age ranges, which limit the potential for generalization to broader populations or industries. Future research could overcome these limitations by exploring different industries or cultural contexts and using more objective means of data collection.

Practical implications: The article offers practical recommendations for creating emotionally compelling campaigns. More significant investment in experiential marketing can strengthen customer bonds and long-term relationships with sports brands.

Social implications: Sports brands uniquely unite people and strongly influence communities, so sports organizations must consider the social consequences of their actions. Their actions can affect physical health and social integration, shaping values and building bonds between people. Sports organizations that consider the social aspects of their activities can build strong, positive relationships with fans, partners, and local communities.

Originality/value: This article advances the understanding of experiential marketing by highlighting the importance of emotional responses in promoting strong associations between consumers and brands. The findings have implications for academics and practitioners working in advertising and brand communication more broadly in the context of the Australian sports industry.

Keywords: Experiential marketing, Brand experience, Emotional response, Brand engagement, sports brands.

Category of the paper: Research paper.

1. Introduction

The relationship between emotions and consumer experiences has gained significant attention from academics and practitioners in the ever-changing landscape of contemporary marketing (Le et al., 2019). As such, brand experience, which aims to generate intense and memorable encounters between brands and consumers, is gaining popularity (Rather, Hollebeek, 2020). This paper examines brand experience in the context of sports brands operating in Australia, focusing on how these brands leverage their experience and emotional response to enhance consumer engagement.

The intersection of emotional responses and brand experiences is becoming an attractive area of research and marketing practice (Mostafa, Kasamani, 2021; Sykora et al., 2022). Consumers no longer view brands as mere providers of products and services. They seek relationships with brands that align with their values, lifestyles, and goals (Akoglu, Özbek, 2022; Chang et al., 2021). As a result, marketers have recognized the need to appeal to consumers' emotional aspects (Ding et al., 2015). This shift in customer expectations has made the brand experience one of the most crucial brand tactics (Rather, 2020). It focuses on delivering a product and coordinating moments that deeply resonate with consumers (Sprott et al., 2009).

The Australian sports industry, deeply rooted in the country's history and culture (Gilchrist, Wheaton, 2017), provides a unique setting for examining the relationships between brand experiences, emotional responses, and consumer brand engagement (Morgan, Taylor, 2017). As a universal medium, sports can unite people from different backgrounds through shared interests (Scola, Gordon, 2018).

Despite the positive attitudes that can be stimulated through brand experiences (Chang et al., 2021; Rather, 2020), there are barriers to effectively implementing these tactics for sports brands, including rapid technological advances, changing consumer behaviour, and the demand for authentic interactions are obstacles that require creative solutions (Lee, S.M., Lee, D., 2020). Furthermore, assessing the emotional effect and converting it into measurable outcomes is not without complications that deserve to be explored (Funk, 2017; Killick, Griffiths, 2022; Larocca et al., 2020). This paper aims to fill the gap in the literature by examining the influence of brand experience and emotional response on consumer brand engagement, a topic that is important as evidenced by Rather and Hollebeek (2020) and other articles (Ahn, Back, 2018; Kim et al., 2020; Sykora et al., 2022). Academics and researchers have been exploring the field of sports brand experiences for several years to understand its influence on consumers'

emotional response and brand engagement, examining topics such as live events (Funk, 2017; Morgan, Taylor, 2017), the development of participatory mobile applications (Killick, Griffiths, 2022), social media interactions (Lee, S.M., Lee, D., 2020), the participation of sports brands in multiple sports competitions and promotions (Zhang et al., 2018), and the study of cultural factors and their impact on consumer engagement (Rather, 2020). However, despite the growing body of empirical research on the subject, little is known about how brand experience influences consumer emotional response and brand engagement in the context of the Australian sports industry (Ahn, Back, 2018; Rather, Hollebeek, 2020).

This study contributes to the debate on the importance of brand experience by examining the complexity of emotional responses, the techniques used and their subsequent impact on consumer brand engagement. Understanding how emotions can be manipulated to enhance consumer engagement in sports brands can inform marketing approaches across industries.

This paper contributes to the growing literature on brand experience related to emotional response. This effect cannot be fully appreciated until we understand how emotional response affects consumer brand engagement and what role brand experience plays in this process. This article advances knowledge in this area by demonstrating the influence of brand experience on emotional response and, as a result, customer brand engagement.

The article is structured as follows. It begins with a conceptual framework and research hypotheses. It then describes the methodology, including the sample selection process, the study procedure, the variables used, and the data analysis and results. It then presents the theoretical contributions, practical implications, limitations, and suggestions for future research directions. Finally, it concludes with conclusions.

2. Conceptual framework and hypotheses development

2.1. Theory of Stimulus-Organism-Response

We used the stimulus-organism-response model (S-O-R) proposed by Mehrabian and Russell (1974) to explain the relationships between the constructs analysed in the study. This model allows us to show the influence of external factors on consumers and their resulting behaviour (Kim, Johnson, 2016; Jacoby, 2002).

A consumer's experience with a brand influences their emotional responses to that brand (Iglesias, Singh, Batista-Foguet, 2011; Brakus et al., 2009). When consumers have memorable, personalized, and positive experiences with a brand (S), they develop emotional bonds (O) that lead to higher brand loyalty, which can result in brand engagement (Khan, Fatma, 2017; Hwang, Choi, 2019). A brand's sensory appeal plays a significant role in engaging consumers' senses (Krishna, 2012; Lemon, Verhoef, 2016; Roggeveen et al., 2020). These experiences trigger

emotional responses that can reinforce brand perceptions, showing that brand experience is a crucial driver of emotional reactions (Brakus et al., 2009; Iglesias et al., 2011). Emotional responses mediate between brand experience and consumer behaviour (Ladhari, 2007). Positive experiences trigger joy, satisfaction, and excitement (Dunn, Hoegg, 2014). These emotions, in turn, influence brand-related behaviours such as word-of-mouth marketing and overall brand loyalty, one of the antecedents of consumer brand engagement (R) (Hollebeek, 2011; Islam, Rahman, 2017).

Previous studies have not directly answered whether there is a relationship between brand experience, emotional response and consumer brand engagement.

2.2. Brand Experience

We used the stimulus-organism-response model (S-O-R model) proposed by Mehrabian and Russell (1974) to explain the relationships between the constructs analyzed in the study.

To survive today, brands need to create strong bonds with their customers. Only in this way can they attract them away from other brands (Mostafa, Kasamani, 2020; Akoglu, Özbek, 2022). The concept of brand experience, initially introduced by Schmitt (1999), has gained importance recently (de Oliveira Santini et al., 2018; Schmitt et al., 2014). In the Australian sports industry, brand experience is integral (Morgan, Taylor, 2017). These experiences serve as the foundation for the brand experience. When consumers directly engage with a product or service, they develop perceptions, emotions, thoughts, and actions (Khan, Fatma, 2017; Mostafa, Kasamani, 2021). Extensive research conducted in the consumer and marketing fields reveals that these experiences materialize during various stages, including the search for products/services, purchase decisions, decision-making processes, product usage, and post-purchase customer service encounters (Batat, 2024).

Brand experience is essentially characterized by a series of consumer reactions encompassing in particular sensory stimuli reception, emotional responses, cognitive appraisal processes, and observable behavioural manifestations triggered by diverse elements (Ding, Tseng, 2015) associated with the brand's visual identity, packaging, communication methods employed, and even ambience created within promotional settings where it is featured (de Oliveira Santini et al., 2018).

The fundamental step towards establishing strong connections between consumers and brands involves facilitating direct interactions wherein customers can personally encounter and immerse themselves in the unique characteristics offered by specific brands (Pina, Dias, 2021; Wiedmann et al., 2018).

Based on the above points, the brand experience can be described as an intangible added value, emphasizing customer senses, feelings, thoughts, and behaviour toward products and services (Girish, Lee, 2019; Van-Dat, Ngoc, 2022).

In conclusion, brand experiences build emotional ties between consumers and brands at a deeper level (Pina, Dias, 2021). In this context, brand experience can be described as an independent variable. It can be assumed that it will positively impact emotional reactions (Ding, Tseng, 2015).

2.3. Emotional Response

Emotions and their associated reactions are central to brand experience due to their immense power (Mostafa, Kasamani, 2021; Sykora et al., 2022). Emotional responses are determined by the brand experience, generating profound effects that go beyond traditional marketing techniques (Chang et al., 2021). For example, emotions consolidate lasting memories long after the experience ends, stimulating active participation. Consumers who feel emotionally connected are likelier to engage in multiple interactions, such as posting on social media, sharing, and attending live performances (Ahn, Back, 2018). Moreover, other studies emphasize that emotionally engaged customers become brand advocates (Funk, 2017; Brzozowska-Woś, 2020). Therefore, emotional reactions offer a unique competitive advantage in a crowded market (Hollebeek et al., 2019). In addition, emotional resonance distinguishes a brand as a significant differentiator (Larocca et al., 2020). Australian sports brands have identified emotional responses as a prerequisite for transforming the typical consumer into an engaged consumer (Greenham et al., 2017). These emotions are at the heart of brand experiential approaches that seek to cultivate a sense of identity, passion, and commitment that surpass traditional advertising offers (Ding, Tseng, 2015). Furthermore, live events play on emotions, where excitement and adrenaline combine to create a unique environment (Trinh, 2018).

Furthermore, some research has shown that in the sports industry, brand experience plays a crucial role in shaping the consumer journey (Akoglu, Özbek, 2022). The emotional responses generated by this brand experience significantly influence how consumers perceive and interact with sports brands (Jung et al., 2011). The connection between consumers and sports brands is firmly rooted in the emotional responses reinforced by solid brand experiences (Coelho et al., 2018). It highlights the importance of engaging with customers' experiences in sports (Morgan, Taylor, 2017). Research has also highlighted that the quality of the brand relationship acts as a mediator in the sports industry.

Since consumers show more positive emotional responses when they have better brand experiences, the following hypothesis is put forward:

H1. Brand experience positively influences consumers' emotional responses in the context of Australian sports brands.

2.4. Consumer Brand Engagement

In recent years, there has been growing interest among academics in consumer brand engagement (Lourenço et al., 2022; Mclean et al., 2021; Obilo, 2021; Schivinski et al., 2020; Fernandes, Moreira, 2019). Several studies have highlighted the importance of understanding customer interactions with brands, encompassing cognitive, emotional, and behavioural aspects (Cheung et al., 2021; Hollebeek et al., 2016). These dimensions contribute to theoretical discussions and hold practical significance (Lourenço et al., 2022). For instance, cognitive and emotional factors greatly influence customers' decision-making processes, and their behaviour can result in repeat purchases (Bowden, 2009; Dwivedi, 2015; Hollebeek et al., 2020; Prentice et al., 2019). The amalgamation of these dimensions during brand encounters plays a vital role in shaping the overall customer experience and subsequently impacts a brand's success (Hollebeek, 2011).

Studies have consistently demonstrated that these complex interactions yield positive business outcomes such as increased customer loyalty, higher sales volume, and improved market share for the brands involved (Bowden, 2009; Islam, Rahman, 2016; Schivinski et al., 2020).

Some studies have confirmed that the emotive response generated by brand experience supersedes transactional exchanges (Prentice et al., 2019). Thus, brand experience lays the groundwork for emotion-based consumer brand engagement (Zollo et al., 2020). Some studies (Killick, Griffiths, 2022; Larocca et al., 2020) have demonstrated that consumers with positive emotional involvement are more inclined to increase brand engagement.

Therefore, it is apparent that Australian sports brands recognize that emotional responses construct an engagement ensemble, ensuring that consumers remain devoted participants in the brand's evolution (Morgan, Taylor, 2017). Nike, a sportswear giant worldwide, deliberately implemented brand experience in Australia to increase consumer brand engagement (Quintal et al., 2020). Brand participation in multiple athletic competitions and promotions provides participants with emotionally resonant and immersive experiences (Zhang et al., 2018). These interactive events, such as the "Nike Run Club" and "Nike Training Club", allow consumers to become involved with the brand's active living philosophy. These encounters surpassed conventional marketing, presenting Nike as a lifestyle facilitator instead of a mere product provider (Quintal et al., 2020).

In the dynamic field of the sports industry, the significance of emotional responses in driving consumer brand engagement has been well established (Akoglu, Özbek, 2022). Additionally, including sponsored athletes in brand mentions indicates that forging positive emotional responses with renowned sports figures can significantly enhance consumer brand engagement (Jin et al., 2013; Zhang, Su, 2023). Leveraging imagery featuring athletes is vital in shaping consumer brand engagement with outdoor sports brands as it stimulates robust emotional responses (Soboleva et al., 2017).

Interestingly, studies have shown that consumers' emotional attachment to a sports brand can outweigh their dissatisfaction with certain aspects (Dessart et al., 2016). Hedonic associations, such as positive emotional responses, have been shown to influence consumer brand engagement (Schivinski et al., 2020). This engagement, in turn, directly affects consumers' emotional reactions (Fernandes, Moreira, 2019). Confirming this, another study by Prentice et al. (2019) indicated that consumers who experience positive emotional responses are likelier to engage with the brand.

In this context, the following hypothesis was developed:

H2. Emotional response positively influences consumer brand engagement within the context of sports brands in Australia when controlled for age and gender.

The proposition of the conceptual model is summarised in Figure 1. This model displays only direct effects.

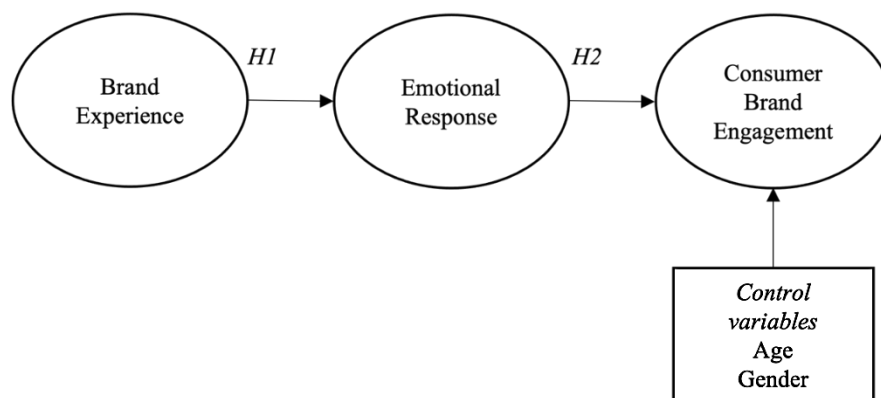


Figure 1. Conceptual model.

Source: own elaboration.

3. Methodology Sample and Procedure

In this study, different brands were used to assess the impact of brand experience on the emotional response and consumer engagement with the brand in the context of sports brands. Each respondent was asked to name a brand in real life whose advertisements they had seen. When people have a comparable experience (for example, contact with a promotional campaign of a sports brand), they are automatically exposed to this brand and, in most cases, start to feel emotions towards it. Therefore, customers were assumed to be exposed to brand experiences that provoke emotional reactions.

The designed study aligns with the positivist paradigm, which is based on verifying previously formulated hypotheses through operationalizing variables and measures (Park et al., 2020). The study focuses on identifying causal relationships using a quantitative approach, which is an online survey. The questionnaire for data collection was created using the Qualtrics platform (Qualtrics XM – Experience Management Software). The questionnaire was pre-tested

on 30 people of different ages. No comments were made to it. The data in the primary study were collected online using the CAWI technique. The study used a non-random (snowball sampling method). A link to the survey was shared on social media (e.g. Facebook (including Messenger), Twitter, Instagram, and Snapchat) and sent by email with a message encouraging people to participate and share the information with friends who had similar experiences with sports brands. The survey invitation also explained the research topic and included brief examples of experiential marketing practices to ensure that respondents understood the concept of “real-life advertising experiences”. Each respondent could only rate one brand. A screening question was also asked to adjust for brand experience bias: “Have you had a real-life advertising experience with a sports brand in Australia?”

A Qualtrics calculator was used to determine the sample size (Sample Size Calculator – Qualtrics). Australian society is relatively young. The average age in 2024 was 39.6 years. The population of Australia is 27,122,411 (as of March 31, 2024) (National, state and territory population, March 2024). Assuming a 95% confidence interval and a margin of error of 5%, the minimum sample size was estimated at 385 units. A total of 610 individuals participated in the study. Only fully completed surveys were assessed for the project; therefore, no data were imputed. After removing incomplete surveys, 551 entries with 28 marks were analysed. The next step was to screen the data and detect univariate outliers. In this phase, responses from 25 individuals were removed, leaving 526 valid questionnaires.

All participants willing to participate in the study were informed about its nature and required to give online informed consent before providing their answers. They were also provided all the necessary information about the study's ethical aspects, including anonymity, confidentiality, the right to discontinue participation, and the right to withdraw their answers before submitting them. Respondents also had to be of legal age to participate in the study. Respondents who did not pass the screening process in the data set were omitted.

In the data reduction stage, invalid entries containing missing responses were excluded, as well as those in which participants responded in all blocks using only one reference point (e.g., using only the value of 5 to complete the study as quickly as possible; $SD_{\text{items}} = 0$) or had little or no variance in response trends (SD_{items} ranging from 0.1 to 0.5) (Schivinski et al., 2021). To avoid data imputation, questionnaires with missing data were also discarded.

Males comprised 54.1% of all respondents, females 45.2%, and 0.7% were non-binary. The majority, 74.7% of the respondents, were from the state of Viktoria. The age ranged from 19 to 51, with most participants being 22 (12.3%). In terms of the educational level of the study sample, 60.2% of respondents had at least some tertiary education. Most respondents (34.9%) reported earning less than A\$25,000 annually. In addition, 61.6% of participants worked as paid employees.

The study adopted a twelve-item scale for measuring brand experience (BE) (Zarantonello et al., 2010), a seven-item scale for measuring emotional response (ER) (Organ et al., 2015), and a ten-item scale for consumer brand engagement (CBE) (Hollebeek et al., 2014). The scales

for measuring brand experience and consumer brand engagement were measured using a 5-point Likert scale, with responses ranging from “strongly disagree” (1) to “strongly agree” (5). The emotional response scale also used a 5-point scale with responses ranging from “not at all” (1) to “very much” (5).

3.2. Data analysis and results

Validation of the scales was accomplished by using the skewness and kurtosis values. There is not a single product with skewness values > 3.0 or kurtosis > 8.0 (Kline, 2011; the data for skewness and kurtosis are displayed in Appendix, Table 3). Cronbach's alpha, mean, and standard deviation were used to ensure the measurements' reliability and validity (Table 1). The components utilised in our investigation generated alpha coefficients ranging from 0.63 to 0.76. Two values were above the threshold value of 0.70 proposed by Bagozzi and Yi (1988), with one scale below the threshold but still acceptable for the study (Van Griethuijsen et al., 2015; Taber, 2018). In this context, the alpha ratings provide evidence of the validity of the scales' internal validity. A correlation analysis was carried out to validate the linkages proposed by the overall model. No correlation was above 0.80, suggesting a moderate correlation between variables (Schivinski et al., 2021).

Table 1.

Correlation matrix and indicators of reliability and validity

	ALPHA	MEAN	SD.	BE	ER	CBE
Brand experience (BE)	0.76	3.41	0.57	1		
Emotional response (ER)	0.63	3.80	0.60	0.39**	1	
Consumer brand engagement (CBE)	0.75	3.62	0.60	0.47**	0.51**	1

Note. ** Correlation is significant at the 0.01 level. ALPHA = Cronbach's alpha, SD. = standard deviation.

Source: own elaboration.

The SPSS regression analysis for brand experience produced statistically significant results. The results of this study do validate hypothesis 1 ($\beta = 0.39$; t -value = 5.10; p -value = 0.001) because brand experience directly influences the consumers' emotional response. In addition, emotional response positively influenced consumer brand engagement, supporting and confirming the hypotheses H2 ($\beta = 0.57$; t -value = 7.11; p -value = 0.001). Furthermore, the VIF factors did not exceed the threshold of 10 (Hair et al., 1995) or even the threshold of 4 (Pan, Jackson, 2008). All the relationships between the control variables and consumer brand engagement were not statistically significant. The results of our testing of hypotheses and estimates are displayed in Table 2.

Table 2.
Standardised structural coefficients of the model

	STANDARDISED BETA	t-VALUE	p-VALUE	ACCEPTANCE OR REJECTION	VIF
H1. Brand experience → Emotional response	0.39	5.10	0.001	Accepted	1.02
H2. Emotional response → Consumer brand engagement	0.50	7.11	0.001	Accepted	1.00
Control variables					
Age → Consumer brand engagement	0.13	1.82	0.71		
Gender → Consumer brand engagement	0.01	-0.23	0.81		

Note. $n = 526$. VIF = variance inflation factor.

Source: own elaboration.

The model is statistically significant and explains 27% of the total variance in the outcome variable, as indicated by the R^2 (coefficient of determination) value. While this value might seem low at first glance, especially given that R^2 values can theoretically range from 0% to 100%, it is crucial to consider the context and nature of the study, which revolves around consumer behaviour (Hair et al., 2016). The R^2 measures the proportion of variance in the dependent variable, which the independent variables in the model can explain. An R^2 of 27% indicates that the model accounts for 27% of the variability in the outcome. This leaves 73% of the variability unexplained, which might suggest the presence of other factors not included in the model. In social sciences, particularly in consumer behaviour studies, lower R^2 values are pretty typical and are not necessarily a defect in the model. Consumer behaviour is inherently complex and influenced by numerous factors, many of which may be unobservable, difficult to quantify, or not captured by the available data. For instance, individual preferences, emotional states, cultural influences, and external market conditions can all significantly shape behaviour but are hard to model comprehensively. Because of these complexities, predicting consumer behaviour with high precision is challenging. Even the best models in the field often achieve moderate R^2 values, as consumer choices are subject to high variability and unpredictability. It is expected to see R^2 values below 50% in behavioural studies (Frankot et al., 2024). The important thing is that the predictors are statistically significant (Figure 2) (Sarstedt et al., 2017).

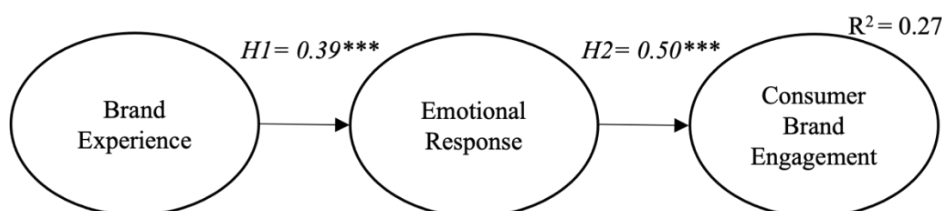


Figure 2. Standardized direct estimates for the final conceptual model.

Source: own elaboration.

4. General discussion

4.1. Theoretical contributions

This paper aimed to address a gap in the existing literature by investigating the relationship between brand experience, emotional response, and consumer brand engagement within the Australian sports industry (Ahn, Back, 2018; Kim et al., 2020; Rather, Hollebeek, 2020). Inspired by previous studies (Funk, 2017; Killick, Griffiths, 2022; Sykora et al., 2022; Zhang et al., 2018), this research sought to understand how brand experience influences emotional response, impacting consumer brand engagement.

To achieve this goal, two primary hypotheses were formulated and tested: First, that brand experience positively affects emotional responses among consumers of sports brands in Australia (Coelho, 2018; Jung et al., 2011; Pina, Dias, 2021). Second, emotional response positively influences consumer brand engagement within the same context (Chang et al., 2021; Dessart et al., 2016; Larocca et al., 2020; Zhang, Su, 2023). The findings of this study confirmed both hypotheses, finding support from different studies (Ahn, Back, 2018; Greenham et al., 2017; Hollebeek et al., 2019).

These results validate and enhance the original concept of brand experience by incorporating emotional responses and consumer engagement as crucial factors in understanding brand interactions (Schmitt et al., 2014; Wiedmann et al., 2018). This expanded framework offers a more comprehensive lens for future research on consumer psychology and marketing opportunities (Akoglu, Özbek, 2022).

Additionally, the research results contribute to understanding emotional drivers influencing consumer brand engagement alongside other relevant works, enriching our knowledge about these psychological mechanisms behind decision-making processes (Ahn, Back, 2018; Rather, Hollebeek, 2020).

The theoretical significance of undertaken research lies in enriching the understanding of the interplay between brand experience, emotional response, and consumer brand engagement within the Australian sports industry. This research strengthens existing experiential marketing frameworks by carefully examining how brand experience influences emotional responses and drives consumer engagement (Larocca et al., 2020; Le et al., 2019). The regression analysis employed in this study provides a robust methodological approach for quantifying these relationships, enhancing our precision in comprehending their interconnectedness (Rather, 2020; Rather, Hollebeek, 2020).

Moreover, this study highlights the crucial role of emotional responses as intermediaries between brand experience and consumer brand engagement (Dessart et al., 2016). This contributes to expanding knowledge of emotional-based marketing, specifically within the context of sports industries (Chang et al., 2021; Funk, 2017).

Furthermore, contextualizing these findings within Australia's sports industry extends the applicability of experiential marketing theories to an environment characterized by deep-rooted emotions and experiences (Dwivedi et al., 2019; Gilchrist, Wheaton, 2017; Morgan, Taylor, 2017). The nuanced insights from this investigation validate existing theoretical foundations while paving new pathways for future explorations. They provide tangible frameworks to guide practitioners in evaluating and improving their branding strategies to cultivate more vital consumer engagements (Akoglu, Özbek, 2022; Cheung et al., 2020; Hollebeek et al., 2019).

4.2. Practical implications

This paper is of practical value for advertising professionals, specifically those in the Australian sports industry (Morgan, Taylor, 2017). Its main aim was to provide actionable suggestions for brands to improve their brand experience initiatives using the literature review and research findings (Akoglu, Özbek, 2022). These recommendations primarily focus on maximizing the brand experiences of consumers to create more impactful emotional responses and increase consumer brand engagement (Chang et al., 2021; Larocca et al., 2020; Trinh, 2018; Sykora et al., 2022).

The study's empirical results indicate that advertising strategies emphasizing a holistic brand experience effectively generate positive emotional responses, fostering greater consumer brand engagement (Greenham et al., 2017; Lee, S.M., Lee, D., 2022; Rather, Hollebeek, 2020). Advertising agencies can utilize this discovery to develop emotionally focused campaigns that engage consumers and establish enduring brand relationships (Dwivedi, 2015; Larocca et al., 2020).

Furthermore, this research provides valuable insights into identifying the emotional triggers that enhance consumer brand engagement within sports brands, where emotional response often plays a significant role (Trinh, 2018).

Following the findings of previous studies in this field (Lee et al., 2019; Lohneiss, Hill, 2014; Pina, Dias, 2021), the goal of this article was to provide practical guidelines for designing and executing experiential marketing campaigns aimed at cultivating consumer brand engagement. Based on the reviewed literature and findings presented in this paper, a comprehensive understanding of the interplay between our variables has been achieved. This knowledge is crucial for advertising professionals in the Australian sports industry (Davey et al., 2023; Morgan, Taylor, 2017). Given that interactions within the Australian sports industry tend to be emotionally charged for consumers, leveraging brand experiences to evoke positive emotional responses becomes paramount in driving greater consumer brand engagement (Chang et al., 2021; Trinh, 2018).

Advertising practitioners should anticipate that carefully crafted brand experiences resonate with consumers and elicit emotional responses that foster their engagement (Funk, 2017; Larocca et al., 2020). The practical insights from this article can guide advertising managers in developing emotionally driven campaigns grounded in understanding how consumers progress

from experiencing a brand to engaging with it. Furthermore, practitioners aim to achieve more impactful consumer brand engagements by tailoring these campaigns to suit specific attributes of the Australian sports industry while aligning them with consumer values and lifestyles (Rather, Hollebeek, 2020; Lee et al., 2019).

Moreover, this study emphasizes a holistic approach when designing meaningful branding experiences where each touchpoint is intentionally designed to elicit desired emotional responses, resulting in enhanced engagement (Akoglu, Özbek, 2022). Advertising practitioners may leverage these findings into refining strategies, ensuring campaign elements create a resonant branding experience, thus enhancing initial consumer engagement and long-lasting relationships (Dwivedi, 2015; Pina, Dias, 2021).

4.3. Limitations and further research

Despite its contributions, this study has several limitations. Firstly, it focused solely on the sports industry, which may restrict the applicability of its findings to other sectors. Second, this research project used data reported by the respondents themselves (study participants were not part of the research panel), introducing potential response biases.

Another limitation is that one of the scales employed for validation yielded a Cronbach's alpha coefficient falling below the generally accepted threshold of reliability (Bagozzi, Yi, 1988), thus compromising result dependability.

The research sample was not representative, and the proportions did not reflect Australia's population. Consequently, such restrictions reduce the generalisability of the findings.

Future studies could explore these variables across different industries and cultural settings to overcome these drawbacks by employing more objective methods while achieving a more diverse participant base, yielding enhanced and less biased outcomes. Investigating additional emotional and psychological factors that potentially influence consumer brand engagement would be beneficial, promoting a comprehensive understanding of consumer behaviour (Kim et al., 2020).

Expanding the research scope to encompass various geographical locations is essential to validating the findings on brand experience, emotional response, and consumer brand engagement. The specific context of Australia may have influenced the results obtained; thus, conducting similar analyses across different countries would provide a more comprehensive understanding of these constructs.

Additionally, incorporating other relevant variables, such as brand loyalty, customer satisfaction, or digital engagement, into this research's model could further enhance our comprehension of factors affecting consumer-brand interactions.

Finally, investigating how digital technologies and social media platforms impact consumer brand interaction using this research framework could offer valuable guidance for advertisers navigating today's digital landscape (Schivinski et al., 2021). With rapid advancements in digital media channels come both challenges and opportunities for brands desiring increased

consumer involvement through experiential marketing. By adopting a multidimensional analytical approach while broadening geographic and sectoral contexts under investigation, future studies can significantly contribute to the existing knowledge base while providing practical recommendations for advertisers to maximize engagement levels and build lasting customer loyalty.

5. Conclusions

This paper studies brand experience, emotional response, and consumer brand engagement in the Australian sports industry.

This study provides compelling evidence demonstrating the influence of brand experiences on emotional responses and subsequently affects consumer brand engagement with sports brands. The approach taken in conducting statistical analyses ensures the reliability and validity of these findings. These results underline the evolving nature of consumer behaviour and emphasise the growing significance of emotions in branding strategies.

This article has implications for the field and the industry involved. In an era when consumers are becoming increasingly discerning, insights gained from this paper hold significant value. They guide navigating complex landscapes encompassing consumer expectations and shifting behavioural patterns.

In addition to contributing theoretical discussions, this study offers actionable recommendations for brands seeking to enhance their experiences by leveraging emotions. These suggestions underscore the importance of creating genuine customer connections rather than focusing solely on transactional interactions.

The results obtained effectively fill the identified gap in the literature, particularly regarding the Australian sports industry. It is a valuable resource for academics and practitioners seeking a well-rounded comprehension of experiential marketing strategies.

This paper highlights the power of interdisciplinary research, combining psychology, advertising, and data analytics to shape a holistic understanding of consumer behaviour. This contribution aligns with larger objectives to create an experience-focused advertising landscape central to consumers' needs in today's changing environment.

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Appendix

Table 3.

