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REDAKTOR NACZELNY – Dr hab. inż. Barbara KULESZ, prof. PŚ  
REDAKTOR DZIAŁU – Prof. dr hab. inż. Radosław WOLNIAK

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**WYDAWNICTWO POLITECHNIKI ŚLĄSKIEJ  
ul. Akademicka 5, 44-100 Gliwice  
tel. (32) 237-13-81, faks (32) 237-15-02  
[www.wydawnictwopolitechniki.pl](http://www.wydawnictwopolitechniki.pl)**

**Sprzedaż i Marketing  
tel. (32) 237-18-48  
[wydawnictwo\\_mark@polsl.pl](mailto:wydawnictwo_mark@polsl.pl)**

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## **FOREWORD**

Presented number of Silesian University of Technology. Scientific Papers. Organization and Management Series. Presented papers contain result of researches conducted by various universities. The number consists of 39 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about circular economy, commercialization, energy management, project management, quality management, safety management, eco-design, human resource management, marketing, ESG reporting, information management, sustainable development, economics, innovativeness, the use of Chat GPT, organizational culture, greenwashing, corporate social responsibility, and industry 4.0.

*Radosław Wolniak*



## A BIBLIOMETRIC ANALYSIS OF THE THEORY OF PLANNED BEHAVIOR IN THE CIRCULAR ECONOMY

Saleh Md ARMAN

Poznan University of Economics and Business; saleh.arman@phd.ue.poznan.pl, salehmd.arman@gmail.com,  
ORCID: 0000-0002-8970-7963

**Purpose:** Despite the increasing relevance of the Theory of Planned Behavior (TPB) in Circular Economy (CE) research, its application and related trends remain insufficiently explored. This study aims to systematically assess the use of TPB within CE literature, focusing on its evolution and identifying key research gaps.

**Design/methodology/approach:** Conducting a bibliometric review of Scopus data from 2016-2024, it examines metrics such as publication counts and citation trends, while employing science mapping techniques to uncover collaborative networks and thematic clusters

**Findings:** The findings reveal a growing interest in TPB's applications, especially in areas such as stakeholder relationships, waste management, and recycling practices.

**Research limitations/implications:** The study also highlights significant research gaps, particularly the need for more empirical investigations and the integration of theoretical, practical, social, and policy implications. Ultimately, this research enhances the understanding of TPB's role in promoting sustainable behaviors, offering a foundational framework for future research at the intersection of TPB and CE.

**Practical implications:** Organizations should promote environmental commitment, educate stakeholders on barriers to CE adoption, and integrate waste management strategies to advance collaborative efforts and position themselves as sustainable leaders.

**Social implications:** Policymakers and community initiatives are essential for promoting CE solutions by fostering sustainable practices through targeted incentives, public awareness, and education to drive environmental sustainability and community engagement.

**Originality/value:** The paper provides researchers with a clear overview and inspire future TPB-based studies in CE. The study used performance analysis to determine contributory journals and researchers and availed bibliometric science mapping tools and gap analysis to identify influential themes and highlighted emerging trends being considered.

**Keywords:** Bibliometric analysis, circular economy, consumer behavior, gap typology, theory of planned behavior.

**Category of the paper:** Literature review.

## 1. Introduction

The circular economy (CE) is an environmental management strategy that aims to minimize waste, conserve natural resources, ensure energy efficiency, benefit businesses and society with enhanced supply chain management systems, safeguard resource stability in the economy, and generate new job opportunities (Singh et al., 2018). CE stresses the cooperative and impactful relationships of human interactions in fostering sustainable business models in replacing traditional take-make-waste systems (Klimas, Ratajczak-Mrozek, 2024).

To understand how CE awareness interacts with sustainable behaviors influenced by external factors, the Theory of Planned Behavior (TPB) is a well-established framework as it helps predict and guide behavior while supporting social, economic, and environmental sustainability (Godinho Filho et al., 2024; Singh et al., 2018).

In this perspective, many studies use the original (Ajzen, 1991) and extended version of TPB, either combining with other theories (Godinho Filho et al., 2024) or considering additional variables (Moreno-Miranda, Dries, 2024), to make the behavioral explanation more meaningful and interactive (Singh et al., 2018).

As CE researchers increasingly utilize the TPB to predict behavior, assessing the evolution and current applications of TPB within CE research is vital for shaping future studies in different fields. However, how to determine the progress of the TPB's application and its current status in CE adoption needs to be clarified. Although interest in TPB and CE has led to a surge in scholarly literature, there is still a lack of academic summaries on their application. Most existing reviews focus separately on either TPB (Fauzi et al., 2024; Si et al., 2019) or CE (Rabbi, Amin, 2024; Razmjooei et al., 2024). No comprehensive review to date provides a state-of-the-art overview of TPB and CE, despite the significance of such retrospectives for understanding emerging research fields (Arman, Ahmed, 2021; Donthu et al., 2021). In this perspective, bibliometric analysis aids in understanding emerging fields by identifying research trends, mapping intellectual networks of topics and authors, and highlighting influential publications, allowing researchers to track the evolution of topics and recognize underexplored areas for initiating further study (Mukherjee et al., 2022). Prior studies on bibliometric analysis have focused on applying TPB to environment-related concepts such as pro-environmental behavior (Yuriev et al., 2020) and environmental science (Si et al., 2019). They found that this combination facilitates advancing theoretical progress and managerial decision making in resolving environmental problems. This finding determines that combining TPB with other environmental issues, such as CE, could unleash new avenues that helps to design environmental strategies in achieving sustainable solutions.

The study's objective is to examine publication trends, key academic contributors, and evolving research themes to gain insights and predict future developments of TPB based studies in CE. To achieve this the study conducted a bibliometric review identifying key themes

and foundational research areas of TPB applications in CE, offering a framework for future research exploration. The research questions, which are crucial for understanding the current state and future research directions of the field, are as follows.

RQ1: What are the most researched topics studied with the most significant frequency and are currently attracting the most attention in TPB framework for CE?

RQ2: What are the research gaps in the current literature?

RQ3: What are the key emerging research trends that could pave the way for unexplored avenues of inquiry in this field, ultimately advancing CE solutions?

The paper's novelty aims to provide researchers with a clear overview and inspire future TPB-based studies in CE. The study used performance analysis to determine contributory academic journals and impactful researchers. The study availed bibliometric science mapping tools to identify influential themes and highlighted emerging trends being considered. Based on the findings, the study located research gaps using Miles (2017) gap typology and suggested future research directions.

The chapters of this manuscript are as follows. Chapter 2 provides a literature overview of TPB and CE. Chapter 3 explains the research methods. Chapter 4 discusses the findings with research gaps, limitations and future research direction. The manuscript ends with a conclusion chapter.

## 2. An overview of the literature

Research on the CE is essential for promoting sustainable development at all levels by reducing waste, improving resource efficiency, and fostering business innovation (Godinho Filho et al., 2024). D'Amato et al. (2017) and Stegmann et al. (2020) emphasize the significance of public awareness and individual commitment to adopting sustainable practices in determining the CE effectiveness at the individual level. Similarly, Belmonte-Ureña et al. (2021) underscore the role of public engagement in achieving sustainable development goals, while Boesen et al. (2019) highlight how raising environmental awareness leads individuals to avoid behaviors harmful to the environment consciously.