List of constructs and descriptive statistics

Constructs and measurements	Mean	Sd.	Skewness	Kurtosis
<i>Emotional response</i> (adapted from Organ et al., 2015)				
[ER] Looking back at your last interaction with a sports brand experience, please indicate the extent to which you felt the following emotions				
[ER1] Happy	4.03	0.83	-0.78	1.05
[ER2] Pleasantly surprised	3.73	0.96	-0.40	0.04
[ER3] Pleased	3.68	1.02	-0.56	-0.21
[ER4] Excited	3.91	0.90	-0.66	0.28
[ER5] Unfulfilled	3.69	1.20	-0.60	-0.53
[ER6] Annoyed	3.83	1.07	-0.63	-0.42
[ER7] Disappointed	3.75	1.19	-0.71	-0.41
<i>Brand experience</i> (adapted from Zarantonello et al., 2010)				
[BE1] I find BRAND X interesting in a sensory way	3.62	1.09	-0.41	-0.54
[BE2] BRAND X makes a strong impression on my visual sense	3.60	1.09	-0.60	-0.24
[BE3] BRAND X does not appeal to my senses	3.36	1.16	-0.38	-0.57
[BE4] BRAND X induces feelings and sentiments	3.56	1.09	-0.71	-0.06
[BE5] I do not have strong emotions for this BRAND X	3.14	1.25	-0.23	-0.96
[BE6] BRAND X Is an emotional brand	3.66	1.18	-0.57	-0.56
[BE7] BRAND X stimulates my curiosity and problem solving	3.21	1.17	-0.12	-0.70
[BE8] I engage in a lot of thinking when I encounter BRAND X	3.13	1.15	-0.01	-0.67
[BE9] BRAND X does not make me think	3.09	1.21	-0.13	-0.79
[BE10] I engage in physical actions and behaviours when I use BRAND X	3.75	1.08	-0.63	-0.39
[BE11] BRAND X results in bodily experiences	3.51	1.02	-0.38	-0.31
[BE12] BRAND X Is not action-oriented	3.38	1.22	-0.31	-0.77
<i>Consumer brand engagement</i> (adapted from Hollebeek et al., 2014)				
[CBE1] Using BRAND X gets me to think about BRAND X	3.32	1.11	-0.32	-0.47
[CBE 2] I think about BRAND X a lot when I am using it	3.21	1.13	-0.06	-0.70
[CBE3] Using BRAND X stimulates my interest in learning more about BRAND X	3.13	1.18	-0.02	-0.82
[CBE4] I feel very positive when I use BRAND X	3.88	0.96	-0.76	0.31
[CBE5] Using BRAND X makes me happy	3.77	1.00	-0.78	0.40
[CBE6] I feel good when I use BRAND X	3.82	0.98	-0.85	0.65
[CBE7] I am proud to use BRAND X	3.77	0.98	-0.66	0.21
[CBE8] I use more BRAND X, compared to other sports brands	3.79	1.14	-0.80	-0.16
[CBE9] Whenever I am wearing a sports brand, I usually use BRAND X	3.63	1.09	-0.46	-0.65
[CBE10] BRAND X is one of the brands I usually wear when I wear sports brands	3.90	1.14	-1.11	0.57

Note. All the items used a 5-point scale.

Source: own elaboration.

METHODS OF MANAGING MULTIGENERATIONAL HUMAN RESOURCES IN THE ERA OF THE FOURTH INDUSTRIAL REVOLUTION – RESEARCH RESULTS

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Purpose: The research objective of the article was to identify the differences arising from the digital competencies of different generations that are highlighted in companies undergoing digital transformation. The purpose of the application was to try to match methods and instruments that would support managers in managing human resources from different generations.

Results: Special attention was paid to recommending management methods and instruments that compensate for digital competence gaps in older generations and relational gaps in younger generations.

Research limitations/implications: The research was conducted using a survey technique. The questionnaire was distributed through a platform designed for marketing research. This distribution channel for the questionnaire package may have limited access to the research for older generation employees. Future surveys should be conducted using direct messages or direct contact with the interviewer.

Practical implications: The results of the research highlighted the integrative role of managers in organizations where employees come from different generations. The findings underscore the importance of each employee having a sense of his or her place in the organization. The results are an inspiration for managers to appreciate the value of multi-generational personnel in the era of Industry 4.0.

Social implications: Intergenerational differences regarding worldview, human ontology, value system, prevailing norms and rules of social coexistence have accompanied humanity since time immemorial. In the current situation, these differences are exacerbated by technological advances. Building intergenerational relations at the professional level based on resentment and antagonism is not appropriate. The role of managers of organizations where employees come from different generations is to make everyone feel their place in the organization and appreciate the value of their work. The task of managers is to build an organizational culture based on dialogue, mutual understanding, openness to diversity and exposure to the resources that each employee brings to the organization.

Originality/value: The addressee of the work is the manager of a company with multi-generational employees. The novelty of the consideration is the formulation of recommendations that serve managers of companies undergoing digital transformation to adapt to the requirements of Industry 4.0.

Keywords: Human resources management, multigenerationality, Industry 4.0.

1. Introduction

Groups of workers in EU occupations vary in the level and prevalence of digital competencies they possess. According to research published by the European Commission, the lack of basic digital competencies is mainly found among older generations. And the Alpha generation is about to enter the labor market. The Alpha generation to a group of people born from 2010 to about 2025. Alpha is growing up in a society where technology is an integral part of their lives. Smartphones, tablets, video games and artificial intelligence are a daily reality for them. Due to the COVID-19 pandemic, the Alpha generation is even more accustomed to working remotely than other generations. Managing each successive generation of employees makes new demands. Managing increasingly younger generations requires adjusting the instruments used within the methods (management methods through communication, delegation, motivation, goals, building and nurturing organizational culture). It seems particularly important to match management methods and instruments with personnel coming from the youngest generations. These groups have the highest digital competencies and at the same time considerable deficits in interpersonal relations. The reason for the article is the recognized research gap on recommending methods for managing human resources in the era of the fourth industrial revolution. A survey of recent global literature (publications from 2017-2024) focused on the 4.0 competencies of multigenerational and multicultural workforce. The literature on the Fourth Industrial Revolution is mainly concerned with the implementation of technology, change management in a transforming enterprise, Meanwhile, there is a lack of publications on the support of HR managers in this difficult period of digital transformation of enterprises. Recognizing this research gap, a research question was posed, viz: What management methods to recommend in a multi-generational work environment in the era of the fourth industrial revolution? What instruments used within management methods to recommend in a multi-generational work environment in the era of the fourth industrial revolution? The research objective of the article was to identify the differences arising from the digital competencies of different generations, which are highlighted in companies undergoing digital transformation. The application goal was to try to match methods and instruments that would support managers in managing human resources coming from different generations. Particular importance was attached to recommending management methods and instruments that compensate for digital competence gaps in older generations and relational competence gaps in younger generations.

The own research presented in this article was preceded by a systematic literature review (see Stawiarska et al., 2024), after which generational diversity (which must be taken into account by a manager using selected management methods during the digital transformation of an enterprise) was found. The premise of the presented study was that: “generational diversity is mainly concerned with digital and relational competencies” and “a manager can, using known management methods with new instrumentation, effectively compensate for identified competency gaps”.

2. Literature review

Technologies introduced into the business processes of enterprises require new predispositions and skills from human resources. Selected literature studies have analyzed the key dimensions: education and qualifications of employees (Benesova et al., 2017); key employee skills required of workers in the era of the fourth industrial revolution. In addition to the need for competence in digitization, AI, robotics and big data (Sima et al., 2020), soft skills (Pejic-Bach et al., 2020), a disposition for continuous training (Flores et al., 2020) and flexibility and a collaborative attitude (Matt et al., 2020) are essential. Some studies have looked at the relationship between social trends and Industry 4.0 technologies (Bednar, Welch, 2020). Researchers have highlighted the changing demographics of the workforce in the context of Industry 4 challenges (Calzavara et al., 2020; Javaid, Haleem, 2020). The researchers, seeing that the demographics of the workforce are changing (there is a general aging of the population and a higher average age of the workforce worldwide), found it worthwhile to study the relocation and distribution of work (remote and smart work) in this context (Calzavara et al., 2020).

Other works have emphasized that the introduction of Industry 4.0 systems and technologies entails opportunities and pitfalls for organization and management (Benesova, Tupa, 2017; Nahavandi, 2019; Xu et al., 2021). Like any transition to a new production paradigm, a new organization of business processes, leadership styles and personnel management methods is required. Educating and qualifying managers (Benesova et al., 2017); managing human-machine interaction, i.e., the connections between the mind of a (human) worker and the (artificial) intelligence of robots to increase collaboration and reduce competition is a new challenge for managers (Nahavandi, 2019; Xu et al., 2021). Extreme connectivity between organizations, employees, workers and robots in a digitized organization creates new social power structures. Previous management methods, may no longer be acceptable in digitally transformed enterprises, may lead to various personnel problems, authoritarian rule by one person. Few researchers argue that new management methods should be proposed in the social sciences and humanities for effective and efficient implementations of Industry 4.0 and 5.0 technologies (Dezi et al., 2018; Ozdemir, 2018) especially in multi-generational environments.

3. Research Methodology

The next chapter presents the results of secondary and primary data research (i.e., collected through a prepared questionnaire). The secondary data research (European Commission, Digital Economy and Social Index 2020) showed generational differences in digital competencies in different countries and jobs. Conducting further research, it was determined that the subject of the study would be only specialists of industrial enterprises coming from different generations. The specialists were selected using the quota purposive selection method. That is, they had to meet the criteria in order to be surveyed (their job position had to be called a specialist for..., they had to be employed at an industrial enterprise). Quota selection for this study meant that specialists from all generations X, Y, Z were surveyed in amounts proportional to the total number of employees in the labor market. However, in the end, after the sample size was set at 150 people, it was decided to keep the same number of respondents in groups belonging to generations X, Y, Z. The research method was a statistical method. The research technique was a survey, the research tool was a prepared survey questionnaire. Distribution of the questionnaire was done through the gogle portal (<https://www.google.pl/intl/pl/forms/about/>). Preparing the research tool was guided by the study's goal of wanting to recognize the differences arising from the digital competencies of different generations, which are highlighted in companies undergoing digital transformation.

In preparing the survey tool, an attempt was also made to confirm the assumptions that: “generational diversity is mainly about digital and relational competencies” and “a manager can use familiar management methods with new instrumentation to effectively compensate for identified competency gaps”. Data collection lasted from May to June 2023. Analysis of the collected data is presented in the chapter: Research results.

4. Research results

The following charts show that in the working environment of many EU countries, a digital competence gap of cadres is emerging compared to the cadres of the countries - leaders of the ranking. Figure 1 shows the Ranking of EU countries according to the Digital Economy and Digital Society Index (DESI, 2000).

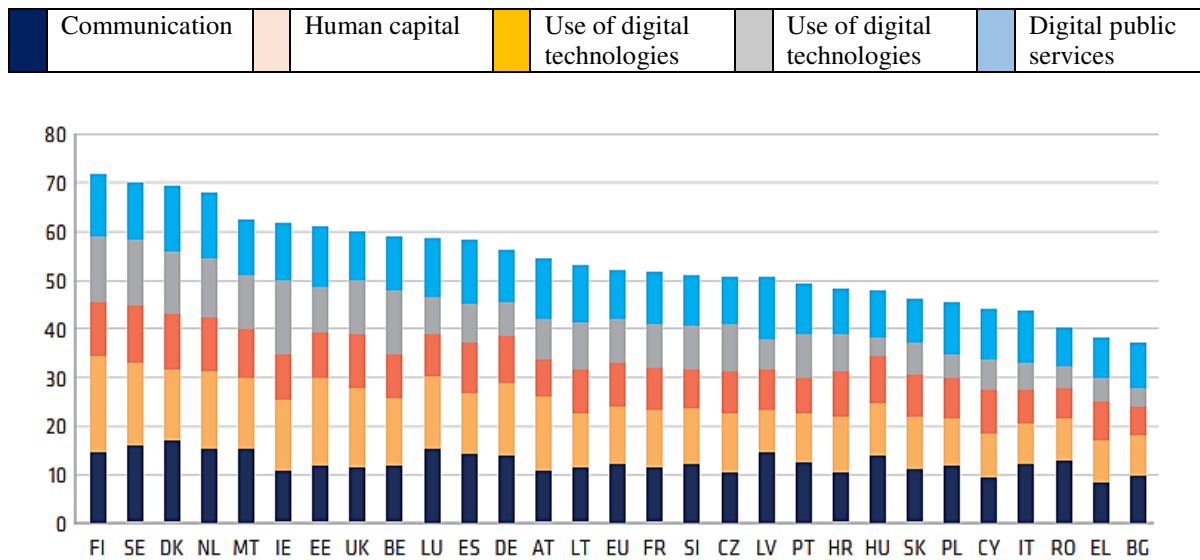


Figure 1. Ranking of EU countries according to the digital economy and digital society index (DESI, 2000).

Source: the European Commission, Digital Economy and Social Index (DESI), 2020, https://arp.pl/documents/41/Kompetencje_cyfrowe_ARP_part_I.pdf

Figure 2 shows the assessment of digital competence of residents in the European Union countries.

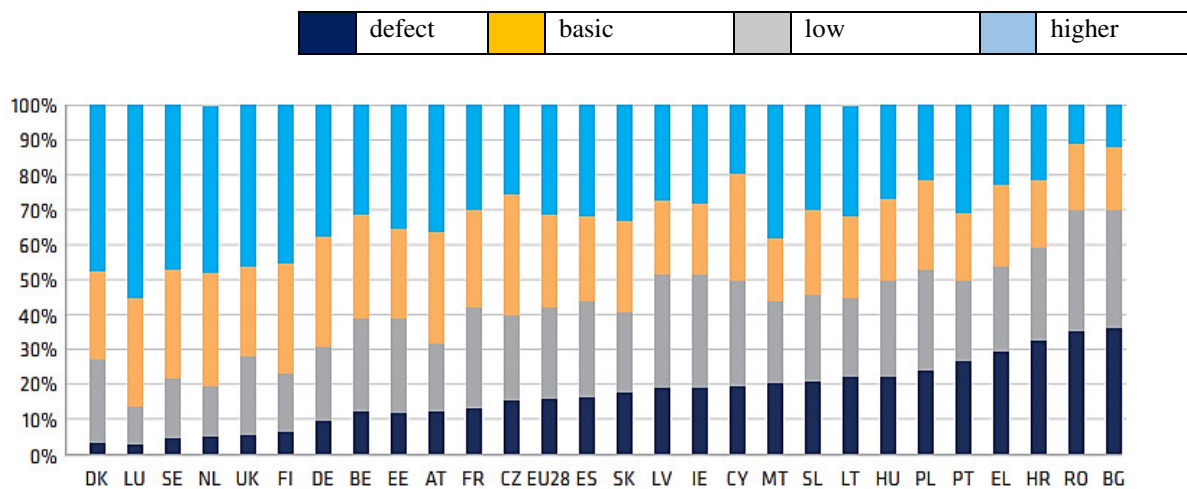


Figure 2. Assesses the digital competence of residents in the European Union countries.

Source: the European Commission, Digital Economy and Social Index (DESI), 2019, https://arp.pl/documents/41/Kompetencje_cyfrowe_ARP_part_I.pdf

Table 2 shows the assessment of digital competence of EU employees of selected professions by level of competence.

Table 2.

Evaluation of digital competencies of EU employees of selected professions (by level of competence)

Occupation performed	Competence level	Percentage of employees (%)
Manager	Basic	8,3
	Advanced	18,7
	Specialized	23,3
Specialist	Basic	38,4
	Advanced	8,9
	Specialized	10,3
Technician	Basic	40,5
	Advanced	9,8
	Specialized	11,8
Office worker	Basic	56,8
	Advanced	13,2
	Specialized	14,1
Machine operator	Basic	27,5
	Advanced	7,1
	Specialized	4,7
Worker	Basic	35,1
	Advanced	7,5
	Specialized	5,7

Source: the European Commission, Digital Economy and Social Index (DESI), 2016, https://arp.pl/documents/41/Kompetencje_cyfrowe_ARP_part_I.pdf

The evaluation of the competence of industrial enterprise specialists by level of sophistication shows that 38.4 percent of them declare basic digital competence, only 10.3 percent of specialists evaluate their digital competence as specialized.

Table 3 shows the evaluation of digital competencies of Polish residents against the EU in age ranges.

Table 3.

Assessment of digital competencies of Polish residents against the EU in age brackets

Age range (years)	Digital competences (%)					
	Low		Basic		Specialized	
	EU	PL	EU	PL	EU	PL
16-24	15	14	25	37	57	48
25-34	21	23	29	38	46	35
35-44	27	37	29	30	36	24
45-54	30	39	29	22	27	11
55-64	31	31	25	14	16	5
65-77	26	20	18	6	7	2
Total populations	26	28	26	25	31	21

Source: https://arp.pl/documents/41/Kompetencje_cyfrowe_ARP_part_I.pdf

The table presented does not show an assessment of the digital competence of professionals employed by industrial companies by generational groups. However, the population data presented in the table confirms quite a disparity in the digital competencies of different age groups.

The following Table 4 presents the qualifications and skills important from the point of view of an Industry 4.0 employee.

Table 4.*Qualifications and skills important from the point of view of an Industry 4.0 worker*

Knowledge of information and communication technologies	Ability to work with data
<ul style="list-style-type: none"> • Basic IT knowledge • Ability to use and interact with intelligent machines • Understanding of machine-to-machine communications, data protection and cybersecurity 	<ul style="list-style-type: none"> • Ability to process and analyze data received from machines • Understanding of data entry, visualization and decision making processes • Basic knowledge of statistics
Know-how techniczne	Personal skills
<ul style="list-style-type: none"> • Interdisciplinary and generic knowledge of technologies • Specialized and generic knowledge of factory operations and production processes • Technical know-how about the machines necessary to operate them 	<ul style="list-style-type: none"> • Ability to adapt in the workplace and readiness for change • Ability to work in a team and willingness to share knowledge • The ability to change the way of thinking under the influence of science

Source: Aulbur, Arvind, 2016.

A study of the literature (Stawiarska et al., 2019, 2021, 2024) made it possible to prepare Table 4. Table 5 groups the competencies of the 4.0 specialist employee so that the manager can support/develop them using specific management methods.

Table 5.*Management methods, and developing new competencies of the employee*

Management method by:	Qualifications and skills important from the point of view of an Industry 4.0 employee and developed by the management method
communicating	<ul style="list-style-type: none"> • communication competences using instant messengers • the ability to use and interact with computers and intelligent machines • data protection and cybersecurity understanding/skills
delegation of authority	<ul style="list-style-type: none"> • interdisciplinary and generic knowledge of technologies and know-how about machines necessary to operate them • specialized and generic knowledge of factory operations and production processes • ability to make decisions regarding digital transformations
motivating	<ul style="list-style-type: none"> • ability to adapt in the workplace and plan development in the context of digital transformation • readiness for changes regarding digital transformation / involvement in the digital transformation process • creativity in implementing increasingly better digital solutions
goals	<ul style="list-style-type: none"> • ability to analyze and process data received from machines • ability to enter visualization data and make decisions based on data • generic knowledge of business statistics
building organizational culture	<ul style="list-style-type: none"> • ability to adapt in the workplace and readiness for change • ability to work in a team and willingness to share knowledge • the ability to change the way of thinking under the influence of science

Source: own elaboration.

The following takes a closer look at each of the management methods, attempts to identify new 4.0 instrumentation that can support the chosen method, and presents the results of our own research (based on primary data obtained through a questionnaire).

5. Management by communication – Essence of the method

The main features of this method are: exposure in the organizational structure of the company of positions and cells oriented to information and communication processes; the use in the company of a rich spectrum of various methods and technical means of information and communication; improvement of information and management processes leading to the improvement of the existing information and communication system in the company. The method assumes the broad participation of employees at various levels (from the highest - the company's board of directors and management, through the managers of functional departments, to the positions of specialists in various fields) supporting the operation of the information system. In the era of Industry 4.0, an important emphasis in the application of this method is on the use of information technology as a tool to support communication, generation and processing of data, scheduling of work and measurement of its effects (Nowicki, 1998). New competencies developed by applying this method (with the use of modern ITC technology tools) are:

- communication competence using instant messaging,
- ability to use and interact with computers and smart machines,
- understanding/skills regarding data protection and cyber security.

The results of the self-assessment of specialists - employees of industrial enterprises are presented in Tables 6-8.

Table 6.

Self-assessment results of specialists - employees of industrial enterprises on communication competence using instant messaging

How do you assess your communication competences using instant messengers?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	20	1	3	1	0
Advanced	2	18	2	39	2	5
Specialized	3	12	3	8	3	45
Weighted arithmetic mean	1,84		2,1		2,9	

Table 7.

Results of self-assessment of specialists - employees of industrial enterprises regarding the ability to use computers and intelligent machines and the ability to interact with them

How would you rate your ability to use and interact with computers and intelligent machines?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	11	1	18	1	30
Advanced	2	23	2	19	2	15
Specjalized	3	16	3	13	3	5
Weighted arithmetic mean	2,1		1,9		1,5	

Table 8.

Results of self-assessment of specialists - employees of industrial enterprises regarding understanding/skills of data protection and cybersecurity

How do you rate your understanding/skills regarding data protection and cybersecurity?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	45	1	30	1	32
Advanced	2	5	2	15	2	16
Specjalized	3	0	3	5	3	2
Weighted arithmetic mean	1,1		1,5		1,4	

6. Management by delegation of authority - Essence of the method

Management by delegation of authority should properly be defined as the delegation of authority, duties and responsibilities (Niemczyk, 2000) and be included among the methods of motivating employees. The essence of delegation is the transfer of specific decision-making capabilities along with the burden of these decisions to lower levels of management (Niemczyk, 2000). By bestowing a task on an employee, a manager simultaneously manifests trust. Thus, he builds the employee's sense of worth and raises the desire for self-development. It allows the employee to identify with the results of the project and build awareness that the role performed/decision made in the implementation of a given project was important for the proper functioning of the company (Timescu-Dumitrescu, 2019). In the era of Industry 4.0, an important emphasis in the application of this method is the use of integrated information systems of the MRP, DRP, CRM classes, where the decision maker on any issue marks it in the system with his/her marker/signature. New technology in support of transparency of responsibility, confirming personally who made the decision, confirming the input of work is

blockchain. New competencies developed by applying the method of management by delegation (with the use of modern technology tools of Industry 4.0) are:

- interdisciplinary and generic knowledge of the technologies and machine know-how necessary to operate them,
- specialized and generic knowledge of factory operations and production processes,
- ability to make decisions on digital transformation.

The results of the self-assessment of specialists - employees of industrial enterprises are presented in Tables 9-11.

Table 9.

Self-assessment results of specialists - employees of industrial enterprises on interdisciplinary and generic knowledge of technologies and know-how about machines necessary to operate them

How would you rate your comprehensive and ever-expanding knowledge of the technologies and machine know-how necessary to operate them?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	15	1	10	1	28
Advanced	2	25	2	22	2	17
Specjalized	3	20	3	28	3	4
Weighted arithmetic mean	2,5		2,76		1,48	

Table 10.

Results of self-assessment of specialists - employees of industrial enterprises regarding specialized and generic knowledge about activities and production processes in the factory

How do you rate your comprehensive and constantly deepened knowledge of factory activities and processes?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	1	1	10	1	32
Advanced	2	5	2	35	2	16
Specjalized	3	44	3	5	3	2
Weighted arithmetic mean	2,86		1,9		1,4	

Table 11.

Results of self-assessment of specialists - employees of industrial enterprises regarding the ability to make decisions related to digital transformation

How do you rate your ability to make decisions regarding digital transformations in your company?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	45	1	30	1	36
Advanced	2	5	2	15	2	10
Specjalized	3	0	3	5	3	4
Weighted arithmetic mean	1,1		1,5		1,36	

7. Management by motivation – Essence of the method

Management by motivation aims to make employees perform tasks with the impact of various incentives. There are many different approaches and ways to motivate employees, such as rewards, employee evaluations and punishment systems. It is also important to understand the needs and goals of employees and create a motivational system that is suitable for them. The effectiveness of a motivational system depends on employee preferences (Gellerman, 1968). Meeting the motivational needs of employees is a challenging task for a manager managing a multi-generational workforce. It is important to keep in mind that each employee may respond differently to motivational stimuli, which often becomes a test of managerial creativity. Employees also differ in terms of temperament, experience, qualifications, character traits (Buchbinder, Shanks, 2007). Motivation involves providing the employee with the right stimulus/motivation to address a need. By providing the right motive that will elicit a productive and engaging attitude, the manager raises the chances of valuable results. In the era of Industry 4.0, an important emphasis in the application of this method is the use of incentive systems based on gamification. There is also the use of mobile applications for the coworking community introducing interesting solutions, comparing the results of different employees. Motivation, especially for the younger generation, has become a widely understood support for rebuilding interpersonal relationships. The new competencies developed by applying the management-by-motivation method are:

- adaptability in the workplace and development planning in the context of digital transformation,
- readiness for change regarding digital transformation/commitment to the digital transformation process,
- creativity and competition in implementing better and better digital solutions.

The results of the self-assessment of specialists - employees of industrial enterprises are presented in Tables 12-14.

Table 12.

Self-assessment results of specialists - employees of industrial enterprises on adaptability in the workplace and development planning in the context of digital transformation

How do you assess your ability to adapt in the workplace and plan for growth in the context of digital transformation?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	10	1	5	1	42
Advanced	2	19	2	15	2	4
Specjalized	3	11	3	30	3	4
Weighted arithmetic mean	1,62		2,5		1,24	

Table 13.

Results of self-assessment of specialists - employees of industrial enterprises on readiness for change regarding digital transformation / commitment to the process of digital transformation

How would you rate your readiness for change regarding digital transformation / commitment to digital transformation?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	31	1	12	1	2
Advanced	2	15	2	25	2	16
Specjalized	3	4	3	5	3	32
Weighted arithmetic mean	1,46		1,54		2,6	

Table 14.

Results of self-assessment of specialists - employees of industrial enterprises regarding creativity in implementing better and better digital solutions

How do you rate your creativity in implementing better and better digital solutions?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	45	1	30	1	20
Advanced	2	5	2	15	2	16
Specjalized	3	0	3	5	3	14
Weighted arithmetic mean	1,1		1,5		1,56	

8. Management by objectives – The essence of the method

Management by objectives is a method of building a coherent set of objectives for all cells and participants in an organisation and assessing the level of performance (Carrolls, 1978). The supervisor and his or her subordinates are supposed to be in agreement on the objectives that will apply over a set period of time. In the era of Industry 4.0, an important emphasis in the application of this method is the use of analytical systems using large data sets from inside from outside the company. Some of the data used comes from beacons operating with BLE technology others from satellites operating with GPS technology, others from KPA KPIs generating information based on artificial intelligence (Przegieliński, Jemielniak, 20023; Marr, 2022). The new competencies developed by applying the Management by Objectives method are:

- the ability to analyse and process data received from machines,
- the ability to input data visualisation and to make decisions based on the data,
- generic knowledge of business statistics.

The results of the self-assessment of specialists – employees of industrial enterprises are presented in Tables 15, 16 and 17.

Table 15.

Self-assessment results of specialists – employees of industrial enterprises on the ability to analyse and process data received from machines

How do you rate your ability to analyze and process data received from machines?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	0	1	5	1	32
Advanced	2	5	2	10	2	16
Specjalized	3	45	3	35	3	2
Weighted arithmetic mean	2,9		2,6		1,4	

Table 16.

Results of self-assessment of specialists - employees of industrial enterprises regarding the ability to enter data visualization and make decisions based on data

How do you rate your ability to enter data, visualize and make decisions based on data?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	25	1	20	1	30
Advanced	2	15	2	15	2	15
Specjalized	3	10	3	15	3	5
Weighted arithmetic mean	1,5		1,9		1,5	

Table 17.

Results of self-assessment of specialists - employees of industrial enterprises regarding generic knowledge of business statistics

How do you rate your knowledge of business statistics?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	45	1	30	1	42
Advanced	2	5	2	15	2	6
Specjalized	3	0	3	5	3	2
Weighted arithmetic mean	1,1		1,5		1,2	

9. Management by means of organisational culture - Essence of the method

The success and broadly understood results of a company's activities depend not only on the managerial skills of its management and its material and financial resources. They also depend on the difficult-to-define atmosphere, the style of conduct, the company's development history, its technical level, the management style, the demographic and psychological characteristics of the employees, the adopted patterns of conduct, together they form what is referred to as organisational culture. Considerations by many authors have shown that organisational culture influences the management methods used (Kinar, 2022) and, conversely, the management methods used shape organisational culture. Organisational culture is also built by the values a manager holds. In the era of Industry 4.0, remote working, open innovation, digital twins of production processes, the building of e-culture must be addressed (Bulińska-Stangrecka H. (2018). An important emphasis in the application of the management method using e-culture is on the formation of the values of the virtual organisation, in which the social responsibility of employees is emphasised. In an open, dynamic virtual organisation, the manager encourages enables and watches over the safe sharing of knowledge, encourages creative work, inspires risk-taking behaviour, all through intelligent information systems (Pol, 2022).

New competences developed throughNew competences developed through the use of this method are:

- ability to adapt in a digital workplace and readiness for digital change,
- ability to work in a team on digital solutions and willingness to share knowledge,
- ability to change one's way of thinking under the influence of learning.

The results of the self-assessment of specialists - employees of industrial enterprises are presented in Tables 18, 19 and 20.

Table 18.

Self-assessment results of specialists - employees of industrial enterprises on adaptability in the digital workplace and readiness for digital change

How would you rate your ability to adapt in a digital workplace and your readiness for digital change?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	10	1	5	1	32
Advanced	2	19	2	15	2	14
Specjalized	3	11	3	30	3	4
Weighted arithmetic mean	1,62		2,5		1,44	

Table 19.

Results of self-assessment of specialists - employees of industrial enterprises regarding the ability to work in a team on digital solutions and the willingness to share knowledge

How do you rate your ability to work in a team on digital solutions and your willingness to share knowledge?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	19	1	5	1	34
Advanced	2	10	2	15	2	12
Specjalized	3	11	3	30	3	4
Weighted arithmetic mean	1,44		2,5		1,4	

Table 20.

Results of self-assessment of specialists - employees of industrial enterprises regarding the ability to change the way of thinking under the influence of science

How do you rate your ability to change your way due to learning?						
degree	Generation X		Generation Y		Generation Z	
Basic	1	10	1	5	1	12
Advanced	2	19	2	15	2	24
Specjalized	3	11	3	30	3	14
Weighted arithmetic mean	1,62		2,5		2,04	

Table 21 contains the summary results of the analyzes collected in tables 6-20.

Table 21.

Analysis of the competences of multigenerational staff in the context of the use of selected management methods in the era of Industry 4.0

Management method by:	Employee qualifications and skills desired in the era of Industry 4.0, and developed thanks to the use of the method	Self-assessment of specialists (employees of industrial enterprises) by generation		
		X	Y	Z
communicating	communication competences using instant messengers	1,84	2,1	2,9
	the ability to use and interact with computers and intelligent machines	2,1	1,9	1,5
	data protection and cybersecurity understanding/skills	1,1	1,5	1,4
Average rating		1,68	1,83	1,93
delegation of authority	interdisciplinary and generic knowledge of technologies and know-how about machines necessary to operate them	2,5	2,76	1,48
	specialized and generic knowledge of factory operations and production processes	2,86	1,9	1,4
	ability to make decisions regarding digital transformations	1,1	1,5	1,36

Cont. table 21

Average rating		2,15	2,05	1,41
motivating	ability to adapt in the workplace and plan development in the context of digital transformation	1,62	2,5	1,24
	readiness for changes regarding digital transformation / involvement in the digital transformation process	1,46	1,54	2,6
	creativity in implementing increasingly better digital solutions	1,1	1,5	1,56
Average rating		1,47	1,83	1,8
goals	ability to analyze and process data received from machines	1,62	2,5	2,24
	ability to enter visualization data and make decisions based on data	1,46	1,54	2,6
	generic knowledge of business statistics	1,1	1,5	1,2
Average rating		1,39	1,85	2,06
building organizational culture	ability to adapt in the workplace and readiness for change	1,62	2,5	1,44
	ability to work in a team and willingness to share knowledge	1,44	2,5	1,4
	the ability to change the way of thinking under the influence of science	1,44	2,5	2,4
Average rating		1,5	2,5	1,62

10. Discussion

A systematic review of the literature confirmed that the digital technologies being implemented into companies require new digital competences from human resources (Benesova et al., 2017). It was also confirmed (by analysis of secondary and primary data), following Sima et al., 2020; Pejic-Bach et al., 2020; Matt et al., 2020, that there are differences between generations not only in the possession of digital competences, but also in relational competences. Researchers who highlighted the changing demographics of the workforce in the context of the challenges of Industry 4.0 (Calzavara et al., 2020; Javaid, Haleem, 2020) inspired the article's premise that: 'generational diversity is mainly about digital and relational competences'.

In contrast, those who emphasized that the introduction of Industry 4.0 systems and technologies entails opportunities and pitfalls for organizations and management (Benesova, Tupa, 2017; Nahavandi, 2019; Xu et al., 2021), inspired the establishment of another premise of the article that, 'and "the manager can, using familiar management methods with new instrumentation effectively compensate for identified competence gaps". In seeking recommendations for managers to utilize management methods for the multi-generational workforce of digitally mourning enterprises, they were guided by the research of Nahavandi, 2019; Xu et al., 2021 and their own research conducted among professionals of industrial enterprises.

11. Conclusions

Managing multi-generational people can present both opportunities and challenges due to the different needs for communication, delegation, motivation, goal-setting or values that determine the construction of a company culture.