In the TPB, an individual's intention is primarily influenced by three factors: attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC), each of which is rooted in specific belief structures: behavioral beliefs, normative beliefs, and control beliefs (Ajzen, 1991; Witek et al., 2023). ATT refers to an individual's evaluation of a specific behavior, SN reflects the perceived expectations of significant others regarding the behavior, and PBC denotes the perceived ease or difficulty of performing the behavior (Ajzen, 1991; Jia et al., 2024). The Theory of Planned Behavior (TPB) has been extensively validated as a robust

framework for predicting pro-environmental behaviors, such as recycling (Wang et al., 2019), green purchasing (Xu et al., 2020), and waste separation (Hu et al., 2021).

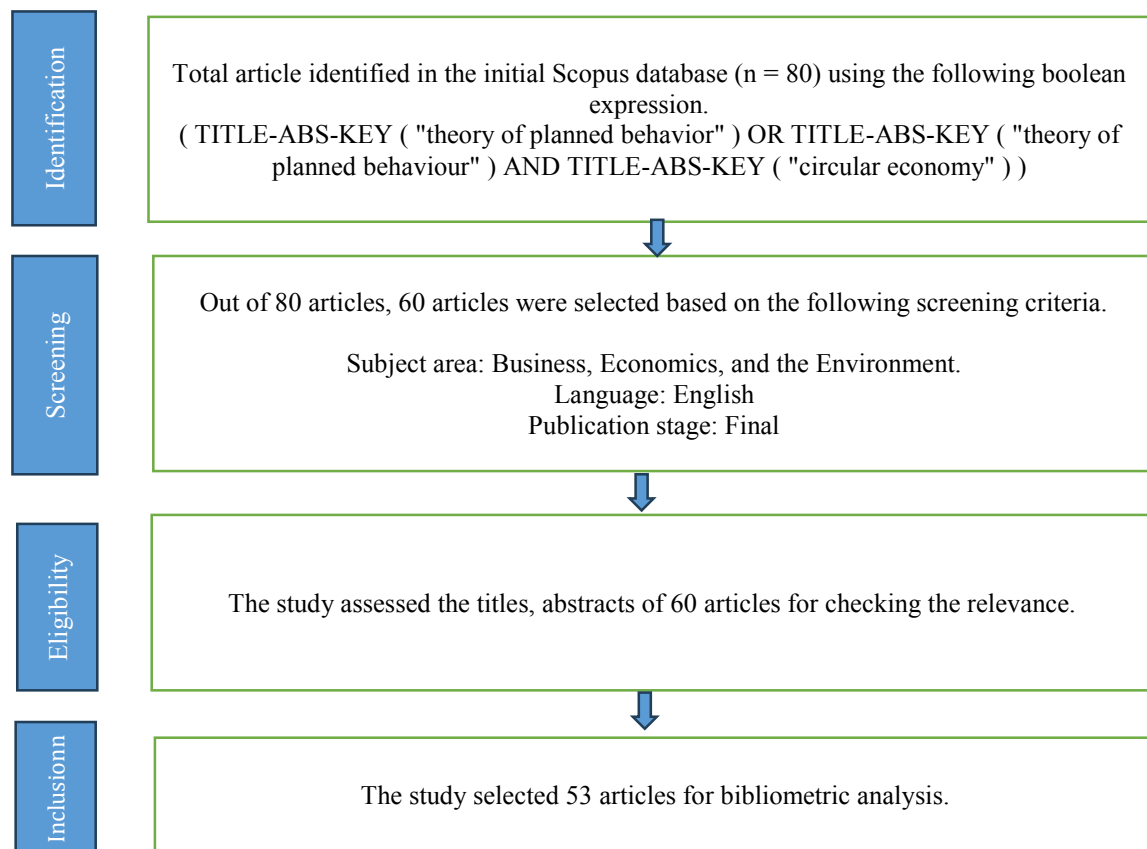
Using TPB in CE, Jia et al. (2024) noted that ATT positively influences on CE (Wang et al., 2019), though some report non-significant effects, such as in plastic return in Pakistan (Khan et al., 2019) and fast-fashion consumption in Italy (Cesarina Mason et al., 2022). Similarly, SN and PBC show mixed results, with SN being a key factor in some contexts, like Hong Kong and Beijing (Wan et al., 2012; Tong et al., 2023) while PBC generally has a positive effect on CE, though some studies found it non-significant (Aboelmaged, 2021). They (Jia et al., 2024) further noted that given the complexity of consumption behaviors in CE adoption, researchers propose that the TPB could provide stronger explanatory power when complemented by additional situational factors.

### **3. Research methods**

To achieve the aim, a systematic literature review is a suitable method for this study because it systematically analyzes existing research to uncover publication trends, identify key contributors, and highlight evolving themes, thereby providing a comprehensive understanding of the current state and future directions of TPB studies in CE (Mukherjee et al., 2022; Paul et al., 2021). The study opted for bibliometric analysis among the domain-based options because it provides qualitative and quantitative insights into a field's bibliometric and intellectual structure by examining the social and structural relationships between various research components (Donthu et al., 2021). For the bibliometric analysis, the study chose the Scopus database. Scopus is one of the largest and most comprehensive multidisciplinary databases of peer-reviewed literature, widely used by researchers from different fields, and is highly regarded for its credibility and effectiveness in conducting systematic reviews (Bosman et al., 2006; Jacob et al., 2024; Vieira, Gomes, 2009). The study avails PRISMA 2020 protocol for conducting the SLR (Page et al., 2021). The study presents the protocol in Figure 1.

In the identification stage, the study searched on Scopus using the TITLE-ABS-KEY command and found 60 documents ranging from 2016 to 2024 to 20th September 2024. Each selected record contained authors, country/regions, article title, year, source title, citation count, abstract, author keywords, index keywords, and references. In the screening stage, journals on business, economics, and the environment subject area were considered. Moreover, these articles were written in English and were in the final stage. In the eligibility stage, the study read abstracts for checking the relevance on the subject area and included 53 papers for bibliometric analysis.





**Figure 1.** PRISMA 2020 protocol of the study.

Source: Created by the author and adapted from Page et al. (2021).

Bibliometric analysis relies on two essential methods: performance analysis and science mapping. Performance analysis assesses the productivity and impact of research using metrics such as publication counts, citation rates, and top journals (Aria, Cuccurullo, 2017; Donthu et al., 2021). Science mapping, on the other hand, examines the intellectual relationships within a field through analyses like co-authorship, bibliographic coupling, and keyword co-occurrence (Donthu et al., 2021). In the co-occurrence analysis, the study used the following formula for assessing average publication year (APY).

$$APY = \frac{\sum(t_i * n_i)}{\sum t_i} \quad (1)$$

According to the formula, if a topic  $t$  appears in two articles ( $n = 2$ ) in 2020, three articles in 2021, and five articles in 2022, then its APY value is 2021.3