Here are some tips for effectively managing staff from different generations:

- Recognize that each generation has unique experiences, values and communication preferences shaped by the events of their formative years.
- Familiarize yourself with the characteristics of the generations remaining in the labor market, such as Generation X, Generation Y and Generation Z.
- Adapt the method of management by communication used to their preferences regarding communication channels and style of message.
- If the company is undergoing a digital transformation, know that generation Z is best equipped to communicate using the tools of Industry 4.0 (the average score for a generation Z professional coming from an industrial company is 1.93 points out of 3 possible - see Table 19). However, digging deeper into the evaluation criteria used in the research, it should be noted that Generation Y scores better in the self-assessment ‘ability to use and interact with computers and intelligent machines’.
- When delegating authority, duties and responsibilities, consider that each generation has different experience, seniority and knowledge.
- If a company is undergoing a digital transformation, know that generation X is best placed to delegate authority to make important transformational decisions. This is because they rate highly on their ‘specialist and generic knowledge of factory operations and processes’. So X should be on the decision-making team. Y delegate authority because they rated themselves high on their ‘interdisciplinary and generic knowledge of the technologies and machine know-how necessary to operate them’ and ‘ability to make digital transformation decisions’. The self-assessment shows that Z are not yet ready to delegate difficult transformation decisions to them.
- Use the management-by-motivation method. It seems to be a universal principle that achievements should be recognized and that conditions should be created to enable continuous professional development of employees.
- If a company is undergoing a digital transformation, know that Generation Y professionals adapt best in the workplace and identify with the planned digital development, but the highest rated motivator for Z is: ‘readiness for change regarding digital transformation/commitment to the digital transformation process’ and “creativity in implementing better and better digital solutions”.

- When managing over goals distribute them, taking into account the experience and knowledge that older generations bring, and create opportunities for knowledge sharing and mentoring.
- Formulate measurable goals, clearly articulate objectives and provide regular feedback on the evaluation of goal achievement.
- Remember, it is also your job to set goals for individual employees. Make your job easier and manage your staff effectively by collecting and analyzing data. Data on performance, employee satisfaction or motivation, will allow you to make more informed personnel decisions. The use of analytical tools supports the identification of areas for improvement and optimizes the allocation of human resources.
- If your company is undergoing a digital transformation, know that Generation Z professionals rated best for their ‘ability to input data, visualize and make decisions based on data’, but to Y they still have the best ‘ability to analyses and process data received from machines’ and ‘generic knowledge of business statistics’.
- Promote a culture of continuous learning to attract the attention of younger generations who may value professional development opportunities. Be open to flexible working arrangements, being aware that younger generations may value work-life balance and flexible schedules. Allow for a variety of working styles, as some may prefer a collaborative environment, while others may excel in a more independent setting. Promote intergenerational integration. Encourage an inclusive environment where all team members feel valued, regardless of age. Avoid making assumptions and stereotypes based on age. Treat individuals as unique contributors with diverse skills and perspectives. Encourage collaboration and inclusion in decision-making processes. Ask for feedback from different age groups to ensure that different perspectives are considered when making important decisions. Emphasize a common purpose: Connect the team through a common purpose or mission that transcends generational differences. Help individuals see how their unique contributions contribute to the overall success of the team or organization. By acknowledging and accepting the differences between team members, you can create a more inclusive and collaborative work environment that leverages the strengths of each generation.
- If your business is undergoing a digital transformation, know that Generation Y professionals adapt best in the workplace and are ready for change; they will be the bridge between the digitally conventional X experience and the digitally creative but apprehensive Generation Z.

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SOCIAL INEQUALITIES AND DISCRIMINATION AGAINST WOMEN IN ACCESS TO HIGH-LEVEL POSITIONS

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Purpose: This article aims to verify the relationship between discrimination against women in access to high-level positions and their discrimination in the choice of their jobs, their return to the labour market, their education in technical subjects and the promotion of their participation in management decision-making.

Design/methodology/approach: The first part of the article includes a literature review that introduces the concept of labour market inequality, with particular emphasis on gender inequality. The next step involved analysing the relationship between the response variable and the explanatory variables. The results of a pilot survey conducted in early 2024 were used for this purpose. The GRETl econometric package was used to determine the degree of correlation between the variables, based on which the parameters of the ordered logit model were found using the ordinary least squares method (OLS).

Findings: The parameters of the developed logit model allowed us to conclude that there is a significant relationship between the dependent variable and the independent variables. According to the respondents, women who are discriminated against in terms of their jobs or return to the labour market after a long break are also discriminated against in terms of access to high-level positions.

Research limitations/implications: An analysis of the results obtained showed that discrimination against women in the labour market is considered a widespread social problem. Consequently, it was assumed that this research should be expanded to include issues aimed at identifying solutions to prevent such practices, among other things. Further, to gain insight into the motivations of the opposite side, surveys should be addressed directly to employers. The survey was a pilot and, as such, no limitations were identified during its implementation.

Social implications: The survey results indicate that gender inequality in the labour market is a widespread problem that generates negative emotions in society. This points to the need for a strategy that can prevent such practices and reduce prejudice at the same time.

Originality/value: The considerations in this article highlight the problem of gender inequalities in the labour market. Particularly noteworthy in this regard is the issue of discrimination against women in access to leadership positions. The article is primarily aimed at women in the labour market and employers.

Keywords: Women in high-level positions, gender inequality, discrimination against women, GRETl.

Category of the paper: Research paper.

1. Introduction

Employment issues continue to be recognised as pertinent, forming the basis of numerous studies. It is worth noting that the labour market is highly heterogeneous in many respects, among which the gender employment gap is often highlighted. In practice, such an approach generally meets with public disapproval.

Apart from the social consequences of inequality, the literature also refers to those of an economic nature. In this respect, it is assumed that high levels of inequality negatively affect economic growth in the long term, consequently exacerbating the problem of social and economic exclusion (Bryan et al., 2024). Estimates suggest that the gap in Gross Domestic Product *per capita* resulting from inequalities between men and women in the European labour market can be as high as 10 percentage points (Cuberes, Teignier, 2016). The inequalities indicated as particularly significant in terms of affecting economic prosperity include such things as differences in wages and access to education (Boboc et al., 2012).

As noted by J. Oczki, inequalities occurring in the labour market are universal and depend both on the individual characteristics of a specific worker (Lüthi, Wolter, 2023), as well as on issues regulated by the market, including the demand for a specific type of work and the supply of a specific group of workers. In practice, efforts to reduce inequalities are primarily driven by public disapproval and divergent attitudes between employers and employees. As shown by the analyses carried out so far, particular attention is paid to gender inequalities in the labour market, where the following are considered key manifestations: gender pay gaps, as well as the unfair assignment of managerial functions and board positions (Oczki, 2015).

The previously mentioned inequalities are closely linked to the segmentation of the labour market based on selected employee characteristics, among which gender is one of the main criteria. Entrusting a position to a specific person does not guarantee success for either party, which is mainly due to the difficulty of matching the employer's needs and expectations with the individual characteristics of the employee. Hiring an employee and then promptly terminating them generates costs for the employer, which is why segmentation — enabling the selection of employees with the characteristics deemed desirable by the employer (e.g. gender) — is used in such cases (Gueltzow et al., 2023). In practice, such categorisation of social groups is not always genuine and often causes them to be perceived through stereotypes and, as a result, to also be discriminated against (Sánchez et al., 2022). The characteristics that employers believe describe discriminated groups include a focus on family life (often linked to the high cost of caring for young children) (de Gispert et al., 2024), lack of commitment to work, no ambition for higher pay, no ambition for promotion, etc. On the other hand, the manifestations of cited discrimination include the gender wage gap and the lack of access to certain positions (including in the technical sciences) (Lindner, Makarova, 2024), including on company boards (Baizan, 2020; Zwiech, 2013).

K. Kompa, D. Witkowska and B. Jarosz emphasise that the spread of gender inequalities is considered an unacceptable phenomenon that should be prevented. This is evidenced, among other things, by existing legal regulations.

This starts with European Union legislation, in which ensuring equal treatment between women and men is a fundamental value guaranteed by the treaties, and the pursuit of this value is one of the main objectives of the EU's activities (Ludera-Ruszel, 2015; Burgoński, 2024). Article 157(1) of the Treaty on the Functioning of the European Union (Consolidated version..., 7.6.2016, pp. 117-118) states that: "Each Member State shall ensure that the principle of equal pay for male and female workers for equal work or work of equal value is applied".

This principle is reiterated in Article 23 of the Charter of Fundamental Rights of the European Union (OJ C 2010 No. 83, item 389). The Council Conclusions of 7 March 2011 (European Pact for Gender Equality (2011-2020), Official Journal of the European Union (2011/C 155/02)), which expand on this, identify ways to close the gender gap in the labour market, combat the exclusion of women on the grounds of age and gender stereotypes and counteract related violence. The need to promote equality in the rules of access to education and training and, finally, to strengthen the professional position of women in political life, to promote female entrepreneurs, to foster gender equality initiatives was emphasised (Majkowska-Szulc, Tomaszewska, 2020).

In Polish legislation, the principle of gender equality is established by Article 33 of the Constitution of the Republic of Poland of 2 April 1997 (Dz.U. /Journal of Laws/ of 1997, No. 78, item 483), providing for equal rights for women and men in family, public, social and economic life. Section 2 of that Article explicitly emphasizes that: "Men and women shall have equal rights, in particular, regarding education, employment and promotion, and shall have the right to equal compensation for work of similar value, to social security, to hold offices, and to receive public honours and decorations". This provision is horizontal, meaning that not only public but also private actors — for example, employers — are obliged to comply with it (Safian, Bosek, 2016; Burek, Kalus, 2013). The prohibition of discrimination was introduced to protect individuals from harmful conduct motivated by discrimination, and as such, it does not matter what entity is the originator of such conduct (Krzemińska, 2006).

Likewise, Article 11² of the Labour Code of 26 June 1974 (consolidated text of Dz.U. /Journal of Laws/ of 2023, item 1465), reiterates the principle of equality of employees, explicitly emphasising that it applies "in particular to the equal treatment of men and women in employment". Here, it is worth recalling that equal treatment does not mean identical treatment. Differences may arise due to personal characteristics of employees, e.g. disability. The Constitutional Court has also indicated that granting additional rights to women aimed at guaranteeing the achievement of equality does not contradict the principle of equality, but rather pursues it (CC judgment of 3.3.1987, P 2/87, OTK 1987, No. 1, p. 2), (Muszalski, Walczak, 2024).

In practice, however, significant disproportions are noticeable when it comes to women in leadership roles. Some authors note that a result of discrimination against women on boards of directors, which is due to (Kompa et al., 2015):

- more difficult access to these positions,
- lower pay for work in the same position compared to a man,
- a longer career advancement path.

Undoubtedly, gender inequality generates considerable tensions, including both among women seeking promotion or higher pay and in the views of the public which, in practice, entails widespread opposition to such conduct. It is not without reason that recent years have seen a particular emphasis on increasing women's participation in decision-making processes, regardless of their place in the organisational structure. It has been pointed out that women in leadership positions create a positive perception of the organisation from the corporate social responsibility standpoint; moreover, they improve the company's image and positively influence financial performance (Evans, 2014). It is further highlighted amidst many opinions that the increase of women's involvement in the management of economic actors contributes to the reduction of men's exclusive right to exercise power. The need to eliminate the "glass ceiling" (Akpinar-Sposito, 2013a; Naguib, Madeeha, 2023; van Ruler, de Lange, 2003), construed as obstacles placed in front of women on the way to promotion, is also considered as one of the key arguments (Akpinar-Sposito, 2013b; Kompa et al., 2016). Efforts to close the gender wage and employment gaps can significantly reduce household income gaps (Azzollini et al., 2023).

As noted above, gender disparities in access to managerial positions are recognised as a widespread problem that, in practice, can involve discrimination against women at many levels of socio-economic life. Considering the above, this article aims to verify the relationship between discrimination against women in access to high-level positions and their discrimination in the choice of their jobs, their return to the labour market, their education in technical subjects and the promotion of their participation in management decision-making.

2. Methods

The article provides a vertical analysis of the labour market from the point of view of those in leadership positions (split between men and women) in the overall workforce. Additionally, the Gretl econometric package (Adkins, 2018; Cotrell, 2021; Kufel, 2013) was used to achieve the previously stated objective, which enabled the influence of the independent variables on the dependent variable to be verified. In this respect, the ordinary least squares method (OLS) was applied, which made it possible to find the ordered logit model parameters. The results of the analysis are presented in the next section of the article.

3. Results

At this point, it is worth referring to the regular labour market analyses carried out by Statistics Poland — the Labour Force Survey (LFS). According to the guidelines, the LFS enables a comprehensive verification of the labour force resources in terms of employed, unemployed or economically inactive status (Statistics Poland, n/a).

Table 1 shows the percentage of leadership positions in the total workforce, broken down by women and men.

Tabela 1.

Share of persons in leadership positions in the total workforce

Item		Employed persons aged 15-89 (in thousands)	Public officials, senior officials and managers (in thousands)	Share of public officials, senior officials and managers in the total workforce (in %)
Q3 2021	Total	16,814	1,103	6.56
	Women	7,630	484	2.88
	Men	9,184	619	3.68
Q3 2022	Total	16,690	1,109	6.64
	Women	7,616	469	2.81
	Men	9,074	640	3.83
Q3 2023	Total	16,873	1,179	6.99
	Women	7,764	471	2.79
	Men	9,109	707	4.19

Source: own elaboration based on the LFS.

The latest LFS analysis of the labour market covers Q3 2023. For comparison purposes, 2021-2022 data for the same quarter were used as well. As indicated by the information in Table 1, the share of all (i.e. female and male) public officials, senior officials and managers in the total workforce was characterised by a regular increase, reaching values of 6.56%, 6.64% and 6.99%, respectively, in 2023. Undoubtedly, the growth of this indicator is the consequence of the increasing number of men occupying the above positions, i.e. from 619,000 in 2021, 640,000 in 2022, to 707,000 in the last period analysed. In contrast, the share of women in leadership positions is characterised by an annual decline, from 3.68% in 2021 to 2.79% in 2023. This demonstrates an increasing disparity between the number of men and the number of women in leadership positions, which was 135,000 in 2021, 171,000 in 2022 and as much as 236,000 in 2023. The downward trend in the number of women participating in management decision-making is indicative of an inconsistency between the initiatives promoted to prevent such situations and the actual state of affairs.

Here, it must be noted that the standards for the empowerment of women to occupy leadership positions, as indicated by international organisations, are still far detached from the views and beliefs prevailing in society, which particularly highlight discrimination against women. Therefore, a preliminary survey was conducted in early 2024 to verify the relationship between the occupation of high-level positions by women and the commonplace discrimination in this regard. The survey questionnaire consisted of a core section of 12 questions and

a demographics section. The survey mainly addressed the situation of women in the labour market and the role they are assigned in their private lives. The answers to the questions were structured according to a Likert scale, to which appropriate values were assigned, namely:

- strongly disagree – 1;
- somewhat disagree – 2;
- no opinion – 3;
- somewhat agree – 4;
- strongly agree – 5.

Responses were collected from 310 respondents, 64.61% of whom were women and the remaining 35.39% men. As for the place of residence, 67.65% of respondents indicated an urban municipality, 21.90% an urban-rural municipality and 10.46% a rural municipality. Notably, 65.25% of the total responses were given by people aged 26-55 years.

To answer the research question posed, the next section of the article assesses the relationship between the dependent variable and the independent variables (Table 2). For this purpose, the GRETLM econometric package was used which, based on the ordinary least squares method (OLS), made it possible to find the parameters of the ordered logit model.

Table 2.

Variables used to develop the logit model

Dependent variable	
D	Do you think women are discriminated against when it comes to access to high-level positions?
Independent variables	
A	Do you think women are discriminated against when it comes to their choice of jobs?
E	Do you think that women's participation in decision-making (e.g. in politics, on company boards, etc.) should be promoted?
F	Do you think that women have free access to all fields of study offered by universities, including male-dominated fields, e.g.: sciences, technical sciences, etc.?
I	Do you think that women are discriminated against in the labour market with regard to their choice of giving birth to and bringing up children?

Source: Own elaboration.

As can be seen based on the information in Table 2, the dependent variable is the respondents' answers as to whether they think women are discriminated against in terms of access to leadership positions. The study looked for a relationship between this aspect and the independent variables, which included issues related to discrimination against women in terms of women entering the workforce, the promotion of women's participation in management decision-making, the issue of free access to university faculties that were commonly dominated by men and discrimination against women in the labour market due to childbirth. The results of this relationship are presented in Table 3.

Tabela 3.

Ordinary Least Squares method (OLS). Dependent variable: D (using observations 1-310 (n = 305)).

	Coefficient	Std. error	t-ratio	p-value	
const	0.124849	0.202624	0.6162	0.5383	
A	0.521445	0.0432095	12.07	<0.0001	***
E	0.277217	0.0418086	6.631	<0.0001	***
F	-0.155550	0.0434537	-3.580	0.0004	***
I	0.275421	0.0483367	5.698	<0.0001	***
Mean dependent var	2.859016	S.D. dependent var		1.391867	
Sum squared resid.	210.7406	S.E. of regression		0.838134	
R-squared	0.642168	Adjusted R-squared		0.637397	
F(4, 300)	134.5957	P-value(F)		1.10e-65	
Log-likelihood	-376.3995	Akaike criterion		762.7989	
Schwarz criterion	781.4005	Hannan-Quinn		770.2392	

Source: Own elaboration.

The results show that there is a significant relationship between the dependent variable and the independent variables selected for the study. The explanatory variables are characterised by high significance, which oscillates at around $p < 0.01$. The signs of the independent variable estimates show that variables A, E and I are stimulants, while variable F is a destimulant. This means that an increase in the values of variables A, E and I implies an increase in the value of the dependent variable D, whereas a decrease in the values of these variables contributes to a decrease in the value of the complex phenomenon. More specifically, respondents who strongly agreed that:

- women are discriminated against when it comes to their choice of jobs (A),
- women are discriminated against in the labour market with regard to their choice of giving birth to and bringing up children (I),
- women's participation in decision-making (e.g. in politics, on company boards, etc.) should be promoted (E),
- also strongly agreed that women are discriminated against when it comes to access to high-level positions.

As respondents' feelings about the above-mentioned aspects decreased, so, too, did their feelings concerning the dependent variables. Therefore, when respondents disagreed with the statements indicated as independent variables, i.e. A, I and E, they also did not believe that women are discriminated against in access to leadership positions. The results obtained for variable F, the destimulant, show that the more respondents disagreed that women have access to all university faculties, including male-dominated fields, the more they expressed the view that women are discriminated against when it comes to access to high-level positions. In contrast, if they agreed with the independent variable, they disagreed with the dependent variable. These scenarios demonstrate a negative relationship between the explanatory and response variables. The value of the R-squared coefficient demonstrates a good fit of the variables to the model, the value of which confirms that the variation in the independent variable

explained 64.21% of the variation in the dependent variable. The p-value for the F-test ranked below 0.01, which also indicates the significance of the variables used in the model.

4. Discussion

The results of the above surveys show that even though gender discrimination of employees is considered unacceptable (according to the position of the European Union, among other things), it is still a commonplace practice among employers, characterised by a negative public perception. The answers given by the respondents demonstrate a widespread belief that women are discriminated against in many respects. This includes the choice of jobs, the decision to give birth to and bring up a child, and access to study in technical subjects. Notably, the promotion of women's participation in management decision-making also plays a vital role in this perspective. All these aspects have an important bearing on women's occupation of leadership positions. In practice, discrimination against women in the labour market is closely linked to their discrimination in accessing high-level positions. Women's career development is severely restricted as early as the stage of their search for a place in the labour market, which prevents them from achieving career advancement at a later stage.

In line with the above, discrimination against women is currently a widespread problem. The public emphasises the need to implement measures aimed at correcting this trend, thus aiming to change employers' attitudes. It therefore seems reasonable to introduce policies that could support women as they re-enter the labour market and then as they build up their leadership positions.

Based on the results of the above research, it can be concluded that discrimination against women in access to high-level positions is closely correlated with discrimination against women seeking employment or returning to the labour market after a long break. This phenomenon should be viewed as a social problem for which preventive action is required. Given the importance of the issue, it is worth expanding the research carried out to include additional issues, such as employers' beliefs regarding the employment of women in various positions. Among other things, this would make it possible to find out whether employers are guided by prejudices in this respect and what these prejudices stem from.

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THE DEVELOPMENT OF THE E-CULTURE MARKET: PERSPECTIVES FROM POLISH CONSUMERS

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Purpose: The aim of the article was to explore the development of the e-culture market from the perspective of Polish consumers.

Design/methodology/approach: The objectives were achieved by conducting a theoretical review of the scientific literature on the e-culture market, supplemented by research on Polish consumers' opinions regarding the functioning and usefulness of the e-culture market. The research was conducted using an online survey technique among 120 Polish consumers aged 20 to 74 at the turn of 2022 and 2023.

Findings: The research results indicated a diverse approach among consumers towards using services and products in the e-culture market. It also identified which institutions offering e-culture services are most popular among digital consumers. The study revealed the most frequently undertaken activities by consumers in the use of e-culture and highlighted the significant impact of virtuality in the context of providing e-culture services.

Research implications: In the future, it would be interesting to expand the scope of the research to other countries in Europe or around the world, or to conduct studies on specific demographic groups (e.g., young people or seniors) to examine how e-culture influences their use of cultural services or products in everyday life.

Originality/value: The article makes a unique contribution to understanding the functioning and usefulness of the e-culture market among Polish consumers. The originality of the topic addressed in the article stands out due to the fact that digital markets (including the e-culture market) are relatively new phenomena, and therefore not fully explored. Expanding knowledge in this area will help to understand consumer attitudes towards the e-culture market and identify various socio-economic aspects.

Keywords: e-culture, e-market, e-consumers, digital, virtuality, Poland.

Category of the paper: research paper.

1. Introduction

The dynamic development of technology and the numerous processes aimed at digitizing various aspects of contemporary life have found their justification in the realm of broadly understood culture. In the face of ubiquitous digitalization, there has arisen a need to transfer many cultural dimensions to the web or create them specifically for digital consumers.

Entities within the e-culture market, encompassing both traditional cultural institutions and newly established digital platforms, play a crucial role in shaping, promoting, and distributing various forms of art, culture, and heritage in the online environment. As society increasingly digitizes its life, these entities transform, adapting to prevailing trends and new challenges.

This article aims to present the functioning of the e-culture market and its institutional entities, as well as to illustrate the development of the e-culture market in Poland in recent years. In the context of a changing technological landscape and social preferences, the role these entities play in the digital world of culture will be analyzed. Through an interdisciplinary review of literature and analysis of information obtained from original research, it will be possible to reveal the complexity of actions undertaken by e-culture entities and outline potential directions for their future development.

2. Literature review

2.1. The E-Culture Market as a Basis for Research

The e-culture market, like any digital market, despite its constantly expanding service offerings and observed developmental dynamics, can be characterized as a relatively young phenomenon. The mentioned developmental dynamics of the e-culture market are conditioned by technological progress and its attractiveness and accessibility to potential consumers (Van der Ploeg, 2003).

The theoretical understanding of culture over the years have led to the development of numerous approaches to this concept. A review of Kroeber and Kluckhohn's conceptions of culture resulted in the creation of types of definitions that emphasize six different aspects of culture (descriptive-enumerative, historical, normative, psychological, structuralist, and genetic definitions) (Gruchoła, 2010; Sobocińska, 2015). In the literature, one can find a modified typology, where a uniform classification criterion is adopted — the way culture is understood, considered fundamental for a given humanistic discipline (Włodarczyk, 2003):

- Anthropological approach – culture as the totality of human creations and actions, free from value judgments and subjective as well as psychological content, fulfilling social and instrumental functions concerning the entire system and the biological needs of the human organism.
- Philosophical approach – culture as a supra-individual intellectual reality.
- Historical approach – emphasizing the historical conditions of cultural phenomena, the precise spatial-temporal localization of the studied phenomena, capturing their variability over time, the mechanisms of cultural transmission, and the issues of cultural transformations.
- Sociological approach – culture as patterns of interaction between individuals and groups.
- Psychological approach – emphasizing the mutual influences of personality and culture.

The e-culture market is based on specific relationships occurring between entities. Some of these entities offer culture, while others consume it, fulfilling their needs by using specific services from a wide range of cultural offerings (Sobocińska, 2008). The cultural market can be defined as the totality of exchange relationships occurring between entities offering goods and services that satisfy needs in the field of culture, and consumers and institutions purchasing cultural goods and services (Wolny, 2023).

It is worth clarifying the definition of an e-consumer. An e-consumer is defined as "an individual who expresses and satisfies their consumption needs through products (goods and services) purchased online" (Jaciow, Wolny, 2011). A digital consumer exhibits purchasing behaviors exclusively online (Jaciow, Wolny, 2022). The most common subject of purchase is services or products.

The entities in the e-culture market can be divided into those related to supply and those related to demand (Janeczek, 2001). It is worth mentioning that the form of supply is a consequence of the activities of entities offering services or specific products (Przybylska-Kapuścińska, 2011). Entities on the supply side of the digital culture market, understood as sellers or providers, include, for example:

- Cultural institutions engaged in creating cultural services or processing existing cultural goods to make them available to consumers.
- Enterprises and cultural institutions that allow browsing of their offerings, checking schedules, or purchasing tickets for various cultural events.
- Institutions or enterprises responsible for running portals and websites dedicated to the broadly understood culture (Wolny, 2013).
- Entities that offer popular culture resources, Entities providing services related to digital culture, including intermediaries and information providers (Sokołowski, 2007).
- Artists who create and share their cultural goods in the digital sphere.

Entities demanding in the e-culture market can be characterized as individuals interested in using or consuming goods or services of broadly understood digital culture. These entities include:

- Individual consumers, who are interested in accessing the wide range of cultural offerings available online.
- Institutional consumers, who utilize the service offerings proposed by public institutions such as cinemas, theaters, museums, philharmonics, art galleries, operas, etc. (Sokołowski, 2007).
- Households (or their residents), who have access to cultural resources available on the Internet, for example, through subscribing to a streaming service that offers a wide cultural database (Wolny, 2016).

The economic aspects of the e-culture market can be considered from two perspectives: as a digitized good or service that responds to specific cultural needs, or as an institutional arrangement (Piotrowska-Marczak, 1987). The first perspective is also understood as tangible and intangible services that directly satisfy consumer needs.

Material goods, when reduced to the virtual space, lose their physical value and become intangible products for humans. For instance, the possibility of taking a virtual tour of a museum, where one can pass by artworks and observe them through a smartphone or laptop screen, does not allow for direct interaction with them. Consequently, it can be stated that e-culture services, as intangible goods, are characterized by the lack of tangible results from interacting with them. Much in this case may depend on the consumer's perception and imagination (Trzeciak, 2011).

3. Scope of research

An online survey technique was used to conduct the e-culture market research. The questionnaire for the study was designed, tested, operationalized, and posted on the online platform webankieta.pl. The research was conducted on a sample of 120 consumers aged 20 to 74 who use digital culture services. For data analysis purposes, respondents were divided into four age groups: consumers up to 23 years old, those aged 23-27, those aged 27-31, and consumers over 31 years old. This division was aimed at achieving an even distribution of group sizes based on the respondents' ages.

The research was carried out between December 2022 and February 2023. Respondents were reached by posting an invitation encouraging them to fill out the questionnaire on social media, specifically on [facebook.pl](https://www.facebook.com). The invitation included information about the purpose of the research, contact details for the research coordinator, a brief description of who was conducting the research, and the estimated time required to complete the survey.

The questionnaire designed for individual consumers consisted of six pages (including the initial screen and thank you note). It was divided into two substantive parts. The first part, which included 19 questions (both closed and open-ended), sought consumers' opinions on the broad use and functioning of the e-culture market in Poland. The second part contained six questions aimed at obtaining sociodemographic data of the surveyed consumer group. Respondents were asked about their age, gender, education, area of residence, subjective assessment of their financial situation, number of people in the household, and professional activity.

Some of the results of the research were previously used in the author's thesis.

4. Research results

Based on the conducted research, the demand for services offered by cultural institutions and for e-culture can be characterized. The responses provided in the questionnaire help understand consumers' attitudes towards accessing cultural goods, the offerings of cultural institutions, purchasing services, and other significant aspects related to the discussed topic. This, in turn, illustrates how e-culture entities are developing in the market.

Cinema is the most popular among consumers of the cultural institutions listed, with one in four respondents declaring frequent use of cinema services. The second most frequently visited institution is the theater, with almost one in ten respondents indicating that they often use theater services. Philharmonic orchestras and opera houses are notably the least popular among audiences, with 57.3% and 71.8% respectively never having used the services of these institutions (Table 1).

Table 1.

Frequency of using cultural institutions by consumers (in %)

Item	Very often	Often	Sometimes	Rarely	Never
Theater	1.0	9.7	24.3	52.4	12.6
Cinema	3.9	25.2	45.6	23.3	1.9
Museum	-	4.9	33.0	48.5	13.6
Art Gallery	-	3.9	16.5	43.7	35.9
Philharmonic Orchestra	-	1.9	6.8	34.0	57.3
Opera House	-	1.2	6.8	21.4	71.8

Source: own study.

To determine consumer attitudes towards the e-culture market, one can analyze how consumers fulfill their cultural needs. The various activities along with their usage frequency allow for identifying aspects that constitute the demand conditions of the e-culture market. The analysis conducted shows that consumers most commonly satisfy their cultural needs by listening to music and watching movies and TV series online (this applies to approximately 80-90% of respondents regardless of age). For the age groups of 27-31 and above 31 years old,

reading books also holds significant importance, with 81.2% and 78.3% of respondents in these age groups, respectively (Table 2).

Table 2.

Ways of satisfying cultural needs by age of respondents (in %)

Item	Total	Respondents by age			
		up to 23	23-27	27-31	above 31
I take part in cultural events, art exhibitions, concerts etc.	42.8	53.8	46.2	44.4	21.0
I go to the cinema	62.7	61.5	46.2	77.8	58.2
I go to the theater	37.2	25.6	15.4	48.1	42.2
I listen to music	87.5	84.6	92.3	96.3	78.5
I watch movies/series online	85.8	82.1	84.6	96.3	75.0
I read books	72.3	61.5	63.9	81.2	78.3
I read e-books	27.6	17.9	30.8	29.6	26.2
Others	5.1	2.6	-	7.4	4.8

Source: own study.

Consumers pursue specific goals online. Fulfilling cultural needs often takes place in the virtual space. Based on the conducted research, the most frequently pursued goals have been identified. The vast majority of respondents indicated that listening to music is the primary cultural goal pursued online. Nearly identical results (over 92%) were found for this activity in the age groups up to 23 years old, 23 to 27 years old, and 27 to 31 years old. In the group of people over 31 years old, watching movies online is the most popular activity. Those activities declare 90% of respondents (Table 3).

Table 3.

Cultural goals pursued online by consumers by age (in %)

Item	Total	Respondents by age			
		up to 23	23-27	27-31	above 31
I watch movies	88.3	79.5	84.6	96.3	90.0
I listen to music	91.9	92.3	92.3	92.6	84.3
I read e-books	24.2	28.2	30.8	33.3	19.6
I watch arts	21.6	12.8	23.1	25.9	23.8
I watch theatrical performance	15.1	7.7	7.7	14.8	24.3
I purchase tickets	62.3	69.2	63.1	81.5	54.6
I am browsing the program of various cultural institutions	54.2	46.2	30.8	66.7	69.3
Others	-	-	-	7.4	-

Source: own study.

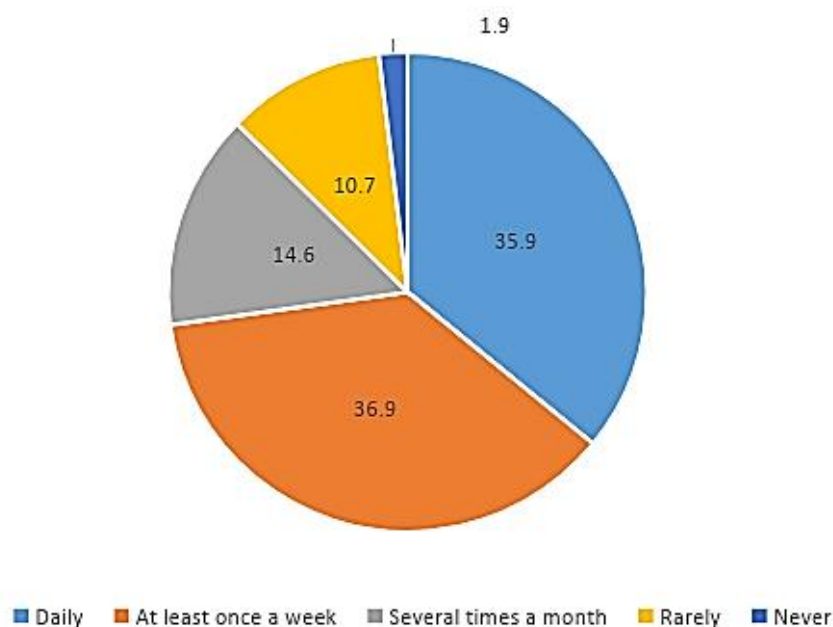
Consumers were asked to identify the distinguishing features of the e-culture market. The youngest group of respondents (66.7%) pointed to virtuality. Consumers aged 23-27 years and those over 31 years (92.3% and 85%, respectively) agreed that free and easy access to services is the best distinguishing feature of the e-culture market. In contrast, the 27-31 age group (88.9%) identified 24/7 availability as the key feature. All of these identified characteristics are a result of technological and informational progress and the continually increasing popularity of digital forms of service expression (Table 4).