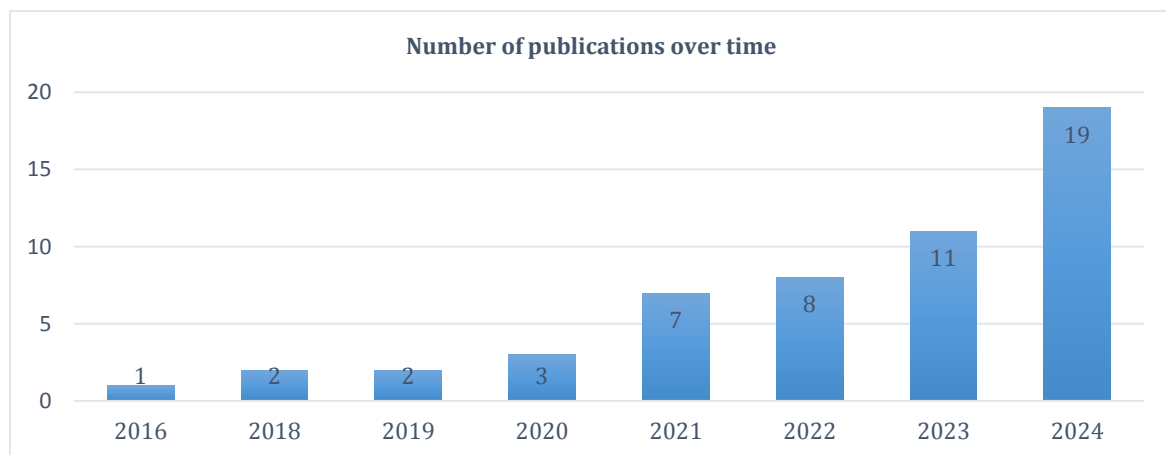
$$[(2 \times 2020) + (3 \times 2021) + (5 \times 2022)] / 10$$

The study utilized VOSviewer for science mapping to better understand research trends, collaboration networks, and thematic clusters. After that, Miles's (2017) gap typology was used to locate gaps in the prior literature, e.g., Arman & Mark-Herbert (2024). The gap typology contains the following gaps: (a) Evidence Gap; (b) Knowledge Gap; (c) Practical-Knowledge Conflict Gap; (d) Methodological Gap; (e) Empirical Gap; (f) Theoretical Gap and (g) Population Gap.

## 4. Results of the research

### 4.1. Performance analysis

The performance analysis offers insights into the development and distribution of using TPB in CE research by examining publication counts, citation numbers, leading publication sources, and the most highly cited works. In Figure 2, the upward publication trend suggests that using TPB in CE will attract growing interest from researchers, especially in determining the challenge of balancing financial, environmental, and social goals in business activities to maximize value.



**Figure 2.** Number of publications on TPB based CE research.

Source: Author's creation based on Scopus data.

Table 1 and 2 presents an overview of the top 5 source titles and highly cited papers on applying TPB in CE research. Two of the highly cited papers belong to the Journal of Cleaner Production, which also has the highest number of documents and citations.

**Table 1.**

*Overview of source title*

Source title based on number of published articles			
Title	Documents	Total citation	Average citation per document
Journal of Cleaner Production	10	557	55.7
Sustainability Switzerland	6	53	8.83
Resources Conservation and Recycling	5	396	79.2
Technological Forecasting and Social Change	2	53	26.5
Waste Management	2	31	15.5

Source: Author's creation based on Scopus data.

**Table 2.**  
*Highly cited papers*

Title	Authors	Source	Citation	Average citation per year
From the table to waste: an exploratory study on behaviour towards food waste of Spanish and Italian youths.	Mondéjar-Jiménez, J.-A., Ferrari, G., Secondi, L., Principato, L. (2016)	Journal of Cleaner Production	209	26.12
Green product attributes and green purchase behavior: a theory of planned behavior perspective with implications for circular economy	Sharma, A., Foropon, C. (2019)	Management Decision	151	30.2
Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs.	Singh, M.P., Chakraborty, A., Roy, M. (2018)	Resources, Conservation and Recycling	150	25
Construction and demolition waste recycling: investigating the role of theory of planned behavior, institutional pressures and environmental consciousness.	Jain, S., Singhal, S., Jain, N.K., Bhaskar, K. (2020)	Journal of Cleaner Production	115	28.75
Assessing the determinants of intentions and behaviors of organizations towards a circular economy for plastics.	Khan, O., Daddi, T., Slabbinck, H., Kleinhans, K., Vazquez-Brust, D., De Meester, S. (2020)	Resources, Conservation and Recycling	95	23.75

Source: Author's creation based on Scopus data.

#### 4.2. Science mapping

The science mapping analysis begins with a co-authorship analysis to explore the collaboration between researchers, measured by the number of jointly authored publications applying TPB to CE research (Bota-Avram, 2023). Table 3 lists the top authors from 53 documents, ranked by the total link strength of their co-authorship among the 201 authors.

**Table 3.**  
*Top 5 most collaborative authors*

Author name	Document	Citations	Total link strengths
Khan, Owais	3	114	8
Daddi, Tiberio	2	111	8
Tan	1	38	8
Li, Fan	1	38	8
Long, Weitong	1	38	8

Source: Author's creation based on Scopus data.

From the co-authorship analysis, significant contributions have emerged. Firstly, the decision makers take CE solutions irrespective of all types of organizations, as evidenced by the work of Khan et al. (2020). Secondly, their contributions have shown that CE solutions can enhance stakeholder relationships (Khan et al., 2023). Third, the collaborative efforts of the next three authors have examined the acceptance of manure management as a CE solution in

agro-economic systems, considering user intention alongside TPB constructs, as well as education, experience, and identity (Tan et al., 2021).

Bibliographic coupling encapsulates the thematic cluster based on seminal, niche, and recent knowledge in TPB applications in CE research. The study derived three research clusters.

**Table 4.**  
*Research themes based on bibliographic coupling*

Theme	Authors	Title	Total citations
CE intention	Mondéjar-Jiménez et al. (2016)	From the table to waste: An exploratory study on behaviour towards food waste of Spanish and Italian youths.	209
	Sharma, A., Foropon, C. (2019)	Green product attributes and green purchase behavior: A theory of planned behavior perspective with implications for circular economy.	151
	Jain et al. (2020)	Construction and demolition waste recycling: Investigating the role of theory of planned behavior, institutional pressures and environmental consciousness.	115
Acceptance of Ce solutions	Singh et al. (2018)	Developing an extended theory of planned behavior model to explore circular economy readiness in manufacturing MSMEs, India.	150
	Khan et al. (2020)	Assessing the determinants of intentions and behaviors of organizations towards a circular economy for plastics.	95
	Ignacio et al. (2019)	A Perception Study of an Integrated Water System Project in a Water Scarce Community in the Philippines.	18
Recycling	Tong et al. (2018)	Behaviour change in post-consumer recycling: Applying agent-based modelling in social experiment.	63
	Koshta et al. (2022)	Sharing economic responsibility: Assessing end user's willingness to support E-waste reverse logistics for circular economy.	49
	Ding et al. (2023)	Determinants of contractor's construction and demolition waste recycling intention in China: Integrating theory of planned behavior and norm activation model.	26

Source: Author's creation based on Scopus data.

The first thematic cluster (24 articles) explores how intentions are formed for adopting CE solutions. Mondéjar-Jiménez et al. (2016) found that marketing and sales strategies negatively impact behavior towards waste management by shaping habits, attitudes, and food waste intentions, with moral attitudes and PBC being key drivers. Sharma and Foropon (2019) examined how product attributes, environmental knowledge, and perceived consumer effectiveness shape green purchase intentions for CE solutions. Jain et al. (2020) highlighted institutional pressures and environmental awareness as critical factors in building waste recycling intentions and stressing the need for government-industry collaboration.