Table 4.*Consumer opinions on the characteristics of the e-culture market by age (in %)*

Item	Total	Respondents by age			
		up to 23	23-27	27-31	above 31
24/7 availability	72.3	59.0	69.2	88.9	68.8
Virtuality	65.3	66.7	77.8	59.3	61.3
Free and easy access to services	79.6	64.6	92.3	74.1	85.0
The ability to actively participate in cultural life without leaving home	54.1	61.5	48.9	70.4	55.5
Low costs of using e-culture services	41.2	31.8	46.2	33.3	29.3
High costs of using e-culture services	18.5	12.5	29.6	7.4	5.7

Source: own study.

The group of surveyed consumers demonstrates relatively frequent activity in using e-culture services. 36.9% of them use e-culture at least once a week, one percentage point less use it daily, 14.6% use it several times a month, 10.7% use it rarely, and 1.9% of the group have never used e-culture (Figure 1).

**Figure 1.** Frequency of using e-culture services (in %).

Source: own study.

The vast majority of respondents (96.1%) stated that e-culture is a useful phenomenon in contemporary times. Conversely, 3.9% of the respondents disagreed with this opinion (Figure 2).

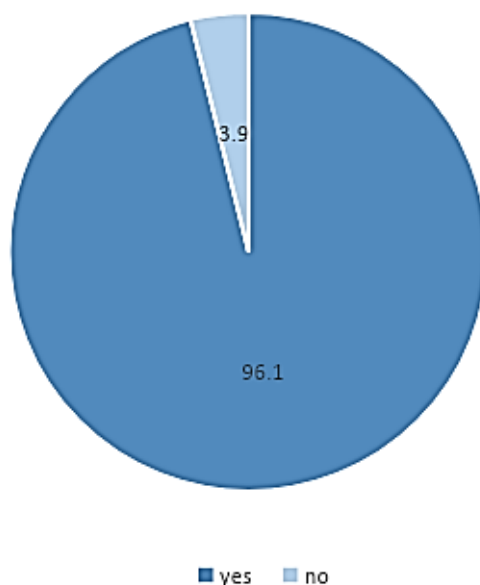


Figure 2. Opinion on the usefulness of the e-culture phenomenon (in %).

Source: own study.

In the conducted research, consumer opinions were sought regarding the functioning of e-culture in Poland, its impact on traditional culture, and the emerging opportunities and threats for development. Many responses did not clearly define consumer opinions, as there were quite wide discrepancies in the answers provided. In the first analyzed question, positive responses were more frequent (definitely yes - 25.3%, probably yes - 33%, maybe - 24.2%), suggesting that consumers prefer the digital form of cultural expression over the traditional one. In the second question, concerning the displacement of traditional cultural heritage by digital forms of culture, opinions varied. However, there is a noticeable tendency towards confirming this thesis (22.3% of respondents strongly agreed, and 31.1% somewhat agreed). In the following question, respondents were asked if virtuality is an opportunity for the development of culture. Respondents clearly expressed affirmative opinions on this topic (32% strongly agreed, and 43.7% somewhat agreed). Consumers undoubtedly perceive the positive impact of the Internet and digitization in terms of expressing and delivering e-culture services and digitizing cultural heritage resources. In the last question, it was suggested that virtuality poses a threat to the development of culture. The majority of respondents disagreed with this thesis, as almost half chose the response 'probably not,' and one in five chose 'definitely not' (Table 5).

Table 5.*Summary of opinions on the usefulness of e-culture (in %)*

Item	Definitely yes	Probably yes	Maybe	Probably no	Definitely no
The digital form of accessing culture is more accessible than the traditional one	25.3	33.0	24.2	15.5	1.9
The digital form of expressing and accessing culture is displacing traditional cultural heritage	22.3	31.1	12.6	28.2	5.8
Virtuality is an opportunity for the development of culture	32.0	43.7	19.4	3.9	1.0
Virtuality is a threat to the development of culture	3.8	14.5	15.5	45.7	20.5

Source: own study.

Respondents were asked to express their opinions on factors conditioning the development of the e-culture market. Among those with basic or vocational secondary education, nearly 80% of responses indicated that high costs of traditional services are a major factor. In both the groups with secondary and higher education, technological and informational progress was highlighted. The development of mass media was also a significant factor for consumers, with more than half of the respondents in each group identifying it as important.

Table 6.*Consumer opinions on the impact of various factors on the development of the e-culture market (in %)*

Specification	Total	Respondents by education level		
		Primary	Secondary	Higher
Technological progress	66.8	52.8	67.6	78.2
Development of mass media	59.6	61.2	62.2	54.4
Lack of interest in the offerings of museums/cinemas etc.	9.8	14.5	2.5	16.9
High costs of traditional services	59.2	79.6	43.3	35.6
Possibility of digitizing cultural resources	44.9	24.3	37.8	52.5
Lack of time for consumers to engage with traditional cultural forms	29.3	19.6	12.7	42.4

Source: own study.

5. Discussion

The conducted research aimed to understand the level of consumer demand for services offered in the e-culture market, their attitudes towards cultural engagement, opinions on the impact of factors on market development, the usefulness of e-culture in the modern world, and other related aspects. The results obtained provide insight into the functioning of entities in the e-culture market.

Consumers engage with culture in various ways and with varying frequencies. The research shows that consumers most frequently choose cinema for cultural experiences (25.2%). Theater is the second most frequently visited institution (9.7%). Opera is the least popular, with nearly 75% of consumers never having used its services. These findings closely match the percentage interest in cultural institutions revealed in the KIM - National Institute of Media (2023) studies, which show 27.9% for cinema, 4.8% for theater, and 1.9% for opera. KIM researchers also noted relatively high consumer interest in attending concerts. However, these data cannot be directly compared to the findings of the current research due to the unspecified types of musical events.

The research provided valuable information about consumer attitudes toward the usefulness of e-culture in the modern world. The results indicate that digital forms of cultural engagement are more accessible to consumers than traditional forms. Positive factors contributing to this choice include 24/7 availability, convenience (the ability to access e-culture from anywhere and at any time), and relatively low costs. Other researchers have also noted the emergence of content personalization features (Gomez-Uribe, 2015), diversity of offerings, and creative ways of content promotion (Matwiejczyk, 2020).

The thesis posed in the research, suggesting that digital forms of cultural expression and engagement are displacing traditional cultural heritage, revealed a complex and varied nature of consumer opinions. Over half of the respondents supported this thesis, one-third disagreed, and one in ten remained neutral. This variability in consumer responses may be attributed to differing levels of acceptance of modern technologies. Some consumers are open to new technologies and readily adapt to digital forms of culture, while others prefer traditional forms. A. Kortosz-Mirecka and M. Mucha (2019) observe that contemporary society exhibits constantly changing cultural and entertainment needs, which translates into a growing tendency to abandon traditional forms of presented cultural resources, such as literature collections in libraries or artworks in galleries or museums. The attendance of cultural participants at various cultural events, such as art exhibitions, theater performances, or movie screenings, is also showing a declining trend (Kortosz-Mirecka, Mucha, 2019).

For some consumers, traditional forms of culture are synonymous with comfort and habit. They may feel a stronger emotional connection, for instance, with physical cultural goods like books, CDs, vinyl records, etc., which makes them reluctant to transition to digital alternatives (Janoś-Kresło, 2008). Other studies suggest that consumers will increasingly return to traditional forms of cultural engagement (Castells, 2003). In contrast, B. Namyślak's research (2013) demonstrated that the digital culture market is on an upward trend in the Polish market. This is evidenced by the connection between economic development and cultural development, which consequently supports investments in e-culture and the media sector.

According to consumers' opinions on using e-culture, it can be inferred that a significant portion of them seeks convenient ways to engage with culture. Over 50% of respondents indicated that the digital form of service delivery is more accessible than the traditional one.

An increasing number of consumers prioritize a high quality of life, which encourages them to turn to e-culture goods more often than to traditional culture. Research has shown that most consumers lean towards modern forms of cultural provision, such as using streaming services or listening to music online. This situation compels public sectors to enhance their creativity and seek new ways to serve consumers on multiple levels, including in digital markets (Wolniak, Jonek-Kowalska, 2020, 2022).

Consumers in the e-culture market are characterized by an awareness of sustainable consumption, which plays a significant role in the contemporary world. The research revealed that younger groups of respondents demonstrate a greater awareness of sustainable use of goods in the e-culture market, which has been also confirmed in the studies by B. Gajdzik, J. Kol, and A. Stolecka-Makowska (2023). It is important to note that consumers, with the progress of the modern world, are constantly evolving and changing their behaviors. As a result, one should expect non-uniform changes in their approach to sustainable development, which may consequently influence their behaviors in the context of engaging with digital markets (de Oliveira, Gomes, de Abreu, Oliveira, da Silva Cesar, 2022; Gajdzik, Jaciow, Wolny, 2023; Gajdzik et al., 2024).

In consumers' opinions, virtuality is an important aspect of the e-culture market. Moreover, over 75% of respondents indicated that virtuality represents an opportunity for the development of the e-culture market. This is likely related to increased consumer awareness and need for using all digital services driven by technological advancement. This result is supported by studies by A. Uzelac (2005) and F. Huysmans and J. de Haan (2003), which show that well-developed network infrastructure positively affects the distribution of digital cultural goods, attracts consumers with its appeal, and stimulates interest in e-culture market services.

6. Summary and conclusions of the research

The conducted research aimed to understand the level of consumer demand for services offered in the e-culture market, their attitudes towards cultural engagement, opinions on the impact of factors on market development, the usefulness of e-culture in the modern world, and other related aspects. The results obtained provide insight into the functioning of entities in the e-culture market.

Recent years have seen developmental changes in digital markets. With technological and informational progress, increasing consumer awareness, and a wide and attractive supply from providers, e-culture has become firmly embedded in consumers' daily lives. Traditional ways of engaging with culture are increasingly being abandoned.

The research conducted for this work aimed to determine the functioning of e-culture market entities based on consumer behavior, their awareness, frequency and manner of use, and the level of demand for services offered by the e-culture market. The findings indicate that consumers are eager to utilize the offerings of the market. Interest in e-culture has become increasingly widespread. Based on the conducted research and secondary information, the following factors influencing consumer engagement with e-culture have been identified:

- The ability to quickly modify the service offerings and easily adapt to consumer needs.
- The virtual nature of the phenomenon, associated with the ease of reaching a large audience.
- The attractive pricing of cultural services (as opposed to traditional service offerings).
- A rich and enticing array of services offered.
- The option to make payments in various forms.
- Anonymity of users online, which facilitates the decision-making process regarding potential purchases.
- 24/7 availability of services (e-culture can be accessed from any location at any time).
- The international dimension of the services offered.

The e-culture market continues to develop. There is an increasing demand for digital cultural services, which consequently leads to a rise in the number of entities providing e-culture (Nielsen Report, 2022). In response to growing demand, the offerings of businesses and cultural institutions are becoming broader and richer (Deloitte Report, 2020). Supply entities compete in ways of delivering culture, incorporating increasingly innovative solutions, such as the use of intelligent recommendation systems based on artificial intelligence or virtual reality as a form of presenting cultural content.

Regarding demand entities (consumers) in the e-culture market, there is a decreasing interest in traditional forms of e-culture provision. These changes are not abrupt but could gradually lead to a significant displacement of traditional cultural engagement methods. It is worth noting the phenomenon of streaming media, which has shown steadily increasing popularity since its market inception. This is likely due to the vast resources that this form of service offers consumers—streaming media libraries contain extensive cultural content that consumers can access multiple times at their chosen location and time. The freedom of access and relatively low costs of online services encourage consumers to frequently utilize this form of accessible culture.

The article's objective has been achieved. The research demonstrated the development and functioning of e-culture market entities and highlighted their future directions. Given the developmental trends in the e-culture market, it is reasonable to assert that cultural institutions and businesses will continue to follow changing consumer needs and emerging technological innovations, consistently expanding their offerings, exploring new forms of online cultural provision, and proposing more engaging and personalized content.

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ENVIRONMENTAL MARKETING OF THE PROVINCIAL CITIES IN POLAND

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Purpose: The survey aims to identify current trends in the green marketing of the provincial Polish cities. The trend analysis will provide an understanding of how cities' authorities promote ecology, what activities and solutions are currently being implemented by them to promote cities from an environmental perspective. The purpose of the analysis is to examine whether the cities' ecological marketing contribute to reducing air pollution?

Design/methodology/approach: The study will use content analysis, and trend analysis. Content analysis will identify elements of green marketing in ongoing projects of the provincial Polish cities. Trend analysis will answer the question of the relationship between green marketing and the level of city pollution.

Findings: Considering that the EU Green Deal guidelines impose air pollution reduction targets on cities and countries, it can be hypothesized that cities should focus their activities on green marketing. It can be assumed that there is a positive (positive) relationship between the marketing activities implemented by the city and the decreasing level of air pollution.

Originality/value: The article makes a significant contribution to the field of urban ecology and municipal marketing research. It combines two key issues: the marketing strategies used by cities to promote ecological activities and the analysis of PM₁₀ air pollution trends. This two-pronged analysis allows for a comprehensive understanding of whether the marketing efforts undertaken have a real impact on improving air quality in Polish cities.

Keywords: marketing, territorial marketing, environmental marketing; Green Deal; air pollution.

Category of the paper: Research paper.

1. Introduction

Environmental marketing of the Polish provincial cities should be an important area of activity for local and regional authorities. The development strategies of Poland's provincial cities include statements of ecological values and objectives, which allows to explore environmental marketing practices. This is increasingly important in the context of sustainable development and growing public awareness of environmental protection and air pollution.

Actions by regional authorities should respond to the needs of achieving the Green Deal goals (European Commission, 2010). They require at the regional level to take appropriate measures in the field of ecology – including renewable energy, changes in urban transportation, increasing green areas, new technologies for sustainable development, education and much more. It is worthy underlining that cities are places where the population and economic activity concentrated the most, caused the problems of air pollution and other environmental issues (Chan, Yao, 2008, pp. 1-42; Mayer, 1999, pp. 4029-37; Zhu et al., 2019, p. 101593).

In the available literature many authors define the term green marketing and explain its meaning in the context of goals, objectives and development prospects (Graczyk, Zarębska, 2000, pp. 107-16). Katrandiev has conducted an in-depth analysis related to the evolution of green marketing (1975-1989) into green marketing (1990-2000), sustainable marketing (post 2000). He has noted that green marketing is part of marketing 2.0, which has been proposed by Philip Kotler (Katrandjiev, 2016, pp. 71-82). Numerous papers address issues associated with the ecological marketing due to the importance of research in the area of sustainable development, as well as practical implications for the EU's Green Economy goals (Śliwińska, 2020; Wilk, 2018, pp. 637-45; Zajkowska, 2015, pp. 359-70). It is worth noting that authors (especially Polish) have connected the concept of green marketing primarily with entrepreneurship (Drapińska, 2015, pp. 277-88; Klonowska, 2002, pp. 12-14; Olejniczak, 2014, pp. 139-44) and consumer needs (Delafrooz, Taleghani, Nouri, 2014, pp. 1-5; Grzybowska-Brzezińska, 2013, pp. 37-58; Hombek, 2019, pp. 1-17; Zaremba, 2002, pp. 151-62). However, few authors have analysed the green marketing from the perspective of city's strategy (Deluga, 2015, pp. 97-108; Guzal-Dec, 2016, pp. 17-27). The international literature often analyses case studies of the use of green marketing in cities (Nas, 2017, pp. 396-422; Reynolds et al., 2023, pp. 2432-58; Schmeller, Pirisi, 2023, pp. 287-309; Sun et al., 2022, pp. 1-10). The researchers also analyse the problem of so-called unreliable environmental marketing, which they call as a greenwashing (Adamkiewicz et al., 2022, p. 100710; Miller, 2017; Seele, Gatti, 2017, pp. 239-52; Wu, Zhang, Xie, 2020). However, in the available literature is lack of comparative studies that have the impact of green marketing toward efforts to reduce air pollution. Therefore, the goal of the analysis is to survey the dependency between environmental marketing in Polish cities and trend of air pollution.

The analysis will help with determining whether the actions carried out by the Polish cities are sufficient to achieve the decreasing of air pollution. Based on the assumptions of Marketing 2.0 by Philip Kotler, it can be assumed that green marketing activities should be correlated with the reduction of urban air pollution. The lack of correlation between variables may indicate the presence of greenwashing.

Ma and others proposed an analysis of city strategies, in which they extracted research tools for analysing city promotion, city marketing and city branding (Ma et al., 2021, p. 3). Based on the proposed indicators for the promotion of cities by Ma, an analysis has been made of Polish provincial cities aimed at reducing air pollution.

The variables used in the analysis:

- dependent variables,
Y – PM₁₀,
- the independent variables,
X₁ – presence of environmental symbol and colours in cities coat of arms,
X₂ – presence of environmental symbol in a city slogan,
X₃ – presence of environmental symbol in city promotion videos, digital brochure,
website.

Two specific questions will be posed in the article:

- 1) Is there differentiation among individual cities in terms of environmental marketing?
- 2) Whether green-oriented marketing efforts are linked to activities to reduce urban air pollution?

The article consists of two parts, in which successively analyses the municipal marketing towards ecology, and in the second part trends of PM₁₀. The analysis will show whether the marketing undertaken to reduce air pollution are sufficient to improve the situation of Polish cities.

2. Polish cities' environmental marketing

There are numbers of reasons why the green marketing is becoming one of the most important areas for Polish cities. First, consumers are increasingly looking for sustainable products and services. Second, governments or the EU are putting pressure on regions to reduce their environmental impact. Third, the growing awareness of climate change is making people more interested in living in cities that are environmentally friendly.

The green marketing of the provincial cities in Poland can take a number of different forms. One approach is to focus on the environmental benefits of the city's natural and built environment. For example, a city might promote its green parks, sustainable transportation system, or energy-efficient buildings. Another approach is to focus on the city's green economy. For example, a city might promote its green businesses, environmental jobs, or sustainable tourism.

There are a number of benefits to the green marketing for Polish cities. It can help to attract tourists and businesses, improve the city's environmental image, reduce its environmental impact, and create a more sustainable future. The promotion of green cities focuses on building awareness and encouraging environmental activities through various forms of communication and education and marketing. Promotion plays a key role in green cities, helping to raise public awareness of environmentally friendly measures.

Logo in communication is one of the signs of brand recognition. It is the customer's first contact with a brand through the name and visual features: logo, colours, symbols (Walas, 2014, p. 30). The city's coat of arms can refer to motifs from the world of plants, animals, elements of the landscape, including, for example, water, forests and others. The following table presents the results of the analysis on the occurrence of elements associated with the environment, nature, ecology (see Table 1).

Table 1.
Environmental motifs in the coats of arms of Polish cities

City	Coat of arms	Colours in logos, coats of arms of Polish cities	Environmental elements
<i>Białystok</i>	White eagle on red background and Lithuanian chase	Red-gold	Animal world
<i>Bydgoszcz</i>	Red city wall with blanks, with a gate and three towers	White, red blue	No direct environmental elements
<i>Gdańsk</i>	On the red field a golden open crown and two isosceles silver crosses	Red-gold	No direct environmental elements
<i>Katowice</i>	A hammer mill device with a cogwheel, on a gold background, placed on a beam, and the Rawa River, which flows through Katowice	Yellow and blue	Landscape
<i>Kielce</i>	Crown with floral motif	Red and yellow	The world of plants
<i>Kraków</i>	Shield topped with a lily motif, with a wall with three towers with lily-shaped fittings, with the White Eagle	Red, blue, white	Animal world, plant world
<i>Lublin</i>	Goat on red background climbing from green turf to green vine bush	Red, green, white	Animal world; plant world
<i>Łódź</i>	Golden boat with oar in red field	Red	Landscape
<i>Olsztyn</i>	The figure of St. James the Elder clad in a long robe, with a pilgrim's staff in his right hand and a shell in his left, with a hat on his head and a halo around it	Blue	Animal world, landscape
<i>Opole</i>	Half eagle and half cross with trifoliate ends	White and blue	Animal World, The world of plants
<i>Poznań</i>	A fortified wall with three towers and an open gate. On the middle one supports a shield with an image of a crowned eagle	Blue, white, gold	Animal world; plant world
<i>Rzeszów</i>	Bachelor's cross on a blue field	White and blue	No direct environmental elements
<i>Szczecin</i>	Crowned griffin on a blue background	Red, blue, gold	Animal world
<i>Warszawa</i>	Mermaid with sword and shield, surrounded by waves	Red-gold	Landscape, animal and human world
<i>Wrocław</i>	Shield with symbols of various families and cities	Red, yellow, white	No direct environmental elements
<i>Zielona Góra</i>	Green background with two towers	Green and white	Landscape

Source: (Miasto Białystok, n.d.; Miasto Bydgoszcz, n.d.; Miasto Gdańsk, n.d.; Miasto Katowice, n.d.-b.; Miasto Kraków, n.d.; Miasto Łódź, n.d.; Miasto Lublin, n.d.; Miasto Olsztyn, n.d.; Miasto Poznań, n.d.; Miasto Szczecin, n.d.; Miasto Warszawa, 2024a; Miasto Wrocław, 2024; Muzeum Historii Kielc, n.d.; Powiat Rzeszów, n.d.; Rada Miasta Opole, 2018; Rada Miasta Zielona Góra, 2004).

Analysing the coats of arms of Polish cities, it can be seen that animal motifs are most common (e.g. Białystok, Lublin, Szczecin, Warsaw). The plant world is less frequently depicted, but it is visible e.g. Kielce, Cracow. There are some motifs related to nature in coats of arms, such as water (Łódź, Katowice), greenery (Zielona-Góra). In the case of Rzeszów, Bydgoszcz and Gdańsk, there is no analogy to nature motifs. In turn, the colours in most coats of arms do are not associated with nature, the green of forests or the blue of water. Only in the case of Zielona Góra, Katowice such connotations occur.

Another distinguishing feature of the city is the slogan, which attracts people's attention. As Mathur emphasizes „Principal among these factors is the desire to improve the financial performance of the firm, which should be viewed positively by investors, and should result in a higher market value of the firm” (Mathur, Mathur, 1995, p. 59).

Analysing the slogan as directly advertises natural values, one can point to examples that confirm such a trend. Bydgoszcz's slogan "Bydgoszcz - a city close to the Brda" is interesting. The city is located near the Brda River, it is a part of the landscape and plays an important role in the residents' life. Bydgoszcz's image as a city near the river is highlighted in many promotional and tourist materials. The city also organizes many events related to the river, such as Rudder on Bydgoszcz, the World Championships in River Crossing (Węgielewska, 2017). A similar role to Bydgoszcz, is played by Białystok's slogan "Białystok - a green city", or Poznań - "Poznań - a city of greenery", both of which refer to nature. Białystok has many green areas, such as parks, forests and gardens, which are important parts of its landscape and contribute to the high quality of life of its residents. This is the slogan through which Białystok students planted 300 oak and spruce seedlings in the city. The undertaking took place within the framework of the project "Clean, Green Cities" implemented by the "Association: Clean Poland Program." Seedlings were donated by the Lasy Państwowe for this purpose, and the city donated the land. The students were assisted by Białystok Mayor Tadeusz Truskolaski and City Council Chairman Lukasz Prokorym, along with councilors (Departament Komunikacji Społecznej, 2022). Poznań, on the other hand, is known for its numerous parks, including the Citadel Park, which is one of the largest city parks in Poland. The city also has many botanical and zoological gardens, which are popular tourist attractions. However, the slogan itself has caused controversy among Poznań residents, who note that only with the logo can Poznan be considered as a green city (Matuszczak, 2024). The most important challenges in the area of climate and air pollution are referred to the slogan "Krakow in a good climate," in which the campaign slogans were Segregate, plant, save, breathe (Miasto Kraków, 2022). In addition, it is worth taking note of the slogans: Szczecin - Floating Garden, Olsztyn - Nature's garden, Katowice city of gardens, which refer to gardens, or more broadly the concept of turning a city into a garden (Sharifi, 2016, pp. 1-16). For example, Katowice, despite its industrial heritage, is trying to promote itself as a resident-friendly city with numerous green spaces, parks and gardens. In this way, the authorities emphasize their commitment to creating a friendly and environmentally friendly urban space (Komorowska, 2010). Gdansk's slogan

"Gdańsk- sea of possibilities" also refers to the natural environment, but also a possibility to development. The city is located near the Baltic Sea, which is an important part of its landscape (Business Insider Polska, 2020). The city organizes many sea-related events, such as Gdansk Sea Days and Baltic Sailing Week. Zielona Góra presented a new slogan in 2019, "Screw yourself in Zielona Gora". In this case, the authors emphasize that the aim of the slogan was to show that the city is family-friendly, encourages active recreation and "you can involve in cycling, wine tourism, marches with sticks or many recreational, cultural, sports events"(Zielona Góra, 2019).

However, not all Polish cities focus on natural assets. Warsaw's slogan, "Fall in love with Warsaw," focuses on city attractions, culture and history (Miasto Warszawa, 2022). However, the city has many green spaces, such as Łazienki Królewskie, Park Skaryszewski and Pole Mokotowskie, which are important natural features in the urban landscape. This could be a potential direction for future promotional campaigns if the city would like to highlight its green spaces. Also, Kielce currently uses the slogan "Kielce. A city where you want to live" (Kowalczyk, 2022). These slogans do not directly refer to nature, but rather focus on the quality of life in the city. As the capital of the Świętokrzyskie Voivodeship, Kielce is surrounded by beautiful natural areas such as the Świętokrzyskie Mountains, nature reserves and scenic parks, which the city should use to promote tourism. These natural assets could be included in future promotional slogans to emphasize the city's proximity to nature and natural attractions, as well as activities focused on preparing tourist and bicycle routes. Similar conclusions can be drawn by analysing Wrocław's approach to advertising the city. "Wrocław - a city of meetings" does not directly refer to nature, but focuses on the city's role as a place for cultural events, meetings and social integration (Polska Organizacja Turystyczna, n.d.). However, Wrocław is a city that has a lot to offer in terms of nature. There are numerous parks, green spaces and rivers, such as the Oder River, which add to the charm of the city. Although the current slogan does not directly emphasize these aspects, Wrocław as a city has many natural assets. Also, the slogans of Lublin, Rzeszów refer to innovation, culture or the inspiring atmosphere of the city ("Lublin. City of inspiration", "Rzeszów - the capital of innovation", "Łódź - a city that surprises", "Breakthrough Opole") and do not refer to natural assets (Miasto Lublin, 2024).

The third promotional component studied is advertising. Advertisements can effectively educate the public about the importance of environmental protection, sustainability and pro-environmental practices. Analysing examples of advertising campaigns for various provincial cities in Poland, it can be seen that they promote various ecological initiatives. The following table presents selected promotions, referring to ecology and the environment (see: Table 2).

Table 2.
Polish cities' environmental campaigns

City	Ecological Campaign	Ecological goals of campaigns
<i>Białystok</i>	By bicycle through Podlaskie	The broadcast, which was produced by Radio Akadera of Białystok in cooperation with the Marshal's Office of Podlaskie Voivodeship
<i>Bydgoszcz</i>	Segregate well for yourself, loved ones and the environment	Educate residents about the benefits of recycling and introduce systems to facilitate waste separation
<i>Gdańsk</i>	Gdansk Eco Zone - Clean City Gdansk	Event in the form of a picnic ecological
<i>Katowice</i>	Eko bajki	"Eco-fairytales" is a project in which fairytales were recorded on behalf of the Katowice City Council, with ecology as the main theme
<i>Kielce</i>	Plastic not for furnace, furnace not for plastics	Program, which promotes alternative materials and reduce the usage of single-use plastic
<i>Kraków</i>	Warmth counts	Educational campaign aimed at residents to promote energy conservation in homes and the use of energy-efficient appliances
<i>Lublin</i>	Donate electro-waste, get a tree	"Tree for Secondary Resources" is a campaign organized by the Regional Directorate of State Forests in cooperation with Kurier Lubelski
<i>Łódź</i>	Cycling May in Lodz	Promote the use of urban bicycles and bicycle infrastructure in the city to reduce emissions
<i>Olsztyn</i>	Don't be disposable	Presentation of educational octagon on waste reduction and eco-consumption
<i>Opole</i>	Bee in Opole	Awareness campaign on importance of bees in nature
<i>Poznań</i>	We are acting for the Climate!	Webinar entitled "Adapting to Climate Change"
<i>Rzeszów</i>	Rzeszow does not agree on smog!	Initiative to promote the attention of the city government to the issue of ecology by schoolchildren
<i>Szczecin</i>	Szczecin environmental education network for the environment	Comprehensive environmental education project subsidized by the Financial Mechanism of the European Economic Area
<i>Warszawa</i>	Partnership for Climate	Information platform for comprehensive, innovative educational and promotional activities related to climate change issues
<i>Wrocław</i>	Wrocław without plastic	Actions taken by the city authorities
<i>Zielona Góra</i>	The game "Kidnapping of Smog"	Festivities and field game

Source: (Anon, 2015; Anon, n.d.; Bydgoszcz, 2023; Fundacja Odzyskaj Środowisko, n.d.; Kokoszkiewicz, 2019; Masłowska-Bandos, 2018; Miasto Gdańsk, 2022; Miasto Katowice, n.d.-a; Miasto Kielce, 2022; Miasto Warszawa, 2024b; Nowa Energia, 2023; Polskie Radio Lublin, 2024; Radio Akadera, 2021; Szczecińska sieć edukacji ekologicznej na rzecz środowiska, n.d.; Urząd Miasta Łodzi, 2024; Wojnowska, 2022).

Through advertising campaigns, cities convey information about initiatives such as recycling, saving energy, using public transportation and reducing plastic consumption. For example, during the "Warsaw segregates" campaign, city authorities informed people about the principles of waste segregation, with an emphasis on proper disposal of plastics and other recyclables (Miasto Warszawa, 2019). In Wrocław, as part of the "Wrocław without plastic" campaign, Mayor Jacek Sutryk handed out bamboo cups convincing residents of the idea of zero waste and reducing the amount of trash produced (Kokoszkiewicz, 2019). An interesting promotion was proposed by the authorities of Poznań, who organized a municipal competition for the best arrangements of home gardens, balconies, greens and elevations (Miasto Poznań, 2021). Effective way to involve the entire local community of Gdansk was a picnic for

residents, in which all the city units that carry out their activities, projects and campaigns for environmental protection and sustainable development, come together in one place to pass on all their knowledge and experience to residents in the field of environmental education. For instance, in Rzeszów, an anti-smog tree - a linden tree (*lime Tilia cordata*) - was planted on November 12, 2021 in Rzeszów's Kotowicz Square, with the participation of 17 people, including the Mayor of Rzeszów. A campaign was undertaken for children (from four Rzeszów schools) to write anti-smog "letters to authorities". Students at schools made anti-smog slogans, which they chanted at a happening in front of City Hall (Wojnowska, 2022). The form of preparing eco-stories can, in turn, can be a very good way for the youngest group to understand the importance of ecology at an early stage in their lives. An interesting form was proposed by the authorities of Zielona Góra, where for few moments the Zielona Góra promenade turned into a theatre. There was an outdoor performance of "To the rescue of Clean land", where a commissioner Smog had to take action to save the land and fight the cruel Smog. To his aid rushed the children, who cared a lot about being able to breathe clean, pollution-free air again (Masłowska-Bandos, 2018). These are just selected examples of promotions that cities are adapting to their specific characteristics. Some of them involve local communities and organizations, making their campaigns more effective.

The above analysis has shown that through advertising, green cities can build awareness of their environmental activities. Advertisements can reach a wide audience, increasing public interest and involvement. In addition, advertisements have the potential to influence residents' behaviour and habits. Creative and inspiring campaigns can encourage everyday eco-friendly activities, such as segregating trash, choosing a bicycle over a car, or conserving energy or water in Polish cities.