The second cluster (18 articles) highlights critical CE solutions tied to behavioral intentions. Singh et al. (2018) found that environmental commitment and green incentives enhance CE readiness in Indian MSMEs. Khan et al. (2020) identified barriers (e.g., lack of recycling and transport facilities, lack of fund, lack of skilled human resources and so on) that prevent Belgian organizations from fully implementing plastic recycling practices despite positive intentions. Ignacio et al. (2019) showed that positive attitudes on CE solutions can significantly boost consumer intentions to adopt integrated water systems in the Philippines.



Khan et al. (2020) suggested about social pressure and enablers (e.g., government initiative and industry competitors) can reduce the barriers. Recently, specific topics in CE, such as reusing electronic products to address e-waste (Walzberg et al., 2022) for promoting second-hand product usage (Arman & Mark-Herbert, 2022), have gained attention. Additionally, changes in business supply chains, particularly through consumer engagement to ensure circularity with a focus on reverse logistics (Fiori et al., 2023), have emerged as promising areas, as indicated in the yellow zone of the graph.

## 5. Discussion

According to Mukherjee et al. (2022), bibliometric analysis facilitates gap analysis in the literature and make suggestions for future research. Based on the analysis, the following research gaps are identified per Miles' (2017) gap typology. The population gap highlights a lack of studies focusing on diverse populations adopting CE solutions, particularly in developing regions (e.g., Bangladesh (Arman, Mark-Herbert, 2021; Islam et al., 2023), India (Baral et al., 2023)) where socio-economic factors significantly influence behavioral intentions. The evidence gap indicates that empirical research surrounding the impact of environmental commitment on stakeholder relationships in various organizational contexts, for example, manufacturing industry in India (Singh et al., 2018), remains underexplored, necessitating further investigation into how these relationships are fostered in practice. The knowledge gap points to the insufficient understanding of how user intentions, influenced by TPB constructs, vary across different demographic groups in the context of CE practices. The practical knowledge gap emphasizes the need for effective educational initiatives to overcome barriers to CE adoption, especially in small and medium-sized enterprises (SMEs). The methodology gap reveals that many existing studies primarily employ quantitative methods, e.g., structural equation modelling, suggesting an opportunity to deploy mixed-method systematic approaches to measure CE solutions' effectiveness. The empirical gap underscores the limited research on the role of social norms and perceived behavioral control in promoting recycling practices, particularly concerning specific waste streams like e-waste (Koshta et al., 2022) and plastics (Khan et al., 2020). Finally, the theoretical gap suggests that the interplay between TPB and other theoretical frameworks, such as the Norm Activation Model (Ding et al., 2023), is not adequately addressed, highlighting the need for integrated theoretical models to enhance understanding.

Based on the gap analysis from the bibliometric analysis, the study recommends several future research directions along with their managerial, policy, and social implications. The findings explore the interplay between population dynamics and the TPB within CE contexts, particularly how varying demographic factors influence behavioral intentions

toward CE adoption. This integrated TPB approach could provide a more comprehensive understanding of the factors influencing adopting CE solutions, enabling scholars to develop multifaceted models that reflect the complexities of human behavior in the context of sustainability. Additionally, the lack of empirical evidence regarding the effectiveness of specific CE practices, such as plastic recycling and e-waste management, indicates a pressing need for research to bridge this knowledge gap. Furthermore, theoretical frameworks should be expanded to incorporate the evolving landscape of sustainability challenges, enriching the discourse on behavioral intentions and CE adoption.

Decision-makers should cultivate an organizational culture that emphasizes environmental commitment, as this has been shown to enhance stakeholder relationships and facilitate the adoption of CE solutions. Managers are encouraged to implement targeted educational initiatives that address existing barriers to CE adoption, thereby empowering stakeholders and promoting collaborative efforts. It's crucial that organizations align their strategies with emerging trends in waste management, such as reverse logistics, to not only improve operational efficiency but also position themselves as leaders in sustainable innovation. This collective effort is key to promoting CE solutions.

Policymakers play a pivotal role in fostering the adoption of Circular Economy solutions, especially in developing regions where socio-economic factors significantly influence behavioral intentions. Targeted support mechanisms and incentive structures must be created to facilitate the transition to CE and encourage organizations to adopt sustainable practices. To successfully adapt CE solutions, the government should actively implement educational and training programs, fostering a positive mindset and commitment in this area.

Community awareness campaigns are essential for raising consciousness about the importance of CE practices and how individual behaviors contribute to environmental sustainability. By educating the public and promoting positive social norms around recycling and sustainable practices, communities can foster a culture of sustainability and enhance engagement in CE initiatives.

The study acknowledges the limitation of opting the Scopus database only which is believe to initiate future research on considering multiple databases. The study also accepts the significance of adopting a hybrid approach, for instance combined with thematic analysis, to explore the detailed research avenues on TPB applications in CE.

## **6. Conclusions**

This study highlights the critical intersections between the TPB and CE, identifying key trends, influential publications, and emerging research gaps. By providing a comprehensive bibliometric analysis, the research not only elucidates the current state of knowledge but also

offers valuable insights for future inquiries into sustainable behaviors and practices. Ultimately, this work lays a foundation for advancing both theoretical understanding and practical applications of CE initiatives, inspiring future sustainability practices.

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## SOCIAL HOUSING IN VIENNA AS A POSSIBLE DIRECTION OF CHANGES IN THE SOCIAL HOUSING SECTOR IN POLAND

Jonasz BŁASZCZYK<sup>1</sup>, Piotr BARTKOWIAK<sup>2\*</sup>

<sup>1</sup> Department of Investment and Real Estate, Poznań University of Economics and Business;  
jonasz.blaszczyk@ue.poznan.pl, ORCID: 0009-0006-7336-216X

<sup>2</sup> Department of Investment and Real Estate, Poznań University of Economics and Business;  
piotr.bartkowiak@ue.poznan.pl, ORCID: 0000-0001-9678-3465

\* Correspondence author

**Introduction:** In recent years, a weak interest in this segment a of the property market has been noticeable among social housing providers. The demand from practice and the existing gap in the Polish literature create a wide field for scientific research of a cognitive and applied nature. Considerations and research in the field of investing in social housing are justified, among others, by the fact that the validity of investing in the social housing market has already been confirmed in highly developed countries, for example in Austria. In Poland, however, this segment is still in the growth phase. Therefore, the potential of the housing and financial markets has not been fully exploited yet. A review of foreign experiences in creating a housing offer for social housing, as well as a detailed analysis of model and innovative solutions, will allow the identification of key success factors for this type of investment project.

**Aim of the paper:** The aim of the work is to present the Viennese model of social construction and housing, its role in the functional and spatial structure of the city, the administrative and organizational environment, and to assess the housing conditions and quality of life that this model offers.

**Materials and methods:** The article uses a structured literature review of social housing, including those from publications of the Statistisches Jahrbuch der Stadt Wien. The study has an overview character.

**Results and conclusions:** The city of Vienna, as a model example of social housing with specific conditions that are difficult to find in other cities and being a city-land that can create its own tax policy, which largely financed social housing, has created a unique ability to meet housing needs through appropriate activities of organizational and administrative structures. and units responsible for construction and social housing management. The Vienna model is not fully adaptable to Polish conditions, due to differences resulting from administrative, legal and financial regulations, as well as a different model of approach to social housing in Austria and Poland (in Austria it is addressed to every citizen, in Poland only to the people).

**Keywords:** social housing, Vienna social housing market, local housing market, housing demand.

**Category of the paper:** research paper.

## Introduction

Social and municipal housing<sup>1</sup> is still an insufficiently researched segment of the real estate market in Poland. Unlike developed Western countries, this segment in Poland is characterized by little diversity in the available forms of residence. In recent years, there has been little interest in this segment among real estate investors. The demand from practice and the existing gap in the Polish literature create a wide field for scientific research of a cognitive and applied nature.

Considerations and research in the field of investing in social housing are justified, among others, by the fact that the validity of investing in the social housing market has already been confirmed in highly developed countries, for example in Austria. In Poland, however, this segment is still in the growth phase. Therefore, the potential of the housing and financial markets has not been fully exploited yet. A review of experiences from other European countries in creating a housing offer for social housing, examples of positive and negative phenomena as well as the history of the development of social housing in their area over the years after World War II based on literature research, as well as a detailed analysis of model and innovative solutions, will allow the identification of key success factors for this type of investment projects. It should be remembered that each country must find its own way of solving the housing issue in this segment, as its conditions are strongly correlated with a given culture, economic situation, size and age of the existing housing resources, as well as the directions resulting from the state's housing policy and implementation of its own tasks by the basic unit of local government - the commune.

The aim of the work is to present the Viennese model of social construction and housing, its role in the functional and spatial structure of the city, the administrative and organizational environment, and to assess the housing conditions and quality of life that this model offers.

In the face of the growing importance of social housing in the debate on housing in Poland, presenting the strengths and weaknesses of social housing in Vienna may help to avoid potential mistakes in the implementation of this type of housing in Polish cities. The essence of this segment of construction and maintaining its high level is subject to the guarantee of housing security for people in worse circumstances by maintaining low rental prices. In Poland, the share of such construction is still very low (Muzioł-Węclawowicz, 2018), which prevents city and municipal authorities from influencing rental prices and, consequently, the quality and cost of living of residents.

Presenting the development of social housing in Vienna over the years and its origins will highlight the various concepts of city development and social housing that dominated at a given time and will show which of these models is the most effective.

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<sup>1</sup> In Poland, this type of housing constitutes the housing stock of a commune and may be intended for residents registered in this commune, however: social - for people with low income; municipal – for various social groups.



## Investigating changes in preferences in the local housing market. Methodological assumptions

An important stage in the preparation of the article was desk research, primarily literature, which concerned the conditions of Viennese social housing. The method of field research on the inventory of selected housing units of social housing was also used to prepare the material. The inventory consisted of locating services, transport hubs and public spaces in the selected area and within a distance of 200 meters from the housing units. To supplement the field inventory, data from the city's geographic information system: *The City of Vienna Geographical Information System (ViennaGIS; <https://www.wien.gv.at/stadtplan/>)*, were used and processed.

The time scope of the work is October 1, 2023 to July 31, 2024, while the spatial scope includes the city of Vienna. Based on data from the Austrian Statistical Office from 2024, the city of Vienna had a population of 2,006,134 people, which makes it the fifth largest city in the European Union. Its area is 414.82 km<sup>2</sup>. According to a study conducted by the Economist Intelligence Unit, Vienna was named the best city in the world in 2024 for the third time in a row. The choice of Vienna as the object of research is due to its great achievements in the field of social housing (hence the mention of the "Vienna model" - Giecewicz, 2008; Hardy, 1934; Förster, Menking, 2024).

The research on social housing in Vienna used data from the *Wiener Wohnen* organization's database regarding the number of social housings in given districts. For the data obtained, the density rate per 1000 inhabitants was calculated for each district (Table 1).

**Table 1.**

*Number of social housings in Vienna in relation to the number of inhabitants (as at the end of 2023)*

District name	Number of social housing units	Number of social housing units per 1000 inhabitants
Innere Stadt	320	19,25
Leopoldstadt	10.759	99,37
Landstrasse	9.372	96,86
Wieden	1.758	52,27
Margareten	5.923	107,66
Mariahilf	1.558	49,58
Neubau	555	17,57
Josefstadt	536	21,72
Alsergrund	1.943	46,04
Favoriten	28.322	129,67
Simmering	16.079	147,46
Meidling	14.159	141,19
Hietzing	4.548	81,85
Penzing	9.253	95,56
Rudolfsheim-Fünfhaus	7.302	95,94
Ottakring	10.133	98,91
Hernals	4.309	76,90
Währing	2.997	58,13
Döbling	10.093	133,65

Cont. table 1.

Brigittenau	12.653	147,66
Floridsdorf	25.614	139,28
Donaustadt	21.056	99,01
Liesing	12.095	102,60
<b>Vienna</b>	<b>211.005</b>	<b>106,46</b>

Source: own study based on data from Wiener Wohnen and Statistika (2024).

Based on calculations, it can be concluded that on average in Vienna there are 106.46 social apartments per 1000 inhabitants. The largest number of this type of premises is in the Brigittenau and Simmering districts - over 147.

## The concept and features of social housing

An important element in defining the term social housing is presenting the meaning of the term public housing.

The UNECE (2015) document on social housing indicates that in many countries, including Poland, Austria and the Netherlands, there is no official definition of social housing, and in countries such as Estonia, Norway or Germany there is no definition of this type of housing, and in France, no definition was unanimously adopted. The CECODHAS-Housing Europe (2010) document emphasizes that it is difficult to provide a clear official definition of social housing due to the existence of many different forms of "off-market" housing.

In the English-language literature, the term Social Housing is presented, for example, in the publication by Donner (2000). However, researchers emphasize that there is no single definition based on which its features can be indicated, including the below-market rent (Scanlon, Whitehead, 2014). Definitions may, however, vary depending on the country in which social housing is located and refer to the ownership of such housing (usually non-profit organizations and local governments - for example the Netherlands or Sweden) or who built such housing (for example Austria and France), or whether the rent is below the market price (Ireland and England), or what is the source of financing and the purpose of the apartments (Scanlon, Whitehead, 2014). According to the definition presented by Donner (2000), social housing includes housing financed from public funds as well as housing with moderate profit. In some cases, a segment of private rental housing may also be considered social housing, provided that public intervention reduces rents or keeps them below market rents. Therefore, social housing should meet the following conditions: financial outlays should include a limited profit or be partially covered by public or private funds, the price for rent or ownership apartment should be below the market level and their subsidization should have a positive impact on the availability of housing for people with low income (Donner, 2000).

An important issue that should be emphasized is the fact that both public and private developers can make a profit in both market-based and social housing (Housing Finance, 1998).

In Vienna, social housing is divided into two subgroups: social housing run by the city (German: *Gemeindebau*) and social housing run by non-profit organizations (Kadi, 2022). Both of these subgroups correspond to the criterion of social housing proposed by H. Ruonavaara (2017), who defined social housing as housing that is not only driven by demand and supply, but is determined by rigidly adopted rules, favoring applicants due to urgent housing needs and striving to provide housing at a price lower than the market price.