3. Trends of air pollution in Polish cities

As mentioned above, an effective advertising campaign promoting a city's green activities can significantly contribute to strengthening its image as a leader in sustainable development. Such an image can attract tourists, investors and new residents who value green values. However, in order for advertising not to be greenwashing, there should be measures taken by cities to improve the ecological situation along with it.

The increase in air pollution is related to the burning of fossil fuels, necessary for household heating or transportation. City authorities are obliged to prevent environmental pollution, including air pollution, due to the EU's goals for implementing the Green Deal. Currently, 12 substances are assessed from the perspective of health protection: sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), benzene (C₆H₆), ozone (O₃), PM₁₀ fine dust (up to 10µm in diameter), PM_{2.5} fine dust (up to 2.5µm in diameter), heavy metals: lead (Pb),

arsenic (As), nickel (Ni), cadmium (Cd) determined in PM₁₀, and benzo(a)pyrene determined in PM₁₀. For plant protection, three substances are assessed: sulfur dioxide (SO₂), nitrogen oxides (NO_x) and ozone (O₃). For each of the listed pollutants, air concentrations are specified that should not be exceeded. The purpose of this paper is to analyse one of the indicated substances, i.e. PM₁₀. This dust is a mixture of airborne particles whose diameter does not exceed 10 micrometers. It is harmful due to its content of such elements as benzopyrenes, furans, dioxins - in a word, carcinogenic heavy metals. The WHO standard for average daily concentration of this dust is 50 micrograms per cubic meter, and the annual standard is 20 micrograms per cubic meter (WHO, 2021). The assessment of air quality is carried out according to the criteria set out in the Directive of the European Parliament and of the Council of May 21, 2008 on air quality and cleaner air for Europe (Parlament Europejski i Rada Unii Europejskiej, 2008) and the Directive of the European Parliament and of the Council 2004/107/WE of December 15, 2004 on arsenic, cadmium, nickel, mercury and polycyclic aromatic hydrocarbons in ambient air (Parlament Europejski i Rada Unii Europejskiej, 2004).

The first of the above-mentioned documents obliges member states, including Poland, to continuously monitor air quality. The directive specifies the minimum number of measurement points and how they should be distributed. The data collected is then transmitted to the European Environment Agency and to the European Commission. It is worth noting that the collected data for analysis was incomplete (missing daily measurements). It was not possible to analyse the occurrence of PM 10 in Gdansk, Opole and Bydgoszcz. This was due to the closure of diagnostic stations and the opening of new ones, which prevented analysis in the period 2013-2022. For the city of Kielce, the data covered the period 2013-2021.

Considering air quality standards, it is necessary to look at the average values achieved by Polish cities. The following table shows data on basic statistics on the occurrence of PM₁₀ dust in Polish cities.

Table 3.

Basic statistics on the occurrence of PM10 during 2013-2022 in Polish cities

City	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
<i>Białystok</i>	12.08	17.30	20.36	21.50	24.47	38.00
<i>Katowice</i>	16.33	25.40	33.68	36.72	44.99	114.16
<i>Kielce</i>	15.06	19.23	25.85	28.76	36.00	72.13
<i>Kraków</i>	16.35	23.60	34.00	38.96	48.02	156.45
<i>Lublin</i>	11.60	18.64	22.97	25.47	30.86	50.00
<i>Łódź</i>	16.29	28.02	35.09	39.30	46.54	90.97
<i>Olsztyn</i>	10.16	16.17	20.45	21.67	25.02	48.80
<i>Poznań</i>	10.48	17.54	23.04	25.13	30.59	72.01
<i>Rzeszów</i>	12.78	19.66	24.85	27.11	31.54	73.88
<i>Szczecin</i>	10.47	16.64	19.46	21.42	23.86	42.82
<i>Warszawa</i>	14.69	21.16	26.57	28.52	33.43	61.42
<i>Wrocław</i>	12.28	19.03	25.04	27.67	33.28	59.42
<i>Zielona Góra</i>	11.67	16.43	20.78	22.85	27.04	47.36

Source: (GIOŚ 2013-2022).

As can be seen in the table, cities such as Katowice, Kraków and Łódź have the highest average PM₁₀ concentrations, indicating greater air pollution problems compared to other cities. In particular, the high quartile and maximum values suggest frequent episodes of high pollution in all three analysed cities. On average, Łódź records the highest pollution during the period under study, while the cities with the lowest PM₁₀ pollution are Olsztyn, Szczecin and Białystok, Zielona Góra. Large spreads between minimum and maximum values in some cities (e.g., Kraków) indicate that there are periods with very high air pollution in winter, which are well above average values.

On the basis of the guidelines set forth in the documents of the European Parliament, the Council, it can be assumed that trends in air pollution should be decreasing. As Magdalena Kuchcik and Pawel Milewski note, for many years of the 20th century, air pollution concentrations remained stable and high in Poland - mainly in Upper Silesia and other heavily industrialized areas. Political, economic and social changes after 1989 - the collapse of many industries, the closure of factories, plants and mines - resulted in a systematic decline in air pollution levels, which have remained at similar levels in Poland since the beginning of the 21st century (Kuchcik, Milewski, 2018). Since 2009, the problem has been diagnosed, and through EU programs, financial assistance is being implemented (under successive editions of the clean air program) for liquidation, changing the heating source from traditional stoves to ecological and 0-emission stoves (Fundusz Ochrony Środowiska w Polsce, 2022). It should be remembered that the reduction of air pollution should be influenced by both functioning EU programs, applied throughout Poland, such as Clean Air, the marketing actions of cities that indicate in their strategies the need to reduce air pollution. The charts below show the trend analysis of PM₁₀ in Polish cities for the period 2013-2022.

Table 4.

Trend analysis of PM10 in Polish cities for the period 2013-2022

City	Time	p-value	Multiple R-squared
<i>Białystok - decreasing</i>	-0.0019811	7.143e-05	0.1256
<i>Katowice - decreasing</i>	-0.004910	0.0001261	0.1176
<i>Kielce - decreasing</i>	-0.003521	0.002044	0.08619
<i>Kraków - decreasing</i>	-0.005954	0.0006274	0.09472
<i>Lublin - decreasing</i>	-0.0031785	1.424e-05	0.1481
<i>Łódź - decreasing</i>	-0.005458	2.881e-05	0.1383
<i>Olsztyn - decreasing</i>	-0.0014884	0.01947	0.04539
<i>Poznań - luck of trend</i>	-0.0012534	0.1566	0.01694
<i>Rzeszów - decreasing</i>	-0.0030264	0.000577	0.09592
<i>Szczecin - decreasing</i>	-0.0022517	0.0001261	0.1176
<i>Warszawa - decreasing</i>	-0.0030180	0.0001109	0.1194
<i>Wrocław - decreasing</i>	-0.0038298	4.41e-05	0.1324
<i>Zielona Góra - decreasing</i>	-0.003086	1.073e-05	0.152

Source: (GIOŚ 2013-2022).

The above analysed models are not satisfactory. The coefficient of determination R² is very low. There is no clearly visible trend, which takes minus values in most models. The changes that occurred in the period 2013-2022 are insufficient to speak of an effective change for the

better in terms of air quality. The model does not describe Poznań, and the p-value for Olsztyn. The coefficient of variation is highest in Łódź, Krakow and Katowice, indicating that these cities are doing the best job of improving the situation, despite the weakest air quality scores.

4. Conclusions

Considering the goals set by the authorities of Polish cities, it should be noted that the measures taken for clean air are not sufficient.

In terms of marketing, it should be confirmed that Polish cities are actively promoting ecology through ecological slogans, as well as campaigns, activities promoting ecology. Analysis of the data confirmed the hypothesis on the decreasing trend of PM₁₀ in Polish cities. On the other hand, it is worth noting that the models slightly explain the actual changes that are taking place in terms of air pollution.

The coefficients of the decreasing trend in most Polish cities indicate little significance of the measures taken. In addition, it can be noted that Poland does not have a large database of long-term air quality measurement capabilities. Often the measuring stations are closed, which prevented analysis for the cities of Bydgoszcz, Opole, and Gdańsk. As a result, it can be pointed out that Polish cities should increase the number of air quality monitoring stations, such points should appear in places most exposed to pollution. Other measures than mere promotion for improving the air quality situation might be important. Investments in renewable energy, infrastructural changes that allow for increased clean transportation can be pointed out here.

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A LOAN FINANCING OF MICRO-ENTERPRISES (RETAIL SECTOR) DURING ECONOMIC FLUCTUATIONS

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Purpose: The study attempts to determine the extent to which the financing of micro-enterprises (from the retail sector) by a bank loan is dependent on current and expected changes in the unstable economic situation in Poland in 2019-2021 (sample period).

Design/methodology/approach: The study used the Pearson's correlation and the DTW methods to explain the relationship between the number and value of loans granted to micro-enterprises (from retail sector) and economic indicators.

Findings: The study shows a strong positive correlation between the change in a number and a value of working capital loans granted to micro-entrepreneurs and the assessment of a direction of change in the economic situation and an indication of a lack of barriers, a decrease in an importance of the barrier (a high competition) or an expected general economic situation of an enterprise. Using the DTW model, a strong adjustment of a change in the number of investment loans granted to micro-entrepreneurs to the assessment of a direction of changes: economic situation, market mechanism, barriers, towards high costs (staff and interest) was observed, and when a dominant sources of financing working capital loans were own funds, bank loans and trade credits.

Theoretical implications: The survey results confirm: unstable times require decisions to be based on a variety of economic factors.

Practical implications: The results of the study indicate a decision-making sensitivity of retail micro-sized enterprises regarding a choice of a type of bank loan in relation to the assessment of a direction of changes in an economic situation in the short term. They may help them build good business relationships with their suppliers. They may be used to banks and other financial providers for building a market offer and for forecasting a credit demand, too.

Originality/value: The value of the study is to present (from two perspectives) a correlation between a number and a value of loans granted to micro-entrepreneurs with changes in selected economic indicators. Conclusions have application value for banks and other financial institutions, as well as micro-entrepreneurs to determine an impact of specific economic indicators on a loan market.

Keywords: micro-enterprise, retail sector, working capital loan, investment loan, Dynamic Time Warping method (DTW).

Category of the paper: The research may involve the empirical and scientific research.

1. Introduction

Interest in micro-enterprises and their role in national economies has been analysed by economists for nearly 50 years. This is due to the fact they constitute the largest group of enterprises (e.g., in Poland in 2020 accounted for 97% of the total number of enterprises (PARP, 2022)) and play an important role in the economic development (Ayyagari, Beck, Demirgüç-Kunt, 2007), social and market (reducing an unemployment or a designing and introducing a product, a service and market innovations (Boyer, Régis, 2014)). In SME sector many employees gain their first professional experience (Zaleśna, 2015), and (in a relation to the entire economy), SMEs are a complementary element to large enterprises and the public sector through cooperation with these entities or activity in market niches that large enterprises are not interested (Kunicki, 2013). They need financing, too.

The study attempts to identify the determinants affecting a number and a value of working capital and investment loans obtained by retail micro-enterprises (during the period of unstable economic situation in Poland: 2019-2021) based on the degree of a dependence of their assessment of CSO's economic climate indicators and indicated loan volumes. There was used data from Central Statistical Office (abbr. CSO) and Credit Information Bureau (abbr. CIB) for these years and two methods: the Pearson's linear correlation coefficient and the Dynamic Time Warping (abbr. DTW). Some strong correlations were identified in the direction of changes in the economic situation and some barriers. The study can be used by banks and other financial institutions, as well as national governments, financial market regulators and micro-entrepreneurs to determine an impact of specific economic indicators on a loan market.

2. Literature review

SMEs have an advantage over large entities in terms of reaction to changing environmental conditions, innovation, fast information flows (PARP, 2010). The literature on the subject indicates that smaller enterprises (due to their flexibility of operation) are easier to adapt to changes in an economic situation, including crisis phenomena (Bartz, 2016). However, the fact SMEs are more easily able to adapt to it, that does not mean they do not feel their negative effects.

Empirical research confirms an activity of the SME sector - during a crisis – is characterized by a decrease in sales revenues (Kola-Bezka, 2011), in investments (Pyka, 2012), delays in payments (Zawadzka, 2010), and even long-term problems with settling liabilities. A form of financing is interesting, too. The enterprises activities can be financed with a capital from internal and external sources (Dylewski, 2016). Their selection depends on many factors,

including economic ones. These may be factors related to a given entity, such as: a type of business, owned resources and their type, a purpose of financing, an economic strength or a creditworthiness (these are microeconomic factors) as well as factors like: an inflation, a level of economic growth, an unemployment rate, interest rates, a public debt (these are macroeconomic factors) (Duliniec, 2015; Wolański, 2015). The analyses indicate an existence of a relationship between a level of macroeconomic measures and the credit market (Calza, Gartner, Sousa, 2003), GDP and a level of interest rates, a demand and a supply of bank loans (Jiménez et al., 2012). It translates into a value and a number of loans granted (Thaker et al., 2013). Other studies confirm a relationship between a credit interest rate and CPI, and a number and a value of loans granted (Castro, 2013), an increase in a risk of loan default along with a decline in real GDP and stock price indices. This is because higher real GDP growth results in higher incomes, and it has a positive impact on borrowers' ability to service their debt (Saba, Kouser, Azeem, 2012). In the case of an economic slowdown: a risk of loan default increases as an unemployment increases and, as a result, difficulties in servicing liabilities increase (Beck, Jakubik, Piloiu, 2015). They are responsible for an increase in a share of non-performing loans (Rajan, Dhal, 2003). The studies determining a relationship between a level of inflation and a share of non-performing loans indicate – as a result of inflation. Credit liabilities become cheaper, what improves their repayment (Anastasiou, Louri, Tsionas, 2016). However, other analyses indicated: a level of non-performing loans increases with an increase in the inflation rate (Cappiello et al., 2010; Klein, 2013) (it contributes to an economic slowdown) or an increase in unemployment (Škarica, 2014).

Financial needs and available methods of financing vary depending on the phases of an enterprise's life cycle (Berger, Udell, 1998). Some studies confirm a thesis: a basic source of the SME sector financing is own funds (Chęciński, 2015; Janik, Gałązka, 2014; Zuzek, 2013). For example: the structure of financing sources of SME enterprises in Poland in 2020 was as follows: 68% were own funds, 9.7% - funds directly obtained from abroad, 9.0% - credits and loans, 4.5% - financial leasing, 3.2% - budget funds, 3.2% - other sources, and 2.4% - unfinanced expenditures (PARP, 2022). This applies above all to enterprises at an early stage of development (Huyghebaert, Van de Gucht, 2007), primarily micro-enterprises. Increased own funds is a better hedging against a risk (it constitutes an enterprise's guarantee base for potential creditors), more freedom in making investment decisions and greater independence of an enterprise in all areas of economic activity (each increase in equity triggers a possibility of obtaining external foreign capital to expand a scale of an enterprise's operations (Wilczyńska, 2016)). However, small amounts of own funds make it often difficult for SMEs to run their business. In subsequent stages of development, a demand for capital increases, SMEs also obtain more assets, they can be used as collateral for an external financing (e.g. bank credits). Assets serve to improve a creditworthiness and attract an attention of investors, who are willing to contribute a financial capital to enterprise for its development. As a consequence, SMEs were starting to replace internal financing sources with external ones, including investors and banks

(bank loans, loans, factoring). A bank loan is one of the most popular forms of external enterprises' financing in Poland (Domańska-Szaruga, Mazurek, 2021; Kozioł, Pitera, 2018; Smolińska, 2016) and throughout Europe (Sierpińska-Sawicz, 2018). Due to the purpose of financing, working capital and investment loans are distinguished (Heropolitańska, Nierodka, Zdziarski, 2020). The bank loan can be granted for various operational purposes (a working capital loan) and development (an investment loan). Commercial enterprises are usually characterized by a fact their asset structure is dominated by current assets, i.e., inventories, short-term receivables (incl. all from their customers) and short-term financial investments financed with own funds, bank loans (usually working capital loans) and trade credits. In economic practice, there are also companies who finance all current assets with variable, short-term capital and have no problems with settlement of liabilities timely (e.g., retail companies). In most enterprises, current assets are partly financed with fixed capital (own funds and long-term liabilities), and with variable capital partly (Janik, Paździor, 2011). Working capital loans are intended to finance current operations and are used to ensure financial liquidity. Investment loans are intended to finance expenditures on tangible fixed assets (they result in the creation of a new or a modernization of existing fixed assets). The credit amount is made available to a borrower according to his individual needs (Grudziński, 2010). There is the study that shows: if internal sources of financing are insufficient to fund planned investments, an enterprise first takes out loans or bank loans, and only after these opportunities are exhausted does it increase its own capital by raising external inflows (Wilczyńska, 2016).

The research indicates: banks are reluctant to lend during the crisis due to higher credit risk. This implies a potential decrease in a number and a value of loans granted to business, especially micro-enterprises (Adamowicz, 2013; Kozak, 2012; Nocoń, 2015). On the other hand, problems related to economic changes may result in an increased demand for loans enabling businesses to survive. In the long term, investment loans ensure that a burden of loan instalment payments is spread over time. Moreover, they can thus provide a stable source of financing in uncertain times.

The main purpose of the study is to attempts to determine the extent to which the financing of micro-enterprises (from the retail sector) by bank loan is dependent on current and expected changes in the economic situation in Poland in 2019-2021 (sample period). The following hypothesis was formulated: *the increase in a number and a value of working capital and investment loans granted to retail micro-enterprises strongly depended on their positive assessment of a direction of changes in an economic situation and a dominant source of financing, which was own funds, in Poland in 2019-2021.*

3. Methods

The survey of working capital and investment loans for retail micro-enterprises was concerned on their number and value. The data, obtained from CIB, were monthly. It has an information on the credit history of a total of 1.4 mln enterprises, farmers and other entities, including 845,000 microenterprises (BIK, 2022). In the study, the potential explanatory variables were business climate indicators taken from the "Economic business climate survey" conducted by CSO (GUS, 2018) and relating to microenterprises involved in retail. This survey is conducted monthly using the business test method with a simple and short questionnaire, which allows the data to be collected quickly and the results to be made available (which is its primary advantage). Responses are collected to questions about the entrepreneurs' opinions on selected factors affecting a current and future (in a three-month perspective) situation of the businesses they manage. The survey concerns such elements of business activity as: an economic situation, a demand and a supply of goods, prices, a general economic and financial situation, a competition, an employment, labor and financial costs, a legislation, encountering "other barriers" (GUS, 2018). The data from the aforementioned CSO survey was compared with a value and a number of working capital and investment loans (the data concerned only retail micro-enterprises). The research period covered 2019-2021, using monthly dynamic data. It should be emphasized that: [...] the indicated CSO studies provide information on the directions of changes observed in the economy, and not on the level of a given factor at a given moment, therefore they are used to analyze trends in economic development. [...] When presenting the results of economic climate surveys in a given month, it should be paid attention not only to whether the indicator in question has a positive or a negative value (which proves that the respondents' opinions are more optimistic or pessimistic, respectively), but mainly to what is the direction of changes observed in a given segment of the economy. [...] This principle applies to both diagnostic and prognostic indicators [...] (GUS, 2018, p. 22).

The analysis of the dynamics of mass phenomena is carried out, among others, on the basis of time series. These are sequences (Y_t) of values of the studied phenomenon observed in successive units of time (months, quarters, etc.), when time is the independent variable. DTW and (for comparison) the popular Pearson's linear correlation coefficient is used in the study. The latter (denoted as (r)) is a measure of the strength of a linear relationship between two variables and can take a range of values $[-1, 1]$ (Okwonu, Asaju, Arunaye, 2020). Reaching a value of $+1$ or -1 means that all data points are on the line of best fit. An absolute value of (r) between $0.5-0.7$ is assumed to mean the correlation between the variables is strong, and between $0.7-1$: a very strong (Statistics, 2022).

On the other hand, DTW stands for time series clustering (Laerd Statistics, 2022). It is a technique for finding the optimal fit between two given time-dependent sequences (to detect similar shapes with different phases), given certain constraints (Müller, 2007). Given two time series, DTW gives the optimal solution in time, with the only constraint being the need to sample at equally distant points in time. If the strings take values from a certain feature space, then a local distance measure (d) must be used to compare them. Intuitively, (d) has a small value when the sequences are similar and a large one when the sequences are different. The algorithm finds a matching path (minimum distance) that passes through low-cost areas (the 'valleys' on the cost matrix) (Georginio, 2022). The choice of this research method was dictated by the type of data, as CSO's indicators are opinions or expectations that may change over time in relation to the actual number and value of working capital and investment loans granted. The 'R' (software language) was used to illustrate the results (Biecek, 2011; Hafner, 2019). One of its strengths is the ease with which well-designed, high-quality charts can be created (Zagdański, Suchwałko, 2016).

4. Results

In the DTW formula, a selection of sequences from 0 to 6000 distances was made. On this basis, 23 combinations (a blue colour) were obtained from 80 combinations and compared with the Pearson's linear correlation coefficient (r . project, 2022) (Table 1). In this latter method, results in the range (0.6-1.0) and [(-1.0)-(-0.6)] were considered to be already quite strong and strong correlation respectively, of which 21 were obtained. The positive correlation (a dark blue colour) occurred in 15 cases (71.4%) most frequently when considering a number or an amount of working capital loans granted to microenterprises (93%) in conjunction with assessments of a direction of change: a CSO's general economic situation, an economic situation of an enterprise, a current general economic situation, a lack of barriers, a shortage of employees, too much competition in the market, current sales and an expected general economic situation of the enterprise. Only in one case was there a positive correlation between a number of investment loans granted to micro-enterprise (from retail sector) and too much competition in a market.

Table 1.

Comparison of selected data obtained with the DTW and the Pearson's linear correlation coefficient in retail micro-enterprises in Poland in 2019-2021

Types of loans	CSO Business Climate Indicators	Pearson's correlation coefficient (r)	R ²	DTW Distance
A working capital loan (amount)	A general economic situation of CSO	0,709460368	0,50	4461639.34
A working capital loan (number)	A general economic situation of CSO	0,783640329	0,61	32600.48
An investment loan (number)	A general economic situation of the CSO	0,461894918	0,21	4522.11
A working capital loan (number)	An economic situation of the enterprise 9	0,749930841	0,56	32602.61
An investment loan (number)	An economic situation of the enterprise 9	0,470308474	0,22	4524.56
An investment loan (number)	CPI	-0,632796175	0,40	4507.83
An investment loan (number)	PPI	-0,289225179	0,08	4480.96
A working capital loan (number)	A current general economic situation 9	0,71669701	0,51	32586.94
An investment loan (number)	A current general economic situation 9	0,39056568	0,15	4509.04
A working capital loan (number)	A lack of barriers 9	0,758905947	0,58	32607.85
An investment loan (number)	A lack of barriers 9	0,481680645	0,23	4529.16
A working capital loan (number)	A shortage of employees 9	0,761049198	0,58	32568.36
An investment loan (number)	A shortage of employees 9	0,543922812	0,30	4491.28
An investment loan (number)	A high labour costs 9	-0,254409014	0,06	4510.01
An investment loan (number)	A high credit interest 9	0,096075902	0,01	4528.07
An investment loan (number)	A high burden on the budget 9	-0,168149474	0,03	4497.89
A working capital loan (number)	Too much competition in the market 9	0,792711288	0,63	32607.06
An investment loan (number)	Too much competition in the market 9	0,722602885	0,52	4530.21
An investment loan (number)	Difficulties with counterparty settlements 9	-0,179445299	0,03	4545.94
An investment loan (number)	An unclear and unstable legislation 9	-0,669351669	0,45	4519.27
A working capital loan (amount)	Other barriers to operation 9	-0,684629784	0,47	4461164.36
A working capital loan (number)	Other barriers to operation 9	-0,725657161	0,53	32125.5
An investment loan (number)	Other barriers to operation 9	-0,38207749	0,15	<u>3981.2</u>
A working capital loan (number)	Current sales 9	0,659376641	0,43	33810.4
An investment loan (number)	A current goods stock 9	-0,045826933	0,00	4622.2
An investment loan (number)	A dominant sources of working capital financing: own funds 9	0,420420999	0,18	<u>561.86</u>

Cont. table 1.

An investment loan (number)	A dominant sources of working capital financing: bank loan 9	-0,032703593	0,00	<u>2965.8</u>
A working capital loan (number)	A dominant sources of working capital financing: trade loans 9	-0,668985492	0,45	31305.1
An investment loan (number)	A dominant sources of working capital financing: trade loans 9	-0,638979886	0,41	<u>3219.4</u>
A working capital loan (amount)	An expected general economic situation of the enterprise 9	0,683110154	0,47	4463438.66
A working capital loan (number)	An expected general economic situation of the enterprise 9	0,727118547	0,53	34399.8
An investment loan (number)	An expected general economic situation of the enterprise 9	0,498692064	0,25	5903.6

Note. A dark blue: a strong and a very strong positive correlation (samples); a blue – a fairly strong correlation; a grey - a strong and a very strong negative correlation.

Source: Own study based on GUS and BIK data.

The negative correlation (a grey colour) occurred in 6 cases only (28.6%) and applied equally to investment loans (a number) and working capital loans (a number mainly) provided to micro-enterprises in connection with assessments of a direction of change concerning: an inflation (CPI and PPI), an unclear and an unstable legislation, other barriers to operation (except e.g., a shortage of employees, high labour costs, credit interests, too much competition in the market) but also a dominant source of financing working capital in the form of trade credit. This may indicate a decrease in demand for investment and working capital loans in the event of a positive assessment in the market situation in the area of: price changes, laws or lowering barriers to operation.

Using the DTW algorithm and analysing an obtained data, it was noted that the smallest distances (from 0 to 6000) occurred in 22 of the 80 combinations (a dark blue colour) between a number of investment loans granted to micro-enterprises and the assessments of: a business climate, a demand and a supply, PPI, barriers towards high costs (employee, interests and high budget burdens), a shortage of employees, difficulties in settling accounts with counterparties and others, and when a dominant sources of working capital financing were: own funds, bank and trade loans. Out of such a wide spectrum, the smallest distance arose in the relationship between a number of investment loans granted to micro-enterprises and the assessment of a direction of change of a dominant source of working capital financing, which was own funds in micro-enterprises (561.86). Another three "small" distances were observed in the case of the relationship between a number of investment loans and the assessment of a direction of change of a dominant source of financing working capital in the form of bank loan, trade loans and other business barriers (respectively: 2965.8, 3219.4, 3981.2). Only in one case was there a convergence of results using both testing methods. It was a number of investment loans granted to micro-enterprises in connection with too much competition in the market.

Thus, it can be concluded from: an increase in a number of loans granted for development activities was correlated with an optimistic search for market viability.

Referring to the smallest distance arose in the four relationships mentioned above, it was illustrated by using the *R-environment*. In the first case, it arose between a number of investment loans granted to micro-enterprises (series 1) and the assessment of a direction of change of a dominant source of a working capital funding in the form of own funds (series 2): 561.86 (Figure 1). There was some visual similarity between the data in Q2-Q4 2019, Q1-Q4 2020 and Q1-Q2 2021.

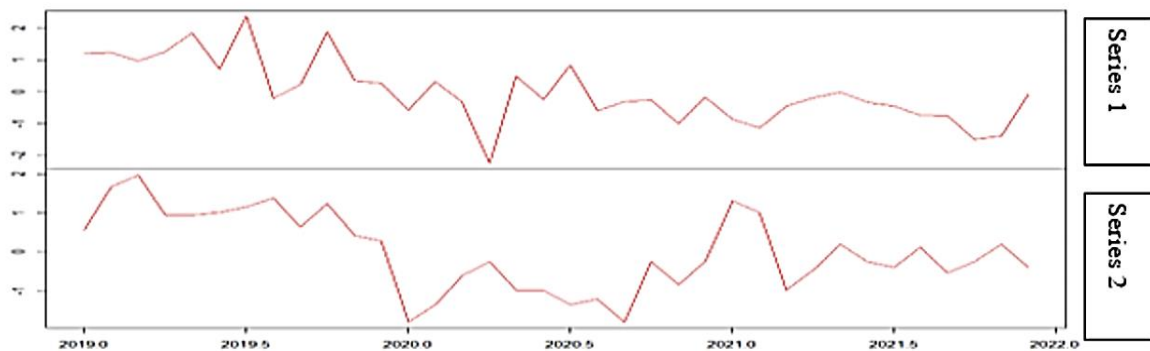


Figure 1. Evolution of a number of investment loans granted to micro-enterprises (series 1) and assessment of a dominant source of financing working capital funding in the form of own funds (series 2) in Poland in 2019-2021.

Source: Own compilation based on GUS and BIK data.

The fit of the data by the DTW algorithm was checked. The values of the tested time series were overlaid and the distances calculated by the DTW algorithm were taken into account. The algorithm found an alignment path (minimum distance) that runs through lowcost areas (Figure 2 – a blue line). The more the line resembles a straight line, the smaller the distances are (the similarity is greater).

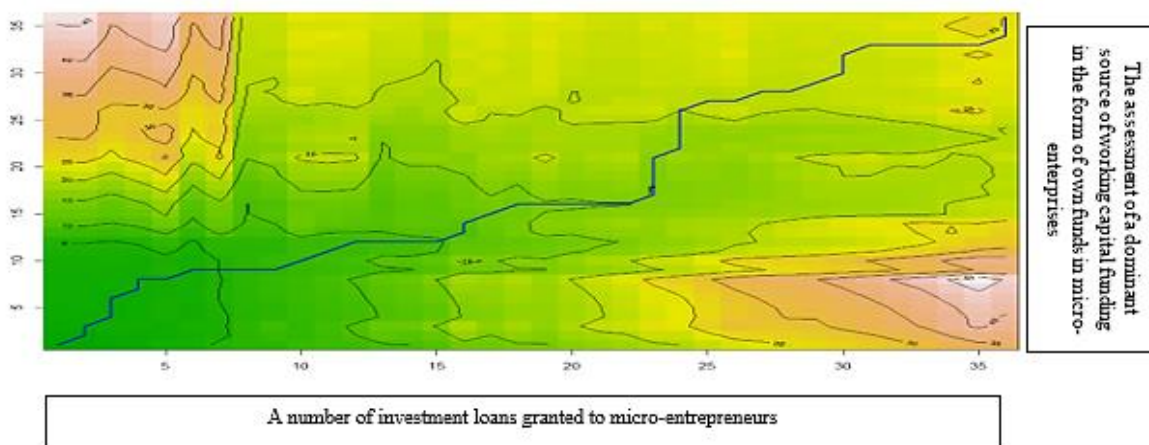
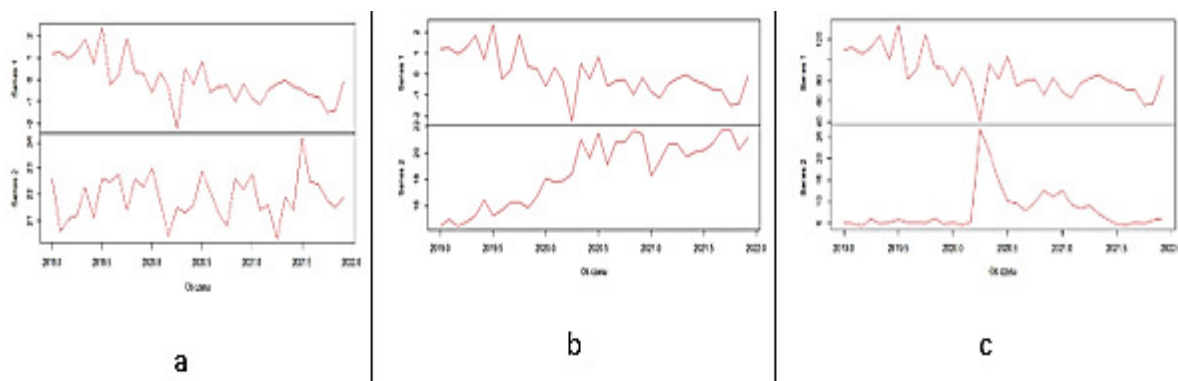


Figure 2. An alignment path for a number of investment loans granted to micro-entrepreneurs and the assessment of a dominant source of a working capital funding in the form of own funds in Poland in 2019-2021.

Source: Own compilation based on GUS and BIK data.

A 'perfect' straight line was not obtained over the entire period studied, but from the 5th to the 24th month a straight line could be drawn. It could indicate a rather strong similarity over this period in a development of a number of investment loans granted to micro-enterprises in relation to the assessment of a dominant source of working capital funding in the form of own funds. On this basis, it can be suggested that during the period of a big instability (the second half of 2019 and the whole of 2020), the entities surveyed tended to pursue a conservative policy of financing working capital assets in the form of maintaining fixed capital, i.e., stabilising sources of financing.

In the other indicated cases the smallest distance is no longer so visible and significant. It relates to the relationship between a number of investment loans granted to micro-entrepreneurs and the assessment of a dominant source of working capital financing in the form of bank loans and trade credits, and other business barriers (Figure 3). From this, it can be noted that there was in Figure 3a some visual similarity between the data in Q2 2019 - Q4 2020, Q4 2020 and Q4 2021, for Figure 3b: Q2 2020 - Q2 2021, and for Figure 3c: only Q4 2020 - Q1 2021.



Note.

- a number of investment loans granted to micro-entrepreneurs (Series 1) and the assessment of a dominant source of working capital funding in the form of bank loans (Series 2).
- a number of investment loans granted to micro-entrepreneurs (Series 1) and the assessment of a dominant source of working capital funding in the form of trade credits (Series 2).
- a number of investment loans granted to micro-entrepreneurs (Series 1) and other business barriers in micro-entrepreneurs (Series 2).

Figure 3. Evolution of a number of investment loans granted to micro-entrepreneurs (Series 1) and the assessment of a dominant source of working capital funding in the form of bank loans and trade credits, and other business barriers in micro-entrepreneurs (Series 2) in Poland in 2019-2021.

Source: Own compilation based on GUS and BIK data.

In these cases, an alignment path (minimum distance) was found - the closer was to the end of the period of the study (it includes a 'not very ideal' or 'ideal' straight line between 1 and 20 or 25 months) and the results were outside the green range. This may indicate a fairly strong similarity in the development of a number of investment loans granted to micro-enterprises in relation to the assessment of a direction of change of a dominant source of working capital funding in the form of bank loans and trade credits throughout 2019 and 2020 (with particular emphasis on the period before the COVID-19 pandemic). Unfortunately, such a relationship

was not observed in the case of the assessment of other barriers to entities' development against a number of investment loans granted. At the time, non-affected entities used these loans when assessments of the prevailing phenomenon were positive.

5. Discussion

Pursuant to the Entrepreneurs' Law (2018), a micro-entrepreneur is an entrepreneur who - in at least one of the last two financial years - met the following conditions: employed on average less than 10 employees (marked as 9) and achieved an annual net turnover or the total assets less than 2 mln EUR (according to the data of CSO, the number of micro-enterprises in Poland in 2020 was 2.194 mln, which accounted for over 97% of all enterprises, excl. farms) (PARP, 2022). The study concerned retail micro-enterprises (entities who declared the type of business as a retail and a repair of motor vehicles, incl. motorcycles (Section G of the Polish Classification of Activities) when applying for external financing). The data of Polish Agency for Enterprise Development (pol. PARP) shows that, in the industry structure of micro-enterprises and SMEs, the largest group was constituted by SMEs from the service sector in 2019-2021 (approx. 52.8%) and every fourth SME belonged to the trade sector (approx. 22%) (PARP, 2020, 2021, 2022) – Table 2. This means the share of the surveyed sector in the economy was significant.

Table 2.

Industry structure of micro, small and medium-sized enterprises in Poland in 2019-2021

Industry structure	2019	2020	2021*
Services	52,5%	52,9%	53%
Trade	22,4%	21,6%	22%
Construction	14,9%	15,4%	15%
Industry	10,1%	10,0%	10,0%
Other	0,10%	0,10%	0%
Total	100%	100%	100%

*Estimated data.

Source: (PARP, 2020; 2021; 2022).

The analyses carried out extend existing studies on the impact of macroeconomic factors on the development of demand for investment and working capital loans in the micro-enterprise retail sector. However, most available studies have used universal macroeconomic indicators. The literature indicates that economic growth and low inflation are key factors influencing credit demand reported by firms (Guo, Stepanyan, 2011; Jimenez et al., 2017). The use of the CSO's conjuncture indicators complements existing analyses and also allows for a better understanding of existing relationships. The results of our study are in line with studies carried out by Peel and Wilson (1996) and Cappiello et al. (2010), among others.

A positive correlation in the Pearson's linear correlation shows that the more positive was the assessment of changes in an economy and reduction of barriers, the more number or value of working capital loans was increased to traders. That could mean: when micro-enterprises were optimistic about a current situation and did not perceive significant barriers to doing business, the more they (most likely) increased the scale of their operations, in effect financing them with working capital loans (banks may also have been optimistic about their creditworthiness). So many correlations can indicate a wide range of dependencies, but also ... a lack of significant correlation. Indeed, working capital loans are common in practice, as long as the company has been in operation for at least two years (has a history with the bank). This general knowledge may, however, be important for banks and other providers of financing for current activities, as the occurrence of the indicated changes may be a source for building a market offer.

Only in one case was there a positive correlation between a number of investment loans granted to micro-enterprise (from retail sector) and too much competition in a market. That could mean: the surveyed enterprises, in order to gain a competitive advantage, invested in their development by acquiring an external, long-term source of financing. And then, knowledge of the industry by bank staff is critically needed to build long-term loan products matching to the market situation. The emergence of competitors in a given sector, in turn, may trigger the need for existing micro-entrepreneurs to implement a specific strategy (e.g. survival or growth).

To some extent, these results correspond with those of other researchers, among others, Zimny (2022) argues that the COVID-19 pandemic affected the financial performance of companies mainly through constraints that reduced demand for goods and services and because of changes in costs incurred. Wellalage et al. (2022) note that COVID-19 caused minor constraints for SMEs worldwide. More recent work provides evidence that the new coronavirus has affected SMEs more than large enterprises (Fabeil et al., 2020; Corredera-Catalán, 2021; Khan, 2022); given their relative financial fragility and disadvantaged position during economic downturns (Berg, Schrader, 2012; Demirgüç-Kunt et al., 2020).

A negative correlation in the Pearson's linear correlation shows that a number of investment loans and working capital loans is inversely proportional to assessments of a direction of change concerning: an inflation, an unclear and an unstable legislation, other barriers to operation (except e.g., employees, credit interests, too much competition in the market) but also a dominant source of financing working capital in the form of trade credit. This may indicate a decrease in demand for investment and working capital loans in the event of a positive assessment in the market situation in the area of: price changes, laws or lowering barriers to operation. This is rather a typical business situation. However, it allows financial intermediaries to offer, for example, savings and investment products at this time. For micro-enterprises, it allows to focus on building good business relationships with their suppliers.

Using the Pearson's correlation method has shown the hypothesis was only partially confirmed with regard to working capital loans (in the very first part: a positive expectations of changes) in Poland in period 2019-2021. This indicates, among other things, the need to look for other research methods, e.g. the DTW one.

Using the DTW algorithm it was noted that the smallest distances occurred in 27,5% of the combinations between a number of investment loans granted to micro-enterprises and the assessments of several elements (like: a business climate, a demand and a supply, barriers towards high costs, difficulties in settling accounts with counterparties), and when a dominant sources of working capital financing were: own funds, bank and trade loans. Out of such a wide spectrum, the smallest distance arose in the relationship between a number of investment loans granted to micro-enterprises and the assessment of a direction of change of a dominant source of working capital financing, which was own funds in micro-enterprises. It may be indicative of the surveyed companies' desire to provide a stable source of financing - not only for fixed assets, but also for current assets in uncertain times. This is one way of financial management, called conservative. It is highlighted when describing micro-enterprises at the first stage of development. In Poland, however, the market for these entities is 35 years old. So maybe this is an effect of their life expectancy. The survival rate was in 2022. 67.0%, i.e. the first year of operation was survived by two out of three newly established companies (in 2022, 299,714 enterprises were established and started in Poland, and by 2023, 200,856 of them remained active on the market) (PARP, 2024). The research did not take into account the duration of micro-enterprises in the retail sector.

Only in one case was there a convergence of results using both testing methods. It was a number of investment loans granted to micro-enterprises in connection with too much competition in the market. Thus, it can be concluded from: an increase in a number of loans granted for development activities was correlated with an optimistic search for market viability.

That information means: the hypothesis was only partially confirmed with regard to a number of investment loans and the positive assessment of a direction of a dominant source of financing, which was own funds, in Poland in period 2019-2021. It appears, therefore, that unstable times require decisions to be based on a variety of economic factors. It would be necessary to test the impact of the indicators studied also on decisions in the construction and industrial sectors to confirm (or refuse) our hypothesis.

An important limitation of the study was the access to data related to the issuing of bank lending decisions, as it is interesting - from the point of view of volatility - to see the period after Russia's attack on Ukraine in February 2022 and the consequent changes in fuel and energy prices (increase in the cost of doing business), inflation rates, among others. They also face an energy and technology transition (PARP, 2023, 2024). Research in 2022-2024 would therefore be desirable to assess the testability of the hypothesis.

The research revealed differences in the characteristics of factors significantly affecting credit demand, of retail micro-enterprises depending on the type of loans. Banks and other financial institutions can use the results of the research to forecast credit demand for micro-enterprises in the retail sector, which will contribute to the modification of pricing and risk policies and, as a result, to the improvement of financial indicators. It will be a challenge for future research to verify whether economic indicators relevant to the level of demand for investment and working capital loans among Polish micro-enterprises are differentiated at the level of groups operating within a department. In addition, in the longer term, we would like to assess the impact of changes in selected economic indicators on the share of non-performing loans in loans granted to micro-enterprises in the retail sector in general.

6. Conclusions

The study considered retail micro-enterprises and covered the unstable period: 2019-2021 in Poland, taking into account the Pearson's correlation method and the DTW model. It indicated - based on the Pearson's correlation - a strong positive correlation between an increase in a number or an amount of working capital loans and positive expectations about a direction of change in a CSO's general economic situation and the enterprise, as well as several barriers relating to: employees, market competition and current sales. Using the DTW model, a strong correlation was observed between an increase in a number of investment loans and positive expectations about a direction of changes in: business climate (incl.: supply and demand, PPI), labour barriers, interest costs and budget burdens, difficulties in settling accounts with contractors, and when the dominant sources of working capital financing were: own funds, bank loans and trade credits.

The results testify, among others, to an increase in demand for working capital loans in the event of a positive assessment of a market situation (mainly based on external factors) and a desire to provide an additional, stable source of asset financing (investment loans) in an unstable period. There were also signs of positive expectations of changes in the economic situation in an unstable period in 2020-2021 (during the COVID-19 pandemic) translating into an increase in the interest of micro-enterprises in bank loans. The results of the study indicate a diverse and uneven correlation involving the direction of changes in the economic situation and some relevant barriers (the hypothesis has been partially confirmed), but also the difference in the results, when using the two methods.

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DIFFERENTIATION IN THE DEVELOPMENT OF THE CULTURAL AND CREATIVE SECTOR IN EUROPEAN COUNTRIES

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Purpose: The aim of the article is to assess the level of development of the cultural and creative sector in Poland in comparison with selected European countries.

Design/methodology/approach: To assess the level of development of the cultural and creative sector, the Hellwig development pattern method and the Ward's agglomerative clustering method were used. A synthetic indicator was developed based on selected diagnostic features, which was used to create a ranking of European countries according to the level of development of the cultural and creative sector. Subsequently, using a dendrogram, countries were grouped based on the similarity of their features.

Findings: The research results indicate variability in the development of the cultural and creative sector—countries were classified into groups with very high, high, low, and very low levels of the synthetic indicator, and clusters of European countries with similar levels of development based on selected diagnostic features were identified. Poland is characterized by an average level of development in the cultural and creative sector. France is the leader in this regard.

Research limitations/implications: This article is part of the ongoing research efforts to create coherent conceptual foundations for defining the cultural and creative sector and understanding its mechanisms of influence on the economy. The presented research may also contribute to further, more in-depth analyses of the impact of the cultural and creative sector on the socio-economic development of European countries.

Originality/value: The article addresses the controversies among researchers regarding the so-called “economisation of culture.” It highlights the increasing importance of the cultural and creative sector in the economy, referencing international studies in this field. Based on diagnostic features selected by the author, a synthetic indicator was constructed to assess European countries in terms of the development of the cultural and creative sector. The article identifies the leaders in this area and the gap between them and Poland. It also distinguishes clusters of countries with similar levels of development based on selected diagnostic features. The analyses focus on the economic role of the cultural and creative sector. The research findings are directed towards the public authorities of the European countries under study, particularly Poland. They may provide guidelines for creating and developing legal and economic solutions that facilitate the growth of the cultural and creative sector. These efforts are of particular importance in the context of rising social welfare, which creates demand for goods and services in this sector, and the increasing expansion of digital technologies and artificial intelligence in various areas of socio-economic life, including creative work.

Keywords: role of culture in the economy, cultural and creative sector, economisation of culture, Z. Hellwig method, Ward method.

Category of the paper: Research paper.

1. Introduction

The cultural and creative sector (CCS) is becoming an increasingly significant component of the global economy, as evidenced by the growing turnover of creative goods and services. As societies become wealthier, there is a shift in the structure of needs—from basic socio-economic needs to higher-order needs such as cognitive, aesthetic, recognition, and self-actualisation needs—which stimulates demand for products and services related to knowledge, science, culture, and entertainment offered by the creative sector. There is an intensification of the semiotisation of consumption and the economisation of culture. In the former case, brand, design, and the symbolic meaning of products and services start to play as important a role as their utilitarian functions (Lash, Urry, 1994). In the latter case, market mechanisms, manifested in the commercialisation of cultural goods, are entering the realm of cultural activities. Culture and the economy are increasingly interwoven.

Efforts are being made to establish coherent conceptual foundations for defining the cultural and creative sector, including the industries that compose it and the mechanisms of its impact on other sectors of the economy. This article fits into the current research trend. It addresses the conditions for the development of the creative sector in the contemporary economy and the dilemmas associated with its measurement at the national level.

The aim of the article is to assess the level of development of the cultural and creative sector in Poland in comparison with selected European countries. It should be noted that the analyses are focused on the economic role of this sector.

In our research, the Z. Hellwig development pattern method and the Ward agglomerative clustering method were used. Based on 8 diagnostic features, a synthetic indicator was developed, which then served as the basis for creating a ranking of countries according to the level of development of the cultural and creative sector. The study covered 23 European countries.

In the first part of the article, the role of culture in the economy is discussed, with references to international studies in this area. The article also addresses controversies among researchers regarding the so-called “economisation of culture.” The second part presents the difficulties associated with measuring the cultural and creative sector in the economy and the operational definition of the cultural and creative sector adopted for the purposes of the study. The research methods employed are then described. The third part of the article includes the presentation of the results of our research. In analysing the variation in the development of the cultural and creative sector in Europe, particular attention is given to the role of the CCS in the Polish

economy. Based on the analysis of activities undertaken in countries with significant CCS participation in their economies, recommendations for Poland are proposed.

2. “Economisation of Culture”? On the Role of Culture in the Economy

The impact of culture on the functioning of the economy is an increasingly explored topic in economics. On one hand, it is emphasised that, through its influence on human and social capital, culture is a significant factor in economic growth and development (Noga, 2014). Culture fosters imagination, sensitivity, creativity, stimulates interests, and teaches different perspectives on the world. It serves as a catalyst for innovation. On the other hand, works of cultural creators are becoming objects of market transactions, increasingly contributing to GDP. There is a distinct interpenetration and mutual stimulation of the economic and non-economic values produced by culture, indicating both an “economisation of culture” and a “culturalisation of economics”. The creator of both concepts is J. Szomburg, who over 20 years ago observed that “separate thinking about culture and economics is becoming an anachronism in the modern world”. He further emphasised that “an increasing number of economic products—and to an increasing extent—are infused with inspirations and meanings rooted in culture, which enhance their value, providing an advantage over other products. Meanwhile, the cultural and artistic sector, previously considered part of the so-called sphere of social services (which create costs rather than economic benefits), is increasingly moving beyond this sphere (...). It is becoming an independent field of economic activity” (Szomburg, 2002). The increase in social welfare has clearly accelerated the phenomena described by the author. With a higher level of education and “artistic refinement” in society, and a relatively high degree of satisfaction of basic needs, attention has shifted towards original goods that fulfil aesthetic needs, enable self-realisation, express personal identity, and offer unconventional, creative ways to spend leisure time. It can be hypothesised that only exogenous factors relative to the market mechanism (e.g., wars, ecological disasters, pandemics—all on a global scale) could significantly weaken the growing demand for goods offered by the cultural and creative sector.

Based on research conducted between 2013 and 2014 across five continents and in 78 countries with varying socio-economic levels, a significant impact of the cultural and creative sector on social welfare, measured by GDP per capita, was demonstrated (Boix Domenech, De Miguel Molina, Rausell Köster, 2022). Moreover, it was found that this impact was notably greater in highly and very highly developed regions (Boix Domenech, De Miguel Molina, Rausell Köster, 2022).

Economic research also highlights the relationship between economic innovation and the cultural sector (Bakhshi, McVittie, 2009). A post-industrial, innovative economy is “based” on culture, which serves as a source of creative attitudes and inspiration, even in the economic sphere.

The economisation of culture is associated with concerns that focusing on achieving economic goals may lead to a decline in the artistic quality of works, an “expansion” of mass culture at the expense of “high culture.” M. Horkheimer and T. Adorno (1994) had already strongly emphasised concerns related to the commercialisation of culture and art, discussing the weaknesses of artistic production subordinated to market demands (Horkheimer, Adorno, 1994). This economic approach to culture, termed “econocentric,” is contrasted with the “culturocentric” approach. Both perspectives have their proponents and opponents (Andres, Chapain, 2012). However, considering that culture, especially “high culture,” is a crucial factor in economic development shaping, as previously emphasised, human and social capital, the innovative potential of countries and regions, and serves as an impulse for the development of economic sectors, public funding of culture and treating these expenditures as investments that often yield returns over the long term is justified. At this point, it is worth mentioning the concept of “concentric circles” (Throsby, 2008). This concept assumes a symbiosis and mutual permeation, as well as numerous interactions among different industries within the cultural and creative sector, which belong to specific concentric circles. The first circle is the so-called “core of creativity”, which includes areas such as painting, sculpture, dance, theatre, photography, museums, and libraries. The next two circles group industries that revolve around this “core”. The second circle comprises industries involved in the production and distribution of creative goods and services, such as the music, film, publishing, and broadcasting sectors. The outermost circle consists of industries primarily engaged in the mass reproduction and distribution of products from this sector, including computer games, design, fashion, architecture, and advertising. The essence of an economy based on the cultural and creative sector is the so-called process of “spilling over” of development, which involves the radiating influence of the “core of creativity” and the subsequent circles on each other (Szultka, 2014). “Creative industries and, subsequently, other branches of the economy need inspiration from cultural activities to develop properly; and culture, to translate into a developmental impulse for the entire economy, requires creative industries. These industries allow the cultural activities—presumed to be autotelic—to achieve “instrumental” effects, commercialise their outputs, and provide a sort of “return on investment” (Szultka, 2014).

In the context of these considerations, does Poland have a chance to base its economic development on the cultural and creative sector?

The answer to this question is complex and requires an assessment of Poland’s strengths and limitations in this regard. An undeniable strength is the relatively high level of creativity and entrepreneurship among Poles, especially the younger generation. This is evidenced by the 2022 PISA (Programme for International Student Assessment) results, which showed that the

creativity of Polish 15-year-olds is among the highest in the European Union. Only students from three countries (Estonia, Finland, and Denmark) achieved higher scores than those from Poland (Dobosz-Leszczynska, Kazmierczak, Weremiuk, 2024). However, there are concerns about the low propensity for collaboration and cooperation among Poles, which is critically important for the aforementioned process of “spilling over” development. This concern arises from the low level of social capital and the deficit of social trust that characterises Poles” (Witczak-Roszkowska, 2017).

3. Methodology of own research

Research on the cultural and creative sector presents methodological challenges. These largely stem from difficulties in defining the scope of the term “cultural and creative sector”. Contributing factors include:

1. The diversity in understanding the concepts of creativity and culture, and the complex nature of interactions between culture and creativity.
2. Different visions of the role of culture in society (Stachowiak, 2015)—whether it has solely artistic significance as an expression of the creator, or also economic significance, where cultural goods become market commodities like other products (Stachowiak, 2015).

Scientific articles often exhibit a certain “chaos” in the terminology used for this area of research, frequently resulting from the mechanical, overly literal translation of terms from English. According to K. Stachowiak (2015), the most commonly appearing terms in Polish are: “cultural industry”, “cultural industries”, “creative industries”, “creative sector”, “cultural sector”, “creative activities”. However, as the author himself points out, these Polish terms referring to the cultural and creative sector do not fully correspond to their foreign counterparts. This is especially true for the terms “cultural industries” and “creative industries”, which have entered Polish usage as translations of the English terms “cultural industry” and “creative industry”. In English, the term “industry” has a much broader meaning and refers to “any economic activity” (Goodall, 1987), whereas in Polish, it means “a sector of material production where the extraction of natural resources and their processing into production means and consumer goods occurs on a large scale, based on the division of labour and with the use of machinery” (Janasz, 1997, p. 42). In this context, it should be noted that many activities related to culture and creativity do not correspond to the term “industry”. This article acknowledges these observations as valid, and for the purposes of the conducted analyses, the term “sector” has been adopted. The sector comprises subsectors and industries of a similar nature; in this case, they are industries whose “activities are based on cultural values or other forms of artistic and individual or collective creative expression”, corresponding to the

definition adopted by the European Commission in the “Creative Europe” programme (European Commission, 2018). Due to the great difficulty in unequivocally assigning certain types of activities to either the creative sector or the cultural sector, and the significant impact of both sectors on socio-economic development, they are treated jointly in this article, which is also reflected in the used term “cultural and creative sector” (CCS).

It must be clearly emphasized that the term “cultural and creative sector” refers to a diverse group of activities “rooted” in culture and creativity. This diversity leads to numerous classifications of activities that make up this sector, depending on the position adopted by researchers. The result of this is various statistical data regarding the development of this sector and its share in the economy, which complicates comparative analyses (Stachowiak, Tomczak, 2015). In this context, it is appropriate to list the cultural activities considered in the conducted research. The cultural activities included in this study are presented in Table 1.

Table 1.

Cultural activities adopted in the own study

Cultural activities based on the NACE classification	
1.	Printing and reproduction of recorded media
2.	Manufacture of jewellery and related articles
3.	Manufacture of musical instruments
4.	Retail sale of books in specialised stores
5.	Retail sale of newspapers and stationery in specialised stores
6.	Retail sale of music and video recordings in specialised stores
7.	Books publishing
8.	Publishing of newspapers
9.	Publishing of journals and periodicals
10.	Publishing of computer games
11.	Motion picture, video and television programme production, sound recording and music publishing activities
12.	Programming and broadcasting activities
13.	News agency activities
14.	Architectural activities
15.	Specialised design activities
16.	Photographic activities
17.	Translation and interpretation activities
18.	Renting of video tapes and discs
19.	Printing and reproduction of recorded media
20.	Creative, arts and entertainment activities
21.	Cultural education
22.	Libraries, archives, museums and other cultural activities

Source: Eurostat.

To examine the regional diversity of the level of development of the cultural and creative sector in European countries, the Z. Hellwig development pattern method was applied, which belongs to the group of taxonomic linear ordering methods. In this method, the assessment of a multifaceted phenomenon is conducted based on an aggregated synthetic indicator. This indicator forms the basis for the hierarchy of the studied objects.

In the author's research on the creative and cultural sector, 8 diagnostic features were taken into account (Table 2). The selection of potential diagnostic variables was based on substantive, formal, and statistical criteria (Strahl, 2006). The set of diagnostic features includes 7 stimulants (features from x_1 to x_7) and one destimulant (x_8). They are derived from three Eurostat surveys (Eurostat, 2022). The diagnostic features regarding the number of enterprises, added value, and net turnover of the cultural and creative sector come from Structural Business Statistics (SBS). According to these statistics, the sector comprises 22 economic branches in the area of culture (Table 1). The diagnostic features illustrating employment in the cultural and creative industries come from the European Union Labour Force Survey (LFS). The international trade in cultural goods is illustrated by diagnostic features derived from the Eurostat Comext database. The diagnostic features considered in the study pertain to the years 2021 and 2022.

Table 2.

Diagnostic features adopted in the own study

	Name of the diagnostic feature
X ₁	Share of enterprises in the cultural and creative sector in the total number of enterprises in the non-financial sector (i.e., industry, construction, market services) (in %)
X ₂	Share of workers in the cultural and creative sector in the total number of workers in the non-financial sector (in %)
X ₃	Added value generated in the cultural and creative sector per employee (in thousand euros)
X ₄	Share of the added value of the cultural and creative sector in the total added value of enterprises in the non-financial sector (in %)
X ₅	Share of net turnover of the cultural and creative sector in the total turnover of enterprises in the non-financial sector (in %)
X ₆	Share of exports of products from the cultural and creative sector in the total exports of a given country (in %)
X ₇	Share of exports of products from the cultural and creative sector of the studied countries in the total exports of the European Union (in %)
X ₈	Share of imports of products from the cultural and creative sector in the total imports (in %)

Source: Original Research.

The Ward method, a hierarchical classification method, was used to cluster countries. The study was conducted based on standardized variables. Clusters were created using Euclidean distance. The application of the Ward method's effects was presented in the form of cluster trees—dendrograms (using the Statistica 13.1 program). This method allowed for the grouping of countries that are most similar to each other and simultaneously maximally different from others in terms of the identified characteristics defining the level of development of the culture and creative sector. In the conducted study, a critical value was established based on the analysis of the agglomeration process plot. After observing the largest increase, where multiple clusters form at approximately the same binding distance, a cut-off point is made, dividing the set into classes (Ward, 1963).

4. Research findings – diversification of the development of cultural and creative industries in European countries

The diagnostic features adopted in the research showed a significant degree of diversity. The coefficient of variation ranged from 35.3% to 171.7%. The European countries included in the study exhibited particularly similar shares of culture and creative sector enterprises in the total number of enterprises within the industry, construction, and market services sections, as well as similar shares of employment in this sector. For these diagnostic features, the coefficient of variation reached the lowest values, amounting to 35.3% and 37%, respectively. The highest share of culture and creative sector enterprises was observed in the Netherlands (11.76%), while the lowest was in Slovakia (3.06%). In Slovakia, the lowest share of employment in this sector was also noticeable (1.67%), in contrast to Belgium, which had the highest level of this share (6.86%).

European countries showed the greatest variation in the share of culture and creative sector products in the total export of the non-financial sector of the European Union—the coefficient of variation was 171.7%. The highest value of this indicator was in France (19.3%), while the lowest was in Cyprus (0.01%).

In light of the diagnostic features adopted for the research, the highest level of development in the culture and creative sector was noted in four countries: France, Cyprus, the Netherlands, and Malta (see Table 3).

Another group of eight countries is characterized by an average level of development in this sector. This group includes: Austria, Sweden, Germany, Belgium, Spain, Poland, Finland, and Slovenia (see Table 3).

A low level of development in the culture and creative sector was observed in seven countries (Latvia, the Czech Republic, Portugal, Greece, Croatia, Lithuania, Hungary), while the lowest level was found in four countries: Luxembourg, Romania, Bulgaria, and Slovakia (see Table 3).

Poland achieved a relatively high 10th position in the ranking of the 23 countries included in the study. However, the Hellwig indicator characterizing the development of the culture and creative sector in Poland was nearly twice as low as that of the ranking leader—France. Poland represented a similar level of development in the sector as Spain and Finland. It is worth noting that, in light of the diagnostic features adopted for the study, a particularly low level of development in the culture and creative sector was characteristic of Slovakia. In this case, the Hellwig indicator was more than 14.5 times lower than in France and nearly 7.5 times lower than in Poland.

Table 3.

Ranking of European countries according to the level of development of the cultural and creative sector

No.	Country	The value of the synthetic Z. Hellwig index (di)
Countries with the highest index		
1.	France	0,419
2.	Cyprus	0,359
3.	Netherlands	0,311
4.	Malta	0,300
Countries with an average index		
5.	Austria	0,280
6.	Sweden	0,277
7.	Germany	0,244
8.	Belgium	0,239
9.	Spain	0,230
10.	Poland	0,219
11.	Finland	0,217
12.	Slovenia	0,201
Countries with a low index		
13.	Latvia	0,180
14.	Czechia	0,179
15.	Portugal	0,159
16.	Greece	0,149
17.	Croatia	0,144
18.	Lithuania	0,131
19.	Hungary	0,115
Countries with the lowest index		
20.	Luxembourg	0,092
21.	Romania	0,053
22.	Bulgaria	0,050
23.	Slovakia	0,029

Source: Own research.

In this study, an attempt was made to determine the critical value based on the analysis of the line plot of linkage distances against subsequent stages of the bonding process. From the analysis of the agglomeration graph, it can be concluded that the point of division on the dendrogram is at the 17th step (the longest vertical line in Figure 1). Thus, the linkage distance is positioned between levels 3 and 6.

The dendrogram division at a linkage distance level of 4 served as the basis for identifying seven groups of relatively homogeneous units, including single-, four-, and six-element clusters. Three countries formed separate, independent clusters. In the taxonomic analysis, two of these countries were classified into units with the highest level of development in the culture and creative sector, namely France and Cyprus, while Belgium was placed into the medium-level group. This indicates clear differences in the level of development of these countries compared to others.

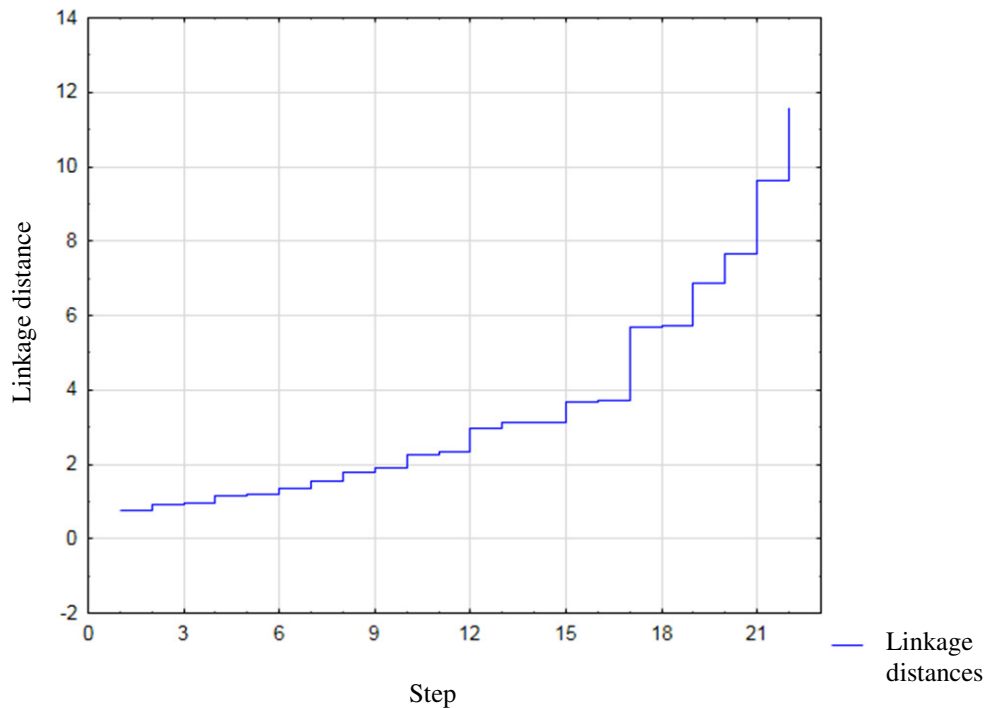


Figure 1. Agglomeration flow chart.

Source: Own research.

A four-element group consisted of two countries with a high Hellwig index level, namely Malta and the Netherlands, and two with a medium level, namely Austria and Sweden. Additionally, two six-element clusters were identified. First six-element cluster: Spain, Poland, Germany, Czech Republic, Latvia, Luxembourg. The first three countries in this cluster exhibit a medium level of CCS development, the next two have a low level, and the last, Luxembourg, has the lowest level. The second six-element cluster includes three countries with a low level of CCS development (Greece, Croatia, Portugal) and three with the lowest level (Bulgaria, Slovakia, Romania). The final, seventh group of clusters comprises four countries. Two of them, Lithuania and Hungary are characterized by a low level of CCS development, while Slovenia and Finland have a medium level.

Both methods presented — cluster analysis and linear ordering — group countries similarly in terms of their development in the CCS.