In the case of the concept of *Gemeindebau*, which is an Austrian-German concept literally translated meaning construction/community building, it usually refers to buildings constructed by a municipality in Austria, especially in Vienna, to provide municipal housing (Kuhnert, 2017).

The Viennese or, more broadly, Austrian, model of providing social housing is characterized by a close link between housing subsidies and the activities of non-profit construction organizations (also referred to as non-profit developers), whose activities are subject to the Act on non-profit organizations engaged in housing construction<sup>2</sup>. Organizations of this type are responsible for approximately 200,000 additional social housing in Vienna, receiving tax benefits in the field of corporate income tax, commercial tax, real estate tax, property transfer tax in the framework of non-profit housing and are privileged recipients of housing subsidies. Under the Act on Non-Profit Housing Organizations<sup>3</sup>, these organizations must provide favorable rental prices even after the expiry of housing subsidy obligations (Kuhnert, 2017; Ludwig, 2017). According to Schipper's (2018) definition, such organizations must ensure that they operate in a non-profit-making manner by providing housing to households that are below certain limits.

Another important definition is the concept of subsidized housing, which is presented in the Vienna Act on the promotion of housing construction and renovation of residential buildings<sup>4</sup>. According to this act, subsidized housing is housing in which the loan from the federal state (German: *Bundesland*) has not been written off or repaid in full, subsidies for it have not been suspended, and 40 years have not passed since the granting of the non-repayable contribution or 20 years have passed since the granting of the subsidy. for construction or until they have been fully repaid. Subsidies within the meaning of this Act may take the form of granting promotional loans from the Land (federal state of Austria), granting construction costs, rent and interest subsidies, granting non-repayable contributions or granting substitute loans.

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<sup>2</sup> Bundesgesetz vom 8. März 1979 über die Gemeinnützigkeit im Wohnungswesen (Wohnungsgemeinnützigkeitsgesetz – WGG)

<sup>3</sup> Bundesgesetz vom 8. März 1979 über die Gemeinnützigkeit im Wohnungswesen (Wohnungsgemeinnützigkeitsgesetz – WGG)

<sup>4</sup> Gesetz über die Förderung des Wohnungsneubaus und der Wohnhaussanierung und die Gewährung von Wohnbeihilfe (Wiener Wohnbauförderungs- und Wohnhaussanierungsgesetz – WWFSG 1989)

According to Cesarski (2013), it is housing that operates within the framework of housing policy, usually covering the sector subsidized (supported) by the state, local government or other public finance sector. Its main features include, among others, the dominance of rental apartments (rents with a lower value than market prices) and the possibility of establishing preferences in the area of availability of apartments for less affluent households or households at risk of exclusion (Przymeński, 2021). The function of such housing is to provide lower standards housing for poor people (Rataj, 2017).

In the model of the socio-liberal economic system in force in Poland, there are two opposing models of the state's housing economy - universal and selective. In the universal model, the state should create opportunities to rent social housing without introducing access criteria based on income, and such housing should be built with the support of public funds and rented at affordable prices, without profit for the owners (Lis, 2018). The selective model, which was implemented in Poland in a broad version until 2016, consisted in providing support from public funds to a selected group of people, for example, based on specific criteria or general social interest - young families, or finally people with higher incomes who have creditworthiness. In the selective model, narrow support was provided to a smaller group of people - with low or very low income and people at risk of social exclusion (Lis, 2018). Examples of the application of the narrow selective model are countries such as the Netherlands and England (Scanlon, Whitehead 2014). According to Lis (2018), the selective model is preferred by European Union institutions, including: the European Commission, which seeks to impose it on the EU countries.

According to Przymeński (2021), the function of social housing is to create conditions for housing demarginalization of people who are unable to provide it for themselves with their own resources, including homeless people able to function independently, and the instrument responsible for this is renting apartments on social conditions. In this definition it is also pointed out that this type of housing creates social, economic, architectural and urban phenomena and problems.

Social housing, according to Polish terminology, is mostly considered to be the social housing sector, which differs from the rest of the sector in terms of lower rents, replacement value of apartments and lower standard. The costs of social rent are partially covered by the commune's budget, which subsidizes the amount of social rent set at half of the lowest rent in municipal resources up to the full rental price (Article 23, consolidated text: Journal of Laws of 2023, item 725). The non-social social housing sector includes, among others, apartments made available to residents with the ability to rent, for an indefinite period of time, covering the entire rental cost. Another example of social housing was (until 2021 - Journal of Laws 2021, item 11) the TBS system (Communal Building Society), which requires participation in the costs of housing construction. It was replaced in 2021 by the SIM system (Social Housing Initiative).

Since the introduction of changes to the Act on the Protection of Tenants' Rights of April 21, 2019, Polish law applies social rent to households with very low income, and indefinite-term lease to people whose wealth can be described as low. In the case of both of these forms of lease, the rent must be lower than market prices and may be additionally reduced if the household income is lower than the level specified in the municipal resolution (Article 7.1, consolidated text: Journal of Laws of 2023, item 725).

To sum up, it should be stated that it is not possible to establish a unanimous international definition of social housing, which results from the diversity of housing markets in specific countries and historical, cultural and political circumstances (UNECE, 2015).

## **Social housing in the context of city development**

The oldest example of construction that can be described as social housing, existing to this day, is the *Fuggerei* estate in Augsburg, Germany, founded in 1521 and funded by J. Fugger, a merchant and banker. The walled estate was and is an enclave with its own streets, squares and church, which allowed residents to work in their place of residence (Giovanazzi, 2023; Zadworny, 2019). Another example of a housing estate intended for the poorest inhabitants was the *Hopital-General* housing estate in Geneva, which differed from *Fuggerei* in that it accepted all people in need (*Fuggerei* only Catholics) (Kingdon, 1971).

Modern social housing comes from the times of the industrial revolution, when in England, after media reports about terrible living conditions in workers' estates and diseases developing there, philanthropists and factory owners began to build tenement houses and housing estates for their employees, such as *Saltaire* from 1853 and *Port Sunlight* of 1888 (Rowan, 2003). These housing estates were designed under the influence of the then new concepts of city development.

The world's first large-scale housing project was an estate built on the site of the former *Old Nichol* slum (London, UK). The estate's design included 1069 two- and three-room apartments with a communal laundry, shops and 77 workshops, intended to become a place of residence for the working class (Greater London Council, 1975; Baker, 1998).

After World War II there was an increase in the active role of governments in the sphere of housing had a significant impact on the development of social housing in Western European countries after World War II. This period in Europe can be divided into three phases, which are described separately for each country in this paper (Scanlon, Whitehead, 2014):

- "reconstruction" (1946-1960), which was intended to reduce the effects of losses and shortages in housing caused by World War II - mainly mass construction,
- the "rise of diversity" (1960-1975), during which the main focus was on housing quality and urban revitalization, and divergences began to emerge in how governments

responded to housing policies related to the economic prosperity of the 1960s and the elimination of the housing shortage associated with World War II, at that time, apart from social housing, issues of housing ownership were important in political programs,

- the "new housing reality" (1975-1990), in which beliefs about the importance of the state's role in providing housing changed, and this was related to the changing economic context, when during this period most countries reduced spending on housing municipal, and housing has become more competitive and market-oriented.