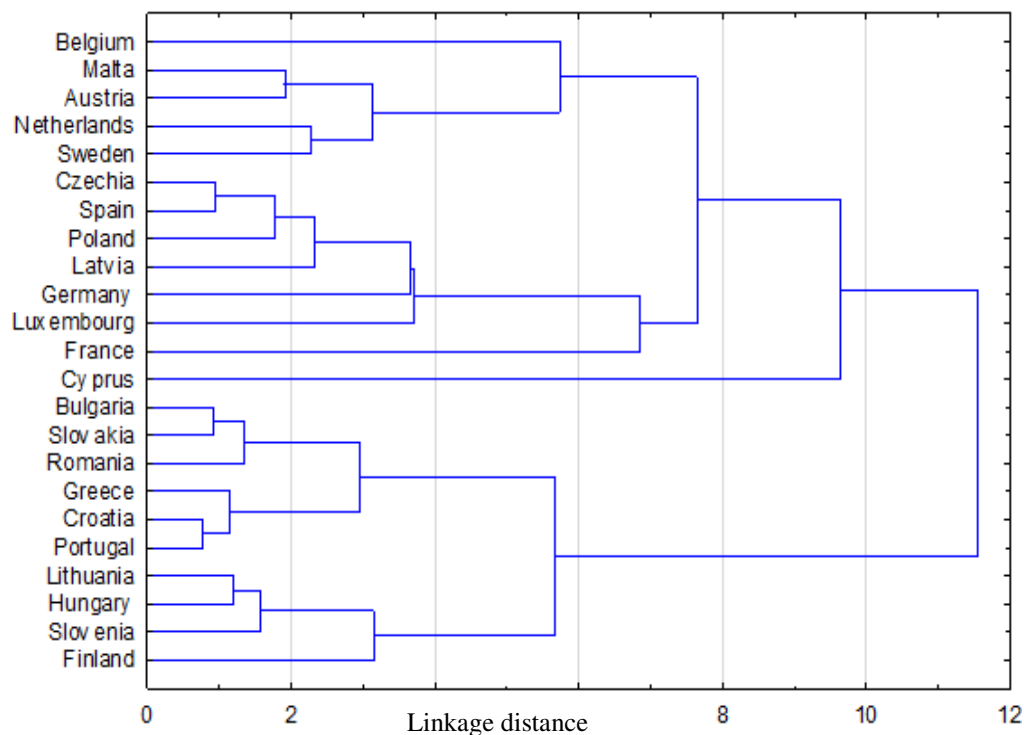


Figure 2. Similarity of European countries in terms of cultural and creative sector development based on the Ward method.

Source: Own research.

The remainder of the article focuses on a comparative analysis of the role of the cultural and creative sector in the Polish economy, against the background of selected European countries, especially France.

In 2021, Poland had 117,754 enterprises in the Culture and Creative Sector (CCS), which is 6.5 times more than Slovakia but 2.5 times fewer than France. The share of these enterprises in the total number of non-financial sector enterprises (i.e., industry, construction, market services) in Poland was 4.4%, compared to 6.8% in France. For comparison, the highest share of enterprises in the CCS was in Sweden, at 11.8%.

The CCS generates a significant number of jobs. In 2021, the European Union had nearly 4 million jobs in this sector, while Poland had close to 250,000. The proportion of employees in the CCS relative to the total number of employees in the non-financial sector was similar in Poland and France, at 2.2% and 2.5%, respectively.

The role of the CCS in the economy is also indicated by its contribution to value added. Analyses revealed a relatively high level of variation in this regard among European countries, with a coefficient of variation of 41%. Cyprus had the highest share of value added from the CCS relative to the total value added of non-financial sector enterprises (5.14%), while Slovakia had the lowest (1.01%). In Poland, the Culture and Creative Sector generated €5.6 billion in value added, which accounted for 1.71% of the total value added. The value added per employee in Polish enterprises in this sector was €40,600, nearly three times lower than the leader in this regard, Belgium. It was also below the European Union average of €72,900. However,

it is important to note that the value added of the CCS declined during the pandemic in most of the countries surveyed. According to UNESCO estimates, the overall contribution of the CCS to global value added dropped by 20-40% in 2020 (BPO Consulting, 2023). The total turnover of the CCS in the European Union also fell by over 30% (Święcicki, Ilnicki, Krawczyk, Biega, Wojnar, 2023). This trend was also observed in Poland, where the sector's share decreased from 2.1% in 2010 to 1.4% in 2019 (Święcicki, Ilnicki, Krawczyk, Biega, Wojnar, 2023). The shift to online activities did not allow sector entities to maintain their revenue at previous levels. According to K. Czyżewski, difficulties in operating online stemmed from a lack of skills to fully utilize digital tools and informational chaos leading to audience fatigue from content overload (Czyżewski, 2020).

It is worth noting the activity related to video game production, which generated a value added of €255.4 million in 2021. The dynamic growth of this activity is evidenced by the increase in the value of the video game market in Poland from PLN 2.38 billion in 2018 to PLN 6.03 billion in 2022 (Marszałkowski, 2023). Not all companies in this sector report high revenues. According to a PARP report, in 2022 there were 494 video game producers and publishers operating in Poland, but less than one-third recorded significant profits (Marszałkowski, 2023). This is largely due to the specifics of this market, particularly the production and publication cycle of a game. Preparing a game and its entire lifecycle can take several years, whereas revenues and costs are unevenly distributed over time (Marszałkowski, 2023). For many firms in this industry, this presents a significant barrier to their development. In this context, it is worth considering public support for such ventures, not in the form of non-repayable grants or various types of subsidies, but on the basis of later state participation in the profits achieved by the companies. This would, of course, require consideration of the potential risks associated with implementing such a project.

Video games created in Poland are known and appreciated beyond the country's borders, as reflected in the fact that 97% of production is exported to foreign markets. In 2021, Poland ranked prominently on the Top200 Steam wishlist (a ranking of the most anticipated titles) globally and was a leader in PC game production, particularly on the Steam platform. An analysis of the demand structure for games on the Top200 Steam list by country of origin revealed that 38% of the demand was for games developed by Polish creators. Poland outperformed the United States in this regard, where the share was 35% (Marszałkowski, Biedermann, Rutkowski, 2021). This indicates the immense growth potential of this industry.

Among the countries surveyed, France, Sweden, and Finland are leaders in terms of value added in the video game industry (see Figure 3). Poland ranked 7th, with the value added in this sector being similar to that of Spain (see Figure 3).

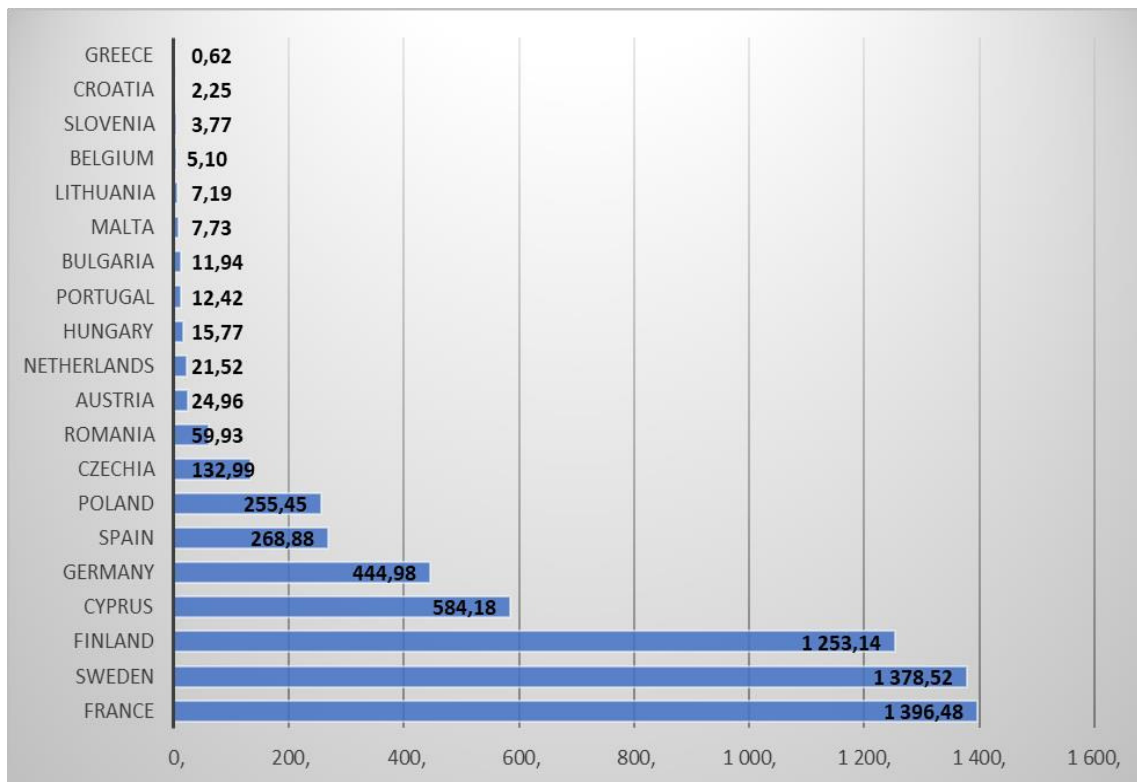


Figure 3. Value added in publishing of computer games (million euro) in European Countries in 2021.

Source: Eurostat.

The high level of development of the CCS in France is also confirmed by statistical data on the share of export products of this sector in the total export of the country. In 2022, this share was 1.65%, the highest among the countries surveyed. Poland ranked 3rd in terms of this share, which was 0.98%. France also distinguished itself with the highest share—over 19%—of CCS products in the total export of the European Union. Poland's share was also significant, at 6.7%.

5. Conclusion

The author's research findings revealed significant variations in the level of development of the culture and creative sector among the European countries studied. France stands out as the clear leader in this area. The CCS plays a crucial role in the French economy, and the French government is aware of its growing importance on the international stage. This is reflected in the "Acceleration Strategy for the Culture and Creative Sector" for 2021-2025, which has a budget of EUR 400 million. The goal of this strategy is to create conditions for the emergence of so-called "unicorns," i.e., innovative companies with high market value, and to promote the export of CCS products and services. Additionally, the "France 2030" plan envisions France achieving a leading role in the production of cultural and creative content. This will be supported by investments in film studios and post-production facilities and by fostering virtual

reality technology. These efforts will be complemented by training courses for professions related to CCS.

It is important to note the unique nature of CCS products: unlike traditional material goods, they do not diminish through use. On the contrary, their utilization often leads to their enhancement and proliferation (Hausner, Karwińska, Purchala, 2017).

In this context, it appears that France, as a country with a significant share of CCS in the EU market, has already gained a substantial competitive advantage over many European countries and is likely to continue expanding it.

Similar to France, Sweden is also taking measures to develop the CCS, as evidenced by its “Creative Sweden” strategy. This strategy highlights, among other things, the significant export potential of CCS and the necessity of supporting it. The study also addressed issues of copyright.

Research has shown that Poland exhibits a relatively high level of CCS development, with its goods and services having the potential to become recognizable symbols of the country, as exemplified by the game “The Witcher”. However, achieving this requires a range of comprehensive actions.

In Poland’s economic development strategies, it is crucial to emphasize the economic role of activities in the field of culture and the arts. Despite ongoing debates about the negative effects of the commercialization of culture, this process is a reality, evident in the intensification of international competition in CCS and the actions taken by countries to support its development. Establishing the Creative Industries Development Centre by the Ministry of Culture and National Heritage in 2022 appears to be a positive step. The Centre's tasks focus on supporting the development of Polish creative industries, particularly game development, film, music, fashion, and visual and applied arts. Its objectives include: building an effective public support system for Polish creative industries; creating conditions for leveraging the potential of collaboration among different creative sectors and between Polish creative industries and other sectors; promoting understanding of the significance of creative industries for socio-economic development as well as for Polish culture and heritage; supporting Polish creative industries in the face of increasing international competition (Centrum Rozwoju Przemysłów Kreatywnych, 2022).

In the context of pro-development activities in CCS, it would be worth considering the creation of public financial support programs for particularly promising CCS sectors, based on subsequent state participation in the profits, which could then be reinvested in further projects.

Given the complex nature of formal matters in the culture and creative sector—especially regarding copyright and related rights—experts highlight the need for legal support for creators. The importance of this support is increasing, particularly with the development of streaming platforms and artificial intelligence (Święcicki, Ilnicki, Krawczyk, Biega, Wojnar, 2023). The importance of this support is particularly pronounced in the context of the development of streaming platforms and artificial intelligence. Unfortunately, the lack of implementation by

Poland of the EU Digital Single Market Directive (the so-called DSM Directive) is detrimental to this. Poland remains the only EU country that has not yet implemented this directive, despite the deadline having expired in 2021. According to the creators of the directive, the Copyright and Related Rights in the Digital Single Market Directive represents an opportunity to strengthen their position in negotiations with major digital platforms that impose their own favourable terms. Without bearing the costs of content creation, these platforms fully utilize and profit from it (Stawiany, 2024).

The development of artificial intelligence presents another challenge for CCS. It could radically transform this sector. In March 2024, the European Union adopted the AI Act (European Parliament, 2024), which aims, among other things, to create regulatory frameworks to ensure the safety and fair use of this technology. Creators are particularly concerned about the use of their works (databases, works of artists, writers, scientists, etc.) in the process of AI learning.

Poland's relatively high level of CCS development provides an opportunity to turn it into a promising source of building a lasting competitive advantage in the international market. However, this requires a series of significant economic, legal, and educational solutions.

The diversity in understanding the concepts of creativity and culture, and the complex nature of interactions between culture and creativity are limitations in research on the cultural and creative sector. This requires unification of definitions and indication of activities included in the sector cultural and creative industries.

This article is part of the ongoing research efforts to create coherent conceptual foundations for defining the cultural and creative sector and understanding its mechanisms of influence on the economy. The presented research may also contribute to further, more in-depth analyses of the impact of the cultural and creative sector on the socio-economic development of European countries.

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THE IMPACT OF SENTIMENT AND TROPES IN MEDIA COMMUNICATION ON THE FORMATION OF ECONOMIC PERCEPTION

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Purpose: This study analyses the impact of expert comments on inflation forecasts among Polish university students. The survey, conducted from April 2023 to February 2024, aimed to assess how positive and negative expert comments influence qualitative and quantitative perceptions of inflation in the context of rising prices. It involved 412 participants, including 326 women, 83 men and three people who did not specify their gender.

Design/methodology/approach: The methodology of the study involved the use of a priming technique by screening a video to standardise participants' understanding of the economic situation. They were then randomly allocated to two groups: one receiving positive comments from experts (Group P) and the other receiving negative comments (Group N). Inflation forecasts were collected both before and after the commentary, allowing analysis of changes in perceptions depending on the tone of the commentary.

Findings: The survey results indicate that expert comments had a significant impact on inflation forecasts. Participants who received positive feedback were more likely to adopt optimistic forecasts, anticipating lower inflation or inflation stabilisation. In contrast, those who encountered negative comments were more likely to forecast faster price increases. Negative feedback had a stronger effect on changing inflation expectations, highlighting an asymmetric information processing effect in which negative news triggers more significant changes than positive news.

Research limitations/implications: The study contributes to a better understanding of how expert opinions shape public inflation expectations, highlighting the need for careful formulation of economic messages. Policy makers and media professionals should be aware of the important role that expert commentary plays in shaping public attitudes towards inflation. The results also have broader implications for economic communication, suggesting that balanced messages are crucial to the effective management of inflation expectations.

Originality/value: The results of the study are a valuable contribution to the field of economic psychology, particularly in the context of communication strategies in times of economic uncertainty. They show how the emotional nature of language influences the perception of content and the reception of media messages, and thus the final decisions of consumers.

Keywords: inflation, behavioral economics, media communication, cognition, language pragmatics.

Category of the paper: Research paper.

1. Sentiment in media communication: definition and mechanisms of influence

The concept of sentiment, widely used in both linguistics and behavioural finance, has a complex and multilayered meaning, making its accurate capture require an interdisciplinary approach. In the literature, *sentiment* is often equated with emotions and moods that influence the decisions made by market participants. Sentiment is often used to describe market sentiment (market sentiment), which can be positive (upward) or negative (downward) (Blazquez, Domenech, 2017). Over the years, researchers have tried to capture the nature of sentiment using various analytical techniques, including text analysis. Modern approaches to sentiment analysis often use Big Data tools, which allows for a more precise understanding of changing sentiment in real time (Blazquez, Domenech, 2017). Textual sentiment refers to the emotional overtones contained in textual content. This can include news articles, social media posts and other user-generated content. Textual sentiment analysis can be reduced to sentiment analysis. It includes the classification and evaluation of emotions expressed in texts.

According to Sanjiva Ranjan Das (2022), textual sentiment analysis can be classified as a data mining method based on tools drawn from linguistics and the psychology of language. When studying sentiment, researchers extract, classify and attempt to evaluate the opinion expressed in various source texts.

In the literature, there are many approaches to classifying emotions that are used in sentiment analysis. A study by Bollen, Mao and Zeng (2011) identified emotions such as calmness, confidence or alertness to predict market behaviour. Other studies, such as those by Saurabh and Dey (2020) focused on emotions such as love, sadness, joy, anger, fear or stress, which they identified as “psychometric words.” Ekman's model of basic emotions working with Paul Ekman's key theory of emotion psychology is another popular model used to analyze emotions in texts, identifying basic emotions such as fear, anger, sadness, disgust, surprise and joy.

In addition to linguistics and the psychology of emotions, the branch of science that studies sentiment is behavioral finance, which deals with the topic of how emotions and sentiment affect investment decisions. Researchers such as Pedro Reis and Carlos Pinho (2020) point out that “sentiments explain movements in financial markets, especially during periods of irrational panic or unwarranted optimism”. In the context of sentiment, the influence of the media in shaping the economic perceptions of audiences cannot be overstated either. The media play a key role in shaping sentiment through the process of information selection. The characteristics of the texts published by media channels can influence market sentiment due to the fact that the media reflect emotions that are not easily quantified, which makes textual sentiment analysis a unique challenge.

2. Priming in media communication: definition and mechanisms of media priming influence on perception

Priming and framing are two key mechanisms by which the media influence audiences, shaping their perception and interpretation of information. Framing is a psychological mechanism that involves singling out a particular topic from among many others and focusing the audience's attention on it when evaluating events or public figures. This process is based on frequent repetition of specific information and exposing it in such a way that it is easily accessible to the audience. According to Shawn Soroka and Stephen McAdams (2022), through priming, the media can shape the hierarchy of topics, which affects the perception of the importance and value of the information conveyed by a media channel. According to the researchers, a fundamental aspect of torching is the repetition of information. Frequent coverage of certain topics makes them readily available in the audience's memory, leading to the perception that they are more relevant. The media can therefore direct the public's attention to specific problems or events, thereby changing perceptions of reality.

In the article *Priming and the influence of news media on public opinion* authors Larry M. Bartels and Robert Ferguson (2020) discuss the mechanisms by which the media influence public opinion through the process of priming. The authors emphasize that priming refers to the media's ability to influence which issues are perceived as important by the public. By selectively exposing certain issues, the media can shape how audiences perceive given thematic strands. Bartels and Ferguson point out that the media not only influence what issues are considered important, but can also change how those issues are judged by the public.

The priming mechanism, although recognised as one of the key tools of media influence on audience perception, is often criticised for simplifying the process of evaluating topics. In reality, audiences do not always react in a predictable way to repeated messages - their reactions are modulated by previous experiences, social context and individual attitudes towards the issues discussed. Therefore, while priming helps to prioritise topics, its effectiveness is not universal and depends on many variable factors. Priming influences the criteria by which audiences judge public figures or social issues. When the media expose economic issues, they become the main criterion for evaluating politicians or government actions. With priming, the media can even change the standards by which audiences evaluate the environment. For example, frequent emphasis on national security can cause voters to view politicians through the prism of their approach to the issue, which influences electoral decisions and selective evaluation criteria.

3. Overview of research and articles

Modern financial markets are largely shaped by factors that go beyond traditional economic models based on rationality and predictability. In *Animal Spirits*, George A. Akerlof and Robert J. Shiller (2009) introduce the concept, which refers to irrational psychological factors that influence economic decisions. This theory suggests that emotions, moods and narratives have a significant impact on economic decisions, often leading to phenomena such as speculative bubbles and financial crises. Therefore, understanding the mechanisms involved in the impact of the sentiment contained in media messages on the recipient of those messages can provide answers to the question of how the media influences the perception of risk associated with investment decisions. Given the dynamic global social and political environment, examining the mechanics of financial decision-making in a volatile environment conducive to irrational decision-making becomes central to the analysis of contemporary economic behaviour. These aspects are particularly relevant in the context of studying the impact of media narratives on consumer decisions and strategies of economic actors, especially in the era of technologisation of most interpersonal communication processes, as well as media or mass communication processes.

Similar conclusions to the authors of *Animal Spirits* were reached by Robert J. Shiller in his book *Narrative Economics* (2019). According to Schiller, it is primarily narratives and stories that play a key role in shaping economic perceptions and market decisions. The author explores how popular stories influence economic behaviour while contributing to economic phenomena. According to Shiller, narratives spread like viruses. This is why they are so effective in influencing the moods of consumers and investors, and thus entire economic systems. In this context, Shiller also emphasises the role of the media in shaping economic perceptions.

The findings on the impact of narratives on financial markets and the real estate sector highlight the importance of narratives as a mechanism for manipulating consumers' economic behaviour. This approach provides a basis for analysing the impact of the sentiment perceived in media messages on strategic and market decisions. In this context, the researcher emphasises the impact of the dynamics of change in the environment, as well as the role of story structure taking into account thematic and emotional context.

Daniel Kahneman, with his prospect theory and the introduction of the dual-system thinking model, adds a new dimension to the discussion on the impact of non-rational factors on individuals' economic perceptions. Economic decisions are often influenced by two types of thinking: fast, intuitive, and slow, analytical. In his book *Thinking, Fast and Slow*, Kahneman (2011) describes how these two systems shape consumer behaviour and decision-making. Fast thinking, which is more susceptible to emotions and priming, often leads to irrational decisions that can have significant economic consequences. In the context of media sentiment, emotional narratives can trigger the fast thinking system, resulting in decisions based on intuition rather than rational analysis. Understanding these processes is crucial for evaluating how media can shape economic perceptions.

Shiller's concept of narrative focuses on the mechanism of the spread of stories, which, like viruses, can influence market decisions. According to critics, this approach over-generalises the manipulative impact of stories, ignoring local cultural conditions and specific perception mechanisms. In this context, Kahneman's approach seems more accurate, pointing to a two-system model of thinking in which quick, intuitive reactions can be both a catalyst for cognitive errors and an effective tool under time pressure. In comparing these two optics, it is worth noting that while both theories offer interesting conclusions, a fuller understanding of economic decisions requires combining both perspectives and taking into account the specific decision-making context.

The concept of *nudges* or subtle prompts influencing consumer decisions, is the central theme of the book *Nudge* by Richard H. Thaler and Cass R. Sunstein. The authors explore how small changes in information presentation can influence behaviour without taking away freedom of choice. In the context of managing media messages, well-crafted communications can promote more conscious and effective economic decisions. Research on the impact of narrative and sentiment on consumer decisions and market strategies demonstrates how *nudges* can be applied in practice to improve market efficiency and support economic stability.

Scientific articles investigating the impact of communication and priming on financial markets and economic decision-making highlight the key role of media message management in the economic context. The article titled *Transparency and Deliberation Within the FOMC: A Computational Linguistics Approach* by Hansen, McMahon, and Prat (2021) shows how different forms of communication by the Federal Open Market Committee (FOMC) influence financial markets, particularly inflation expectations and investment decisions. The researchers conclude that transparency and clarity in communication help shape stable expectations, which

are crucial for effective inflation forecasting. At the same time, complex and conflicting messages can lead to increased uncertainty and market volatility. To gather data for verification, the researchers used advanced linguistic analysis techniques to study FOMC communications. Additionally, they applied sentiment analysis tools to identify positive, neutral, and negative aspects of the messages. Beyond linguistic content, they examined the correlation between the language used in the communications and market reactions, such as changes in stock prices, interest rates, and inflation expectations. It was found that increased transparency in FOMC communications leads to more predictable market reactions. The tone and linguistic structure of the messages have a direct impact on inflation expectations and investment decisions. Messages with a positive tone often result in increased market optimism. The study results show how crucial thoughtful media message management is in influencing economic perceptions. The article demonstrates that both the form and content of communications can significantly affect investment and consumer decisions. Clear and consistent messages can help maintain stable inflation expectations, while complex and conflicting information can lead to uncertainty and erroneous forecasts.

Similarly, in the article *News and Narratives in Financial Systems: Exploiting Big Data for Systemic Risk Assessment*, authors Nyman, Kapadia, Tuckett, Gregory, Ormerod, and Smith (2020) examine how media narratives and sentiment affect financial systems and how they can be used to assess systemic risk. This study fits into the broader context of analyzing the impact of emotions and priming on how market participants perceive economic conditions. The data analysis conducted for the article included large text datasets, such as newspaper articles, analyst reports, and other media communications regarding finance, collected over several years. The key findings from the analysis relate to the impact of narratives and sentiment in media communications and their influence on risk perception among market participants. Emotionally charged narratives can lead to abrupt market reactions, contributing to volatility and financial instability. The authors emphasize the role of big data in shaping economic perceptions. According to the researchers, the use of big data techniques allows for a better understanding of the dynamics of narratives and their market impact. Additionally, the ability to track changes in the tone and themes of narratives provides valuable insights into potential systemic risks. The researchers also highlighted the importance of sentiment and priming in media, which can act as tools for predicting future market events. The positive or negative tone of narratives is undoubtedly significant in the context of estimating investor expectations and financial decisions.

In a similar vein, the article *The Impact of News Sentiment on Housing Prices: Evidence from China* by Zhou and Huang (2020) investigates how media sentiment affects real estate prices in China. The article introduces a new perspective by focusing on sellers rather than consumers purchasing goods or services. The authors analyze how media sentiment can shape sellers' decisions regarding pricing and investment strategies. After comparing communications containing positive and negative sentiment, the researchers concluded that positive media

sentiment leads to an increase in real estate prices. Sellers, perceiving optimistic narratives, are inclined to raise prices, expecting higher demand. On the other hand, negative sentiment in media communications can lead to price reductions or transaction slowdowns, as sellers adjust to expectations of lower demand and higher risk, which are determined by consumer sentiment. The article by Zhou and Huang demonstrates that media and their emotional content influence strategic decisions of sellers in the real estate sector. Media sentiment acts as a form of priming that leads to changes in pricing and investment strategies. Sellers react to media narratives by adjusting their actions to changing market expectations.

Summarizing the views presented on the impact of media sentiment and narratives on economic decisions, it should be said that they show the complexity of this problem, while it should be emphasized that they also show some important differences. Akerlof and Shiller in *Animal Spirits* and Shiller in *Narrative Economics* emphasize that irrational, emotional narratives can lead to market disorders such as speculative bubbles, pointing to the strong but one-sided influence of narratives on markets. On the other hand, Kahneman in *Thinking, Fast and Slow* introduces a more nuanced approach, suggesting that a two-track thinking system - fast, emotional versus slower, analytical - mitigates this influence, pointing to a more complex decision-making mechanism. Thaler and Sunstein in *Nudge* offer a contrasting perspective, suggesting that rather than creating chaos, properly constructed media messages can gently shape consumer decisions, promoting more informed and rational choices. The articles by Zhou and Huang and Nyman and co-authors acknowledge the impact of narratives and sentiment on markets, but differ in their assessment of the strength of that impact, with Zhou and Huang focusing on short-term effects, while Nyman examines long-term systemic risks. As a result, each of these works brings different insights into how the media shapes economic decisions, from narrative manipulation to the potential for improving decisions through well-informed media coverage.

4. Method Description

The study was conducted between April 2023 and February 2024 among self-supporting students from Polish universities who are not analysts. A total of 412 participants took part in the study, including 326 women, 83 men, and 3 individuals who did not specify their gender. The age of the respondents was between 18-30 years (Figure 1).

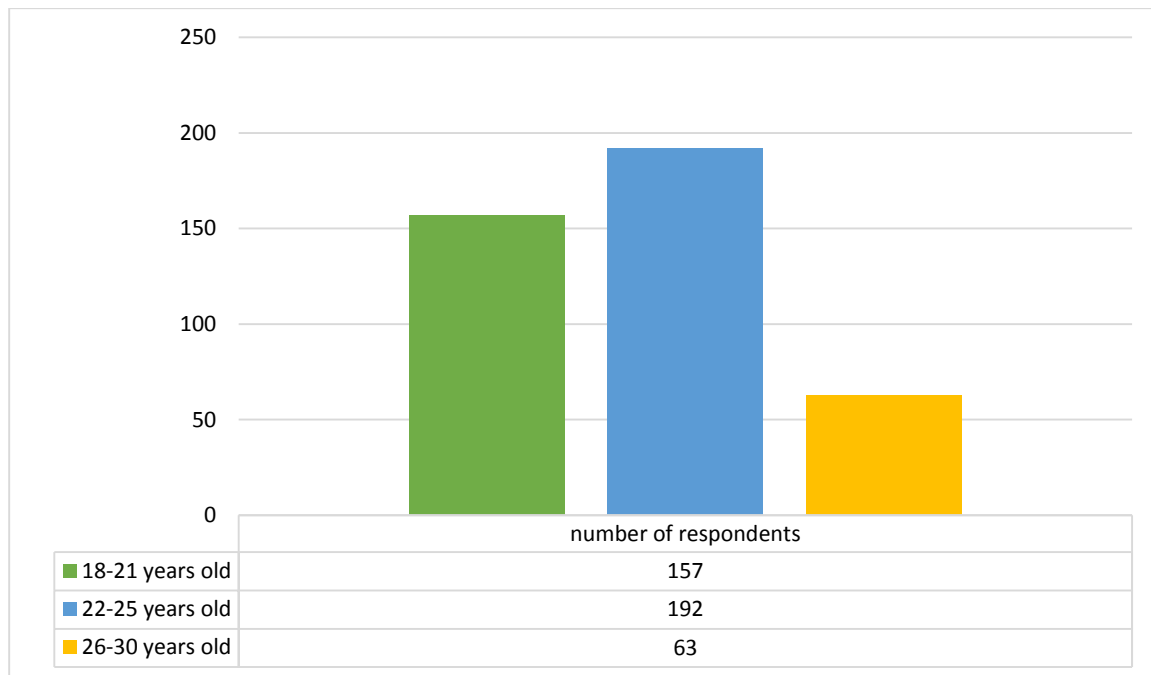


Figure 1. Number of study participants by age group.

Source: Own elaboration based on data collected in the original study.

Participants were first asked to complete a demographic survey. Due to the dynamic economic situation in Poland during the study period, characterized by rising inflation, participants were shown a video. The material aimed to equalize the cognitive understanding of the economic environment and neutralize media information presented in Polish media. As a result, all participants, through the application of priming, responded to the questions from the same cognitive baseline.

After watching the video, participants received a message that, in addition to describing the economic situation and its prospects both domestically and internationally, provided information about an inflation rate close to the inflation target of 2.1%. After reading the message, participants estimated the inflation rate both qualitatively and quantitatively. In the qualitative assessment, participants could choose one of the following options:

In your opinion, over the next 12 months, will prices:

- rise faster than they are now,
- rise at the same pace,
- rise more slowly than they are now,
- remain unchanged,
- decrease.

In the next step, participants were randomly assigned to read an expert commentary—either a positive version (Group P) or a negative version (Group N). They then had the opportunity to modify their estimated inflation rate.

5. Results

Regarding the qualitative estimation of inflation, it can be concluded that depending on the expert commentary read (positive vs. negative sentiment), the analysis showed statistically significant differences in the change of option selection during the second assessment (Table 1).

Table 1.

Mann-Whitney U Test (with continuity correction) for qualitative inflation forecasts in relation to the type of expert commentary (N valid Group P = 208; N valid Group N = 201)

Variable	Z	p	Z	p
Change in qualitative inflation	-9.86	p < 0.0001	-10.31	p < 0.0001

Source: Own elaboration based on data collected in the original study.

In the overall sample, 3 participants did not respond to the qualitative assessment of inflation changes. The positive commentary was read by 208 participants, while 201 participants read the negative commentary.