The dynamics in the development of social housing could be noticed after 1945, especially in France, where there was an increased supply of social housing due to the large number of homeless people and living in poor conditions. In the 1960s, social housing was aimed at middle-class people at the beginning of their residence, and in the 1980s, as a result of initiatives towards housing ownership, social housing in France became the place of residence for the majority of less wealthy people (Levy-Vroelant, 2007). Such housing estates were built mainly in newly founded cities (French: *villes nouvelles*) or in suburbs where low-rent apartments were located (*Habitation à Loyer Modéré*), often in huge housing complexes.

A big problem for this type of construction currently in France is the increase in socio-spatial segregation. The least affluent citizens using social housing live in socio-economically disadvantaged neighborhoods, while social tenants with higher incomes live in neighborhoods where a quarter of households are made up of people in managerial positions or people running their own businesses (Levy-Vroelant, 2007). Moreover, most immigrants in the municipal sector (70% compared to 55% for the entire social sector) lived in housing estates built between 1949 and 1974. A big problem for such people was leaving social housing due to the large difference in rents between social and private housing. In 2000, the *SRU Act* (12-13) was introduced, which imposed on the mayors of cities with a population of over 5,000 residents are obliged to have at least 20% of the total number of apartments in social housing. Currently, there are two types of organizations building social housing in France (*Habitation à Loyer Modéré*) - public bodies financed by local authorities and non-profit housing construction organizations.

In turn, social housing in Germany has historically been based on subsidizing private enterprises by the public sector in order to build new social housing or revitalize existing housing estates. The legal basis for social housing was Act II<sup>5</sup>, introduced in the 1950s in Germany. *Wohnungsgesetz*, the aim of which was to create housing that was accessible to a wide group of recipients in terms of its size, equipment and rent level. In turn, in the GDR, social housing was concentrated in the hands of the state sector, which carried out mass construction called *Plattenbau*. However, 1/4 of all apartments throughout the country were run by local government administration (Droste, Knorr-Siedow, 2014) in the form of rental apartments, and 25% were run by workers' cooperatives. After the reunification of Germany,

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<sup>5</sup> Zweites Wohnungsbaugesetz (Wohnungsbau- und Familienheimgesetz - II. WoBauG)

a large part of the estates from the GDR period were abandoned by better-off residents, replaced by older and less wealthy people.

Social housing in Denmark since the 1940s has focused on small, centrally located housing estates. In the 1960s, estates of high-rise apartment blocks began to be built in the suburbs, which are now often plagued by social problems. The majority of Denmark's social housing sector consists of approximately 700 non-profit organizations that manage housing estates with a total of 511,000 homes. apartments (20% of Denmark's total housing stock). The public sector consists of only 2% of the total housing stock, however, since 1994, local government units have had to approve the construction of new social housing estates in their area (Scanlon, 2014).

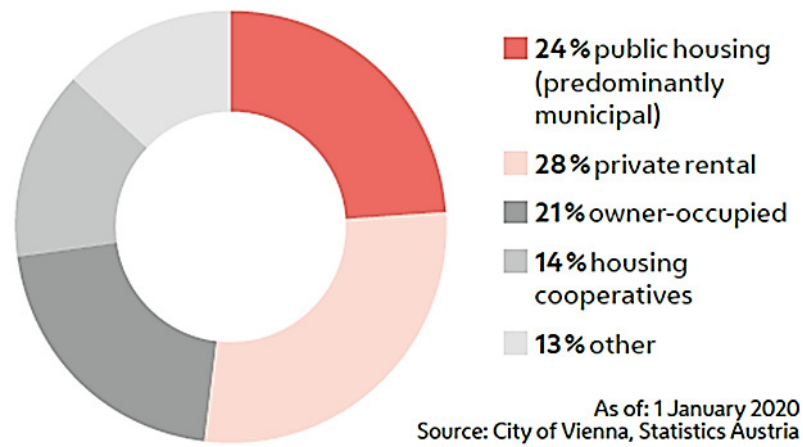
Since the 1990s, voices have been raised about increasing ethnic segregation, as nearly half of immigrants and refugees in Denmark live in public housing (Boligministeriet, 1996), a disproportionate percentage of them live in the oldest housing estates of the public sector and in the most vulnerable neighborhoods. Between 1984 and 1993, the percentage of immigrants living in the most problematic neighborhoods tripled (Hummelgaard et al., 1997). The Danish social housing market, unlike the markets in some European countries such as England, increased from 1996 to 2006 from 19% to 21% of the total number of inhabited apartments in the country (Scanlon, 2007).

## **Social housing in Vienna**

Social housing in Vienna is considered a model way of developing social housing. This is due to the comprehensive approach to the topic and early systemic solutions, which was the program proposed at the turn of the 1920s, during the so-called "Red Vienna", which, in addition to the construction of social housing itself, also ensured the creation of a network of social, cultural, pedagogical activities and medical clinics, improving the quality of life of residents, including the previously neglected working class. Access to basic services thanks to the placement of service premises in social buildings is implemented in this type of construction in Vienna to this day, updating the needs to current conditions, supplementing the residential development with office spaces and apartments with sliding walls allowing to adjust the size of rooms and entire apartments depending on the needs. family size or other needs.

In 2020, 24% of Vienna's inhabitants lived in public housing - mainly social housing (Figure 1). Non-profit construction organizations have been mainly responsible for the growth of the social sector in recent years, with the sector growing by 75% between 2001 and 2020. The housing stock of social housing has a different distribution in Vienna and throughout Austria. When it comes to local government ownership, in Vienna 26% of the total housing stock is owned by local governments, while in Austria as a whole it is 10%. If this is related to the housing stock, social housing in Vienna is 48%, and in the rest of Austria it is 25%

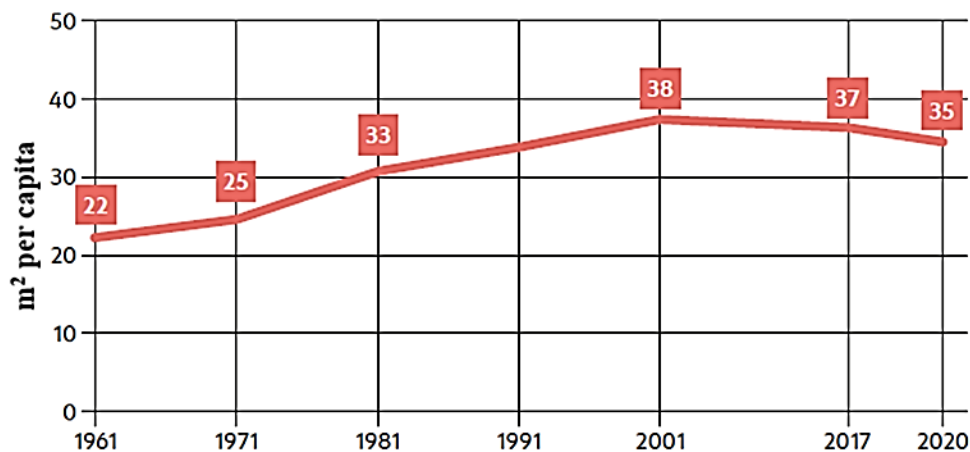
(Reinprecht, 2007). The privatization of the state housing stock since 2000 did not result in a decline in the number of social housing units in Vienna, as they constituted a small percentage of this type of housing.