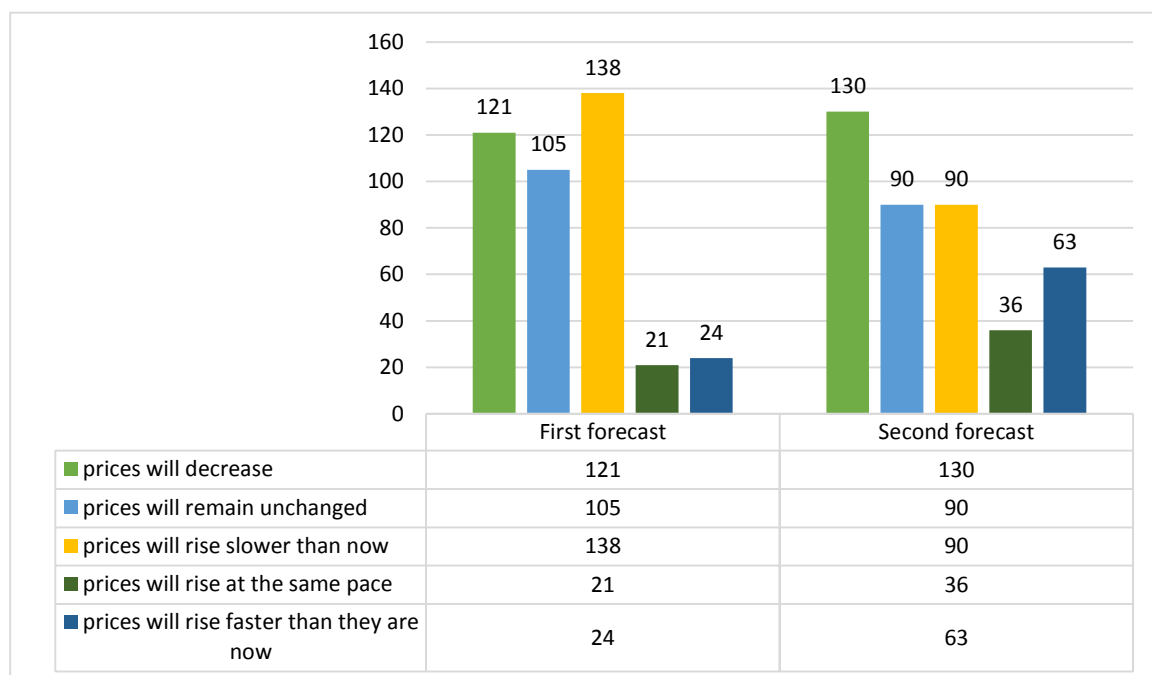


Figure 2. Qualitative inflation estimation considering the first and second forecasts.

Source: Own elaboration based on data collected in the original study.

In the initial inflation estimation, 121 participants indicated that prices would decrease, while 24 participants chose the option "prices will rise faster than they are now". After reading the expert commentary, the number of participants who believed prices would decrease increased to 130, while the number of those who thought prices would rise faster than now increased to 63 (Figure 2).

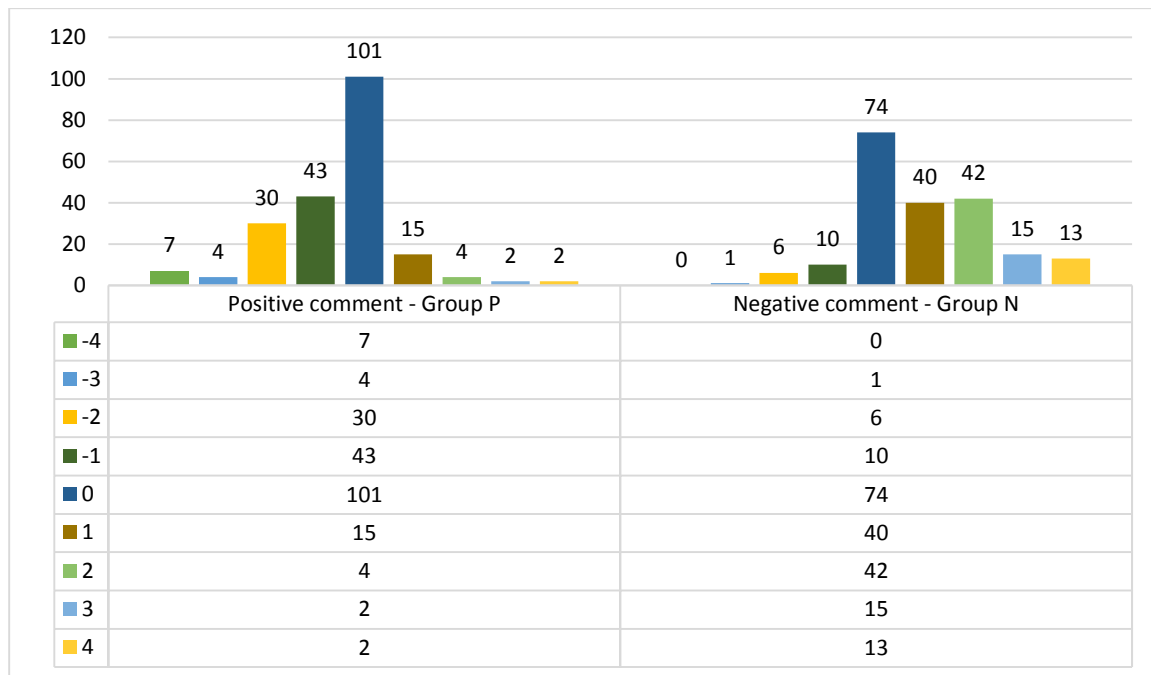


Figure 3. Distribution of results for changes in qualitative inflation depending on the nature of the expert commentary.

Source: Own elaboration based on data collected in the original study.

For the positive commentary, 101 participants (48.56% of Group P) maintained the same opinion after reading it, meaning they did not change their view. In the case of the negative commentary, 74 participants (36.81% of Group N) held the same opinion. Additionally, the analysis showed that among those who read the positive expert commentary, 84 participants (40.38% of Group P) selected an option indicating a slower inflation rate or no inflation during the second assessment. Among those who read the negative commentary, only 17 participants (8.46% of Group N) made a more optimistic assessment than in their first choice (Figure 3).

In terms of worsening the inflation forecast, 23 participants (11.06% of Group P) in the group that read the positive commentary chose such an option. In contrast, in the group that read the negatively toned expert commentary, 110 participants (54.73% of Group N) did so (Figure 3).

Among those who received the positive commentary, 58 participants (27.88% of Group P) made a qualitative change of one level compared to the first indication, while 49 participants (23.56% of Group P) made a change of 2 or more levels. In the group that read the negative commentary, 50 participants (24.87% of Group N) made a one-level qualitative change compared to the first indication, while 77 participants (38.31% of Group N) made a change of 2 or more levels.

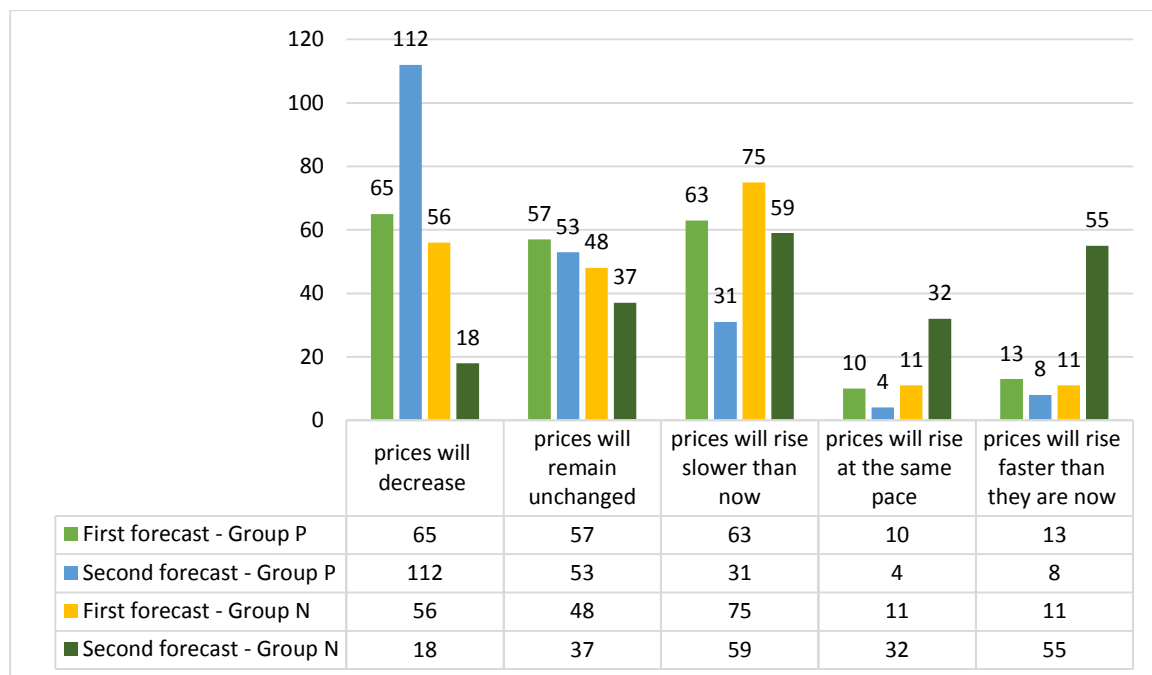


Figure 4. Number of participants selecting each qualitative forecast variant before and after reading the expert commentary, considering the tone of the expert commentary.

Source: Own elaboration based on data collected in the original study.

Comparing the first and second qualitative inflation estimations, the largest percentage change in Group P was noted for the forecast "prices will decrease within 12 months". In Group N, the largest change occurred for the forecast "prices will rise faster than they are now" (Table 2).

During the first inflation estimation, the option "prices will decrease within 12 months" was indicated by 65 participants in Group P and 56 participants in Group N. After reading the commentary, the number of participants selecting this option in Group P increased to 112, reflecting a 72.31% rise. In Group N, the number of participants dropped to 18, a 67.86% decrease compared to the first estimation (Figure 4, Table 2).

For the option "prices will rise faster than they are now," 13 participants in Group P and 11 participants in Group N selected it during the first estimation. After reading the commentary, 8 participants in Group P selected this option, a 38.46% decrease compared to the first estimation. In Group N, the number of participants increased to 55, a 500% increase compared to the initial choice (Figure 4, Table 2).

Table 2.

Dynamics of changes in choices considering the division into Group P and Group N (%)

Forecast	Group P forecast 2/1	Group N forecast 2/1	Overall forecast 2/1
Prices will rise faster than now	61.54%	500.00%	262.50%
Prices will rise at the same pace	40.00%	290.91%	171.43%
Prices will rise more slowly than now	49.21%	78.67%	65.22%
Prices will remain unchanged	92.98%	77.08%	85.71%
Prices will decrease	172.31%	32.14%	107.44%

Source: Own elaboration based on data collected in the original study.

Table 3.

Share of each inflation forecast variant overall during the first and second forecast with a division into Group P and Group N

Forecast	First forecast			Forecast after expert commentary		
	Group P	Group N	Total	Group P	Group N	Total
Prices will:						
rise faster than now	6,25%	5,47%	5,87%	3,85%	27,36%	15,40%
rise at the same pace	4,81%	5,47%	5,13%	1,92%	15,92%	8,80%
rise more slowly than now	30,29%	37,31%	33,74%	14,90%	29,35%	22,00%
remain unchanged	27,40%	23,88%	25,67%	25,48%	18,41%	22,00%
decrease	31,25%	27,86%	29,58%	53,85%	8,96%	31,78%
Total	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Source: Own elaboration based on data collected in the original study.

Considering the first inflation estimation, the highest percentage of choices (33.74% overall) was noted for the option "prices will rise more slowly than now", with 37.31% of participants in Group N and 30.29% in Group P selecting this option. The choice of this option in the second estimation decreased by 34.78% overall and accounted for 22.00% of all responses (Table 2, Table 3).

In the forecast following the expert commentary, the highest overall percentage of choices (31.78%) was recorded for the option "prices will decrease within 12 months". During the first estimation, 29.58% of all participants chose this option.

6. Research conclusions

The conducted research clearly demonstrates a significant impact of expert commentary on students' inflation forecasts. The analysis reveals that both positive and negative comments substantially influence inflation perceptions, as confirmed by statistical analysis. The Mann-Whitney U test identified significant differences in the changes in inflation forecasts depending on the type of commentary, with both positive and negative comments showing a strong effect on predictions, with p-values below 0.0001.

After reviewing the positive commentary, the majority of participants (84 individuals) predicted a lower inflation rate or no inflation at all, indicating a tendency towards an optimistic view of the economic situation under the influence of positive stimuli. Conversely, the negative commentary had a more pronounced effect, leading a larger number of participants to revise their forecasts towards a more pessimistic outlook. Specifically, 110 participants believed that prices would rise faster than they currently do, highlighting the stronger influence of negative messages on forecast adjustments.

The study results also illustrate how different inflation forecast variants shift under the influence of commentary. For instance, the number of participants predicting a price decrease rose from 65 to 112 following the positive commentary, while it dropped from 56 to 18 after

the negative commentary. Similar shifts were observed across other forecast options, underscoring the significant role expert commentary plays in shaping perceptions of future inflation trends.

The interpretation of these results is grounded in several psychological mechanisms. Availability heuristics suggest that the most recent information, such as expert commentary, dominates perceptions of the economic situation. The priming effect, stemming from prior exposure to a neutral video and an inflation message, may have influenced how participants processed subsequent information. The authority effect highlights the strong impact of expert opinions on participants' attitudes, while the emotions triggered by the commentary—whether positive or negative—significantly shape their inflation forecasts.

Additionally, the asymmetry in information processing, where negative messages have a stronger impact than positive ones, further explains why negative comments led to more significant changes in inflation forecasts. Negative information tends to be processed more deeply, which may account for its stronger influence on inflation perception compared to positive commentary.

These findings emphasize the importance of understanding the influence of expert messages on inflation forecasts and highlight the need for careful formulation of economic information in the media. Effective management of inflation perception requires consideration of both positive and negative messages and their potential impact on public attitudes and economic decisions.

Acknowledgments

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AREAS OF USE OF ARTIFICIAL INTELLIGENCE IN ENTERPRISE STRATEGY. SELECTED ISSUES

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Purpose: The aim of the article is to attempt to analyze the current status of using artificial intelligence tools and new technologies in the development of enterprises, taking into account internationalization processes.

Design/methodology/approach: Systematic literature review (SPL).

Findings: By analyzing the literature, it is possible to confirm or deny the developing technological trends, in particular the use of artificial intelligence tools, and try to determine the research gap in this area, indicating the necessary further scientific research.

Research limitations/implications: The limitation is the access to source materials and the need to monitor constant, new research in this rapidly changing scientific area.

Originality/value: research paper.

Keywords: AI, development management, industry, brand strategy, internationalization of enterprises, artificial intelligence tools.

1. Introduction

Internationalization in management sciences is the so-called process of expansion into various markets, which is one of the most important and key factors for companies that want to develop, grow and remain in global markets. The strategy of building a competitive advantage in foreign markets opens up opportunities for companies, but also shows that there are still many challenges and dilemmas. One of the barriers may be technological progress, which is not always quickly implemented in the organization's activities. With the rapid technological development and the growing importance of artificial intelligence, companies can use AI tools that serve in the process of internationalization and efficient communication with international customers. Internationalization can be understood as the expansion of the firm's activities to international markets. It takes place between countries, regardless of whether the activities involve countries as a whole, branches, sectors, regions, companies, entrepreneurs or consumers (Gorynia, 2021). Companies internationalise for different reasons including

corporate growth, new market opportunities, internalisation as well as vertical integration (Törnroos, 2002). Many factors drive the internationalization process of companies, shaping their strategies and goals in global markets. Understanding these factors is crucial for companies that want to expand their operations beyond their domestic market. Companies start internationalization for a variety of reasons. Hollensen (2014) emphasizes the importance of two sets of motives: proactive and reactive. Proactive motives occur when a company decides to change its strategy because it wants to leverage its particular skills or take advantage of new opportunities in the market. Reactive motives, on the other hand, occur when a company reacts to pressures or problems in its home or foreign market and passively adapts its actions over time. In proactive motives, one of the most important is the desire to grow. The more a company is motivated to grow, the more it will do to grow, including actively seeking new opportunities to meet its growth and profit goals.

The presented article reviews the literature related to the use of AI tools in building strategic activities of the company, primarily with regard to communication with international customers. The choice of this specific research method allows for a broader view of research on artificial intelligence, especially in an international perspective, and drawing conclusions in predicting trends in new technologies and their development in the future. In this context, the research questions remain important:

1. How does artificial intelligence affect the building of communication with international customers?
2. What limitations and deficiencies may occur in the implementation of artificial intelligence tools in enterprises?

The dynamic impact of the internationalization process in today's conditions determines the revival of the economic, socio-political and cultural development of all countries (Nowakowski, 2005). At the same time, the main forms of internationalization ensuring further unification of the world are: increased international and investment trade, activation of transnational corporations and an increase in their influence on economic processes in the world economy, diversification of global financial and labor markets and increased competition. For over 200 years, internationalization has occurred in many sectors of the world economy, both production and non-production. The field of internationalization includes productive forces, production, exchange (in the development of international trade relations), transportation (in the system of international transportation systems), fuel and energy complexes, distribution (of capital, migration of labor), consumption (rational consumption of manufactured products by partner countries), information systems and management (combining the efforts of international economic entities in order to widely use experience in managing economic processes at the national and international levels) (Schumpeter, 1960, p. 348).

Strategic management involves developing and implementing plans that are consistent with the organization's goals and objectives. This process is continuous and evolves as the organization's goals and objectives change. An important aspect here is the implementation of

new technologies to maximize profits in the short term. Organizations practice strategic management to remain responsive to international trends and external changes, such as economic growth. Dess, Taylor, and Lumpkin (2004) indicate that it involves three continuous processes: analysis, decisions, and actions (Fig. 1). This includes analyzing strategic goals along with the organization's internal and external environment.

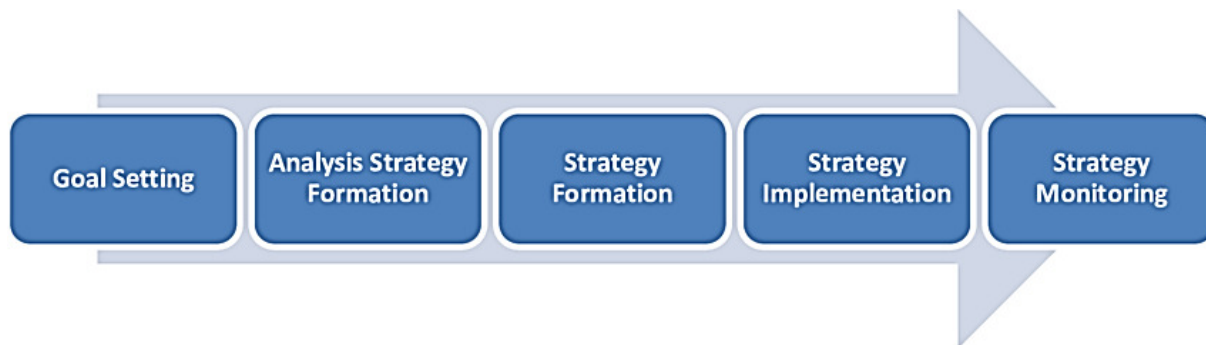


Figure 1. Key Concepts for Strategic Management Process according to Stevens.

Source: (Stevens, 2014, p.14).

Digital transformation and the use of artificial intelligence (AI)-based tools in communicating with international customers are topics intensively researched in scientific and industry literature. In this aspect, the new Uppsala model, which was developed due to rapidly changing market conditions, is not without significance. The model explains that due to increasing globalization and technological development, the form in which companies develop in new markets and build competitive advantages will also change (Vahlne, Johanson, 2020).

Success is not only experience and competences, but also the speed and ability to adapt to changing global conditions and the use and implementation of available technological tools in the company's operations.

2. Digital transformation and tools

Using modern digital tools like ChatGPT can significantly impact the quality of communication between companies and customers, both positively and negatively. Here are some aspects to consider:

Possibilities

1. Speed and availability

Tools like ChatGPT allow companies to respond to customer inquiries in real time, which significantly reduces the waiting time for an answer. AI automates many routine marketing tasks, like customer segmentation, email campaign management, and analyzing campaign results, saving time and resources.

2. Personalization

Thanks to advanced algorithms, these tools can analyze the history of customer interactions and adapt responses to individual needs and preferences, which builds more personalized relationships. AI helps create more personalized marketing campaigns by analyzing customer data. This allows companies to deliver content that matches individual preferences and behaviors.

3. Scalability

ChatGPT and similar technologies can handle many inquiries from different customers at the same time, allowing companies to effectively manage a large number of interactions without the need to hire additional staff. AI helps improve advertising campaigns in real time by adjusting strategies based on the analysis of results and user reactions.

4. Quality of answers

These tools can use a huge database, which allows them to provide precise and comprehensive answers to customer questions, even in complex matters. AI analyzes customer journeys, identifying key touchpoints and improving customer experiences at different stages of the buying journey

There are also barriers and challenges that are difficult for companies to implement AI tools.

Challenges and barriers

1. Lack of human touch

Automated responses can sometimes seem impersonal or unempathetic, which can lead to customer frustration, especially in more complicated or emotional situations.

2. Errors and imprecision

Despite the advanced technology, ChatGPT can sometimes provide incorrect or inadequate answers, which can affect customer trust in the company.

3. Dependence on technology

Too much reliance on digital tools can lead to the atrophy of interpersonal skills among employees and a weakening of the relationship between the company and the customer.

4. Data security issues

Storing and processing customer data by such tools is associated with the risk of violating privacy, which can lead to legal and reputational problems for the company.

The use of modern digital tools has the potential to significantly improve the quality of communication between companies and customers, offering fast, accessible and personalized support. However, to fully realize these opportunities, companies must also be aware of the challenges of automation and ensure that these technologies are used in a way that supports, rather than replaces, human connection and empathy. Digital transformation refers to the integration of digital technologies in all areas of a company's activity, which leads to fundamental changes in the way an organization operates and in delivering value to customers. The literature indicates that AI is one of the key elements of digital transformation, especially

in the context of communication with customers (Vial, 2019). Artificial intelligence in communication with customers is mainly used in the form of chatbots, virtual assistants and analytical tools that enable personalization and automation of interactions (Adamopoulou, Moussiades, 2020). Studies show that these tools can significantly improve the efficiency of communication, reducing response times and enabling customer service in different time zones (Kumar et al., 2019). AI-based tools can analyze large amounts of data, which allows for a better understanding of customer needs and adapting communication to their expectations (Davenport, Ronanki, 2018). On the other hand, the literature also highlights the challenges related to the lack of empathy and limited ability to deal with unusual situations (Huang, Rust, 2018). Communication with international customers brings challenges related to cultural and linguistic diversity. AI can help overcome language barriers, for example through automatic translations (Luo, Wiseman, 2021). However, the literature indicates that fully understanding the cultural context and linguistic subtleties is still a challenge for AI algorithms, which can lead to misunderstandings and reduced communication quality (Cui, Wu, 2017). Automation of communication with customers is a key factor, as AI brings many benefits, including reduced operating costs, increased service availability, and the ability to scale operations to international markets (Brynjolfsson, McAfee, 2017). AI tools also allow for better management of customer data, which leads to more precise market segmentation and better message targeting (Sharma, Sharma, 2020). Communication with customers, especially in global processes, is a significant factor for companies in the process of internationalization. The importance of AI activities is particularly visible in the advertising industry, where contact with the customer is direct and indispensable. The implementation of AI in companies, especially in the advertising industry, was driven by several key factors emphasized by industry professionals in Europe. The fact that AI can quickly generate new ideas and creative content, allowing agencies to explore more creative paths without the limitations of human capabilities alone, turned out to be important. Maintaining a competitive advantage, better efficiency, reducing costs and minimizing risk are also important (Fig. 2).

The advertising industry in Europe sees Gen AI as a transformative technology that enhances creativity, efficiency, personalization, and data-driven decision-making. As research continues to evolve, the benefits of Gen AI are likely to become even more pronounced, shaping the future of advertising strategies.

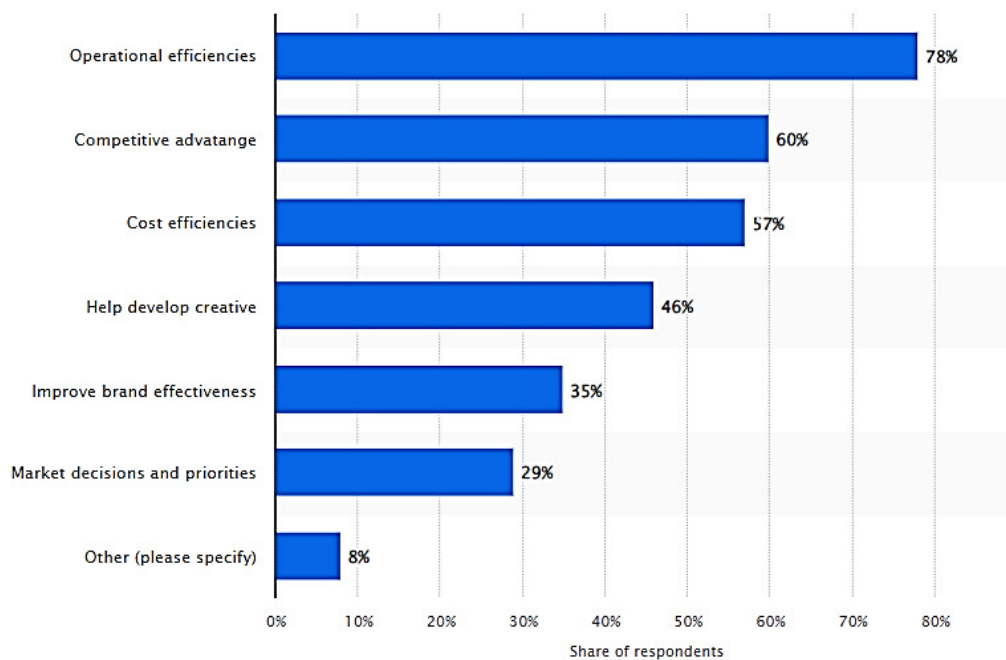


Figure 2. Reasons for generative artificial intelligence (gen AI) adoption by businesses according to advertising industry professionals in Europe as of February 2024.

Source: Statista, 2024.

While AI encompasses all technologies that simulate human intelligence, such as machine learning, pattern recognition, planning, and natural language processing, Generative AI focuses on creating new data (e.g. text, images, sounds) based on patterns learned from existing data. AI uses a variety of algorithms and models, such as regression, decision trees, neural networks, and Generative AI specifically uses generative models, such as GANs (Generative Adversarial Networks) and transformation models (e.g. GPT, BERT) (Russell, Norvig, 2016). In terms of applications, AI can be used for data analysis, process automation, classification, prediction, while Generative AI focuses on creating new content, such as generating text, images, music, and simulations (Bostrom, 2014). Generative AI is a specialized form of AI that focuses on creating new data and content, which has great importance in many fields. Considering the rapid technological growth, the implementation of individual tools is significant especially in such socio-economic areas as Sales of goods and services, Marketing, Finance, Supply chain management (process automation issues) and many others (Fig. 3).

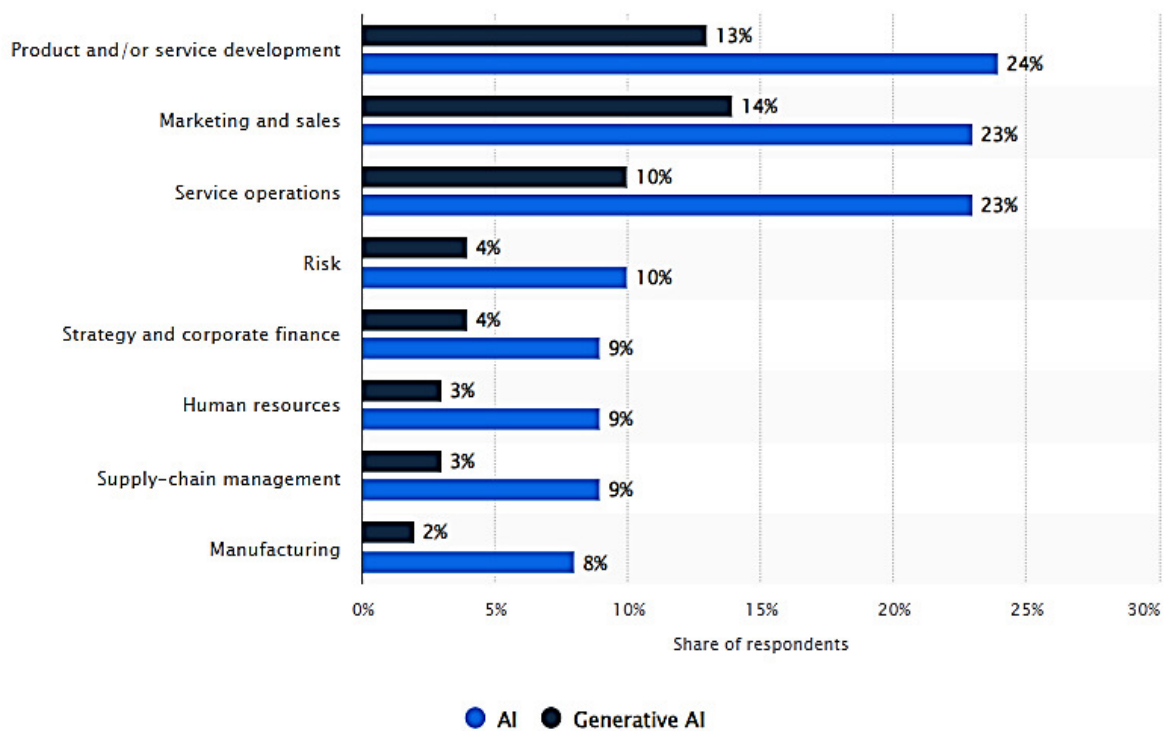


Figure 3. Artificial intelligence (AI) and generative AI adoption in businesses globally in 2023, by function.

Source: Statista, 2023.

3. Conclusion and discussion

The literature predicts further development and improvement of AI tools in the context of communication with customers. It is expected that future solutions will be even more integrated with everyday business processes, which will allow for even greater personalization and automation of communication (Wilson, Daugherty, 2018). Companies benefit from optimizing collaboration between humans and artificial intelligence. A survey of 1075 companies in 12 industries found that the more of these principles companies adopted, the better their AI initiatives performed in terms of speed, cost savings, revenues, or other operational measures (Fig. 4).

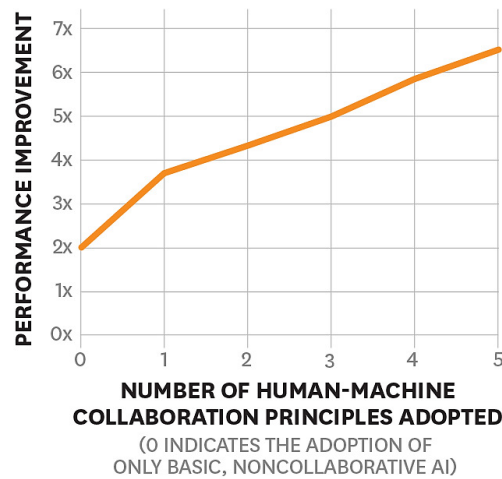


Figure 4. The Value of Collaboration.

Source: Wilson, Daugherty, 2018.

The presented literature review does not exhaust the topic of strategic challenges that companies implementing artificial intelligence face. After analyzing the presented research, it can be stated that artificial intelligence is one of the fastest growing trends in digital transformation, and the tools it offers allow for efficient, fast, effective and personalized communication with customers, especially in the international dimension. Additionally, it should be emphasized that barriers and limitations are an indispensable element of every transformation. In this aspect, opportunities should be sought to minimize risk, equipping especially management and employees with competences, knowledge and skills related to the use of new tools.

Integrating AI with internationalization processes is an extensive topic that shows both rapid technological progress (inevitable) as well as challenges and barriers that modern companies face. Companies themselves are looking for motivation and reasons to implement modern solutions related to artificial intelligence in their development strategies. However, it should be remembered that “Artificial intelligence can help scientists from various fields, from astronomy to genomics, analyze complex data, discover patterns, and conduct new research” (Kenchakkanavar, 2023, p. 223). However, the key aspect remains the topic of relationships and interactions with customers, because “there is a positive relationship between AI and customer experience” (Abu Daqar, 2019, p. 30). In terms of challenges and barriers, one of the main challenges when using AI-based tools in market research is confirming the quality of data. Data that is inaccurate, incomplete, or biased can lead to erroneous conclusions, negatively affecting business decisions. This is also mentioned by Soswa (2023), who states that data collected and provided by AI is not always accurate and reliable. The competences of managers and employees of the organization, which are related to the skills of managing and processing data obtained thanks to modern AI tools, are also important. Knowledge about the status of Polish companies in this area is still being updated and in further research will require a broader perspective not only related to the adaptation of entrepreneurs to new technological conditions, but also to the ability to manage these processes and their development in the long term.

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