**Figure 1.** Percentage breakdown of the housing market in Vienna in terms of ownership in 2020.

Source: Der Wiener Gemeindebau. Geschichte, Daten, Fakten, Stadt Wien – Wiener Wohnen, 2021.

In Austria in 2020, the rate of residents owning a flat was one of the lowest in Europe and amounted to 48.8%. In Vienna itself, this rate increased from 17.5% to 21% during the period under study. However, the average apartment area per person in residential buildings in Vienna was 35m<sup>2</sup> and compared to 2001 it decreased by 3m<sup>2</sup> (Figure 2).



**Figure 2.** Average living space per person in Vienna in 1961-2020.

Source: Bauer, Fendt, 2023.



## Summary

The city of Vienna, as a model example of social housing with specific conditions that are difficult to find in other cities and being a city-land that can create its own tax policy, which largely financed social housing, has created a unique ability to meet housing needs through appropriate activities of organizational and administrative structures. and units responsible for construction and social housing management.

Based on the literature research and analyses, conclusions, directions and recommendations for further research in this area can be indicated.

- 1) A diverse approach to spatial planning, urban development programmes and the city's financial conditions over many years caused social housing in the Vienna area to have a wide cross-section of buildings, ranging from single, intimate estates to huge apartment blocks or entire quarters (Superblocks) located in different parts of the city, in every district.
- 2) The city currently has 210,600 social housing units, housing around 500,000 people. In addition to municipal housing, non-profit social housing is also developed within Vienna, so that approximately 60 per cent of the city's population lives in these two types of social housing (Ludwig, 2017). Social housing is developed evenly throughout the urban area, excluding the central districts, where there are only individual buildings. This has to do with the urban development model adopted in the early development of this type of residential property.
- 3) Living conditions in social housing vary according to the size of the housing complex, the period of its construction and its modernisation. The first buildings of this type that were built in the city significantly raised the living conditions, the subsequent buildings contributed to an increasing average flat size per inhabitant until 2001. The majority of flats are located in close proximity to public transport and services, which significantly contributes to the quality of life of their inhabitants. In 2019, 69.5 per cent of Gemeindebau flats were classified in category A on a three-stage scale, while 15 per cent were classified in category B. Scale A corresponds to an area of at least 30m<sup>2</sup>, comprising rooms such as a room, a kitchen or kitchenette, an entrance hall, a bathroom with toilet or a separate bathroom and toilet, and a common heating supply or equivalent heating in the flat. Scale B corresponds to the same set of rooms without additional facilities.
- 4) The most important advantages of the Viennese social housing model include favorable financial thresholds needed to apply for social housing, which allows for the creation of socially diverse housing estates, very good connectivity of housing estates regardless of the period of their construction, even distribution of real estate throughout the city and their wide range of sizes, as well as the inclusion of services in their structure.

The biggest disadvantage of the Viennese social housing model is its lack of universality due to specific administrative or tax conditions and the lack of adaptation of public spaces in older housing estates to the needs of universal planning.

- 5) The Vienna model is not fully adaptable to Polish conditions, due to differences resulting from administrative, legal and financial regulations, as well as a different model of approach to social housing in Austria and Poland (in Austria it is addressed to every citizen, in Poland only to the least wealthy people). The construction and land policy of social housing in Vienna results from existing Austrian and Viennese legal regulations. It would be of great value to adapt to Polish conditions (local government administration) a similar organizational level used in Vienna and to act for the development of the city in the area where the city has land resources or to purchase them for social housing before changing the local development plan for a given area. It is also worth considering the concept of social buildings that can perform various functions (apart from residential ones) and enabling residents to manage the size of their apartments.

A significant barrier in the pilot stage of research was the inability of the *Wiener Wohnen* organization to provide data on the social structure or ethnicity of residents of social housing. Hence, the study lacked analyzes of the demographic and social structures of residents of social housing estates, which constitute an important demand element of this housing construction market.

In the second stage of the research, the authors of the study plan to compare the Viennese social housing model with models used in other European cities, including Polish cities, which would enable a more objective assessment of individual models.

Another interesting issue would be to study and compare the quality of life in housing estates from the "Red Vienna" period and contemporary social housing in this city, as well as to compare the quality of life between social housing estates owned by the city and those built by non-profit construction organizations. Such issues would require the use of social research methods, including surveying residents, which, due to the above-mentioned limitations, was not possible at this stage of the research.

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## THE COMMERCIALIZATION OF COMMUNICATION: NAVIGATING STRATEGIC VALUE, CULTURAL DYNAMICS, AND ETHICAL CHALLENGES

Mateusz BYCZYK

Poznan University of Economics and Business, Department of Organisation and Management Theory, Poland;  
mateusz.bczyk@ue.poznan.pl, ORCID: 0000-0003-3188-2619

**Purpose:** This article investigates the commercialization of communication within organizations, focusing on its drivers, impacts, and ethical considerations. By analyzing cultural and technological influences, the study aims to provide a comprehensive understanding of how communication, as a measurable asset, shapes organizational interactions and performance.

**Design/methodology/approach:** Specifically, this paper uses a Critical Literature Review (CLR) to investigate previous studies on communication in the disciplines of management, economics and human resource management. In order to gauge what is known about the commercial value of communication, comprehensive review of 30 relevant publications from 2009 to 2022 was conducted.

**Findings:** The study reveals that while communication technologies and tools can be commodified, the intrinsic human value of authentic interaction remains essential for organizational success. Technological advancements, such as social media and ICT tools, have enhanced communication efficiency but also pose challenges like information overload and reduced clarity. Cultural dynamics play a pivotal role, requiring adaptive strategies to navigate the differences between collectivist and individualist societies. Ethical concerns, including equity and transparency, are increasingly significant in communication practices.

**Practical implications:** The findings provide practical guidance for organizational leaders on how to effectively combine commodified communication tools with authentic, human-centered interaction. By prioritizing ethical and culturally aware communication practices, leaders can foster greater employee engagement, improve teamwork, and drive innovation.

**Social implications:** The study highlights the importance of fair access to communication tools and practices, particularly in diverse and multicultural workplaces. By promoting inclusivity and transparency we can foster stronger collaboration and trust, addressing broader social concerns about fairness regarding communication.

**Originality/value:** This study offers different perspective on the relationship between internal qualities of human communication and its growing commercialization in modern industry. It can be useful for communication professionals, leaders, and scholars who want to comprehend the economic and ethical consequences of communication in corporate settings.

**Keywords:** Communication, commercialization of communication, communication improvements, communication dynamics, organizational communication.

**Category of the paper:** Literature review.

## 1. Introduction

Human contact and organizational performance are largely dependent on communication, which has developed from a natural activity to a precise and purposeful tool. In the modern business environment, communication is more than simply an interpersonal skill; it shapes company's identity and outcomes. We can see this development in many industries. Currently, communication is absolutely essential not just to business in general but especially in areas such as public relations, marketing, journalism and information technology. Following that, Total Corporate Communication (TCC) is crucial for controlling company identity and shaping stakeholder behavior (Balmer, 2017). TCC includes both "controlled" and "uncontrolled" interactions, which together form a comprehensive strategy, shaping how organizations are perceived and how they function (Balmer, 2017). Building on this foundation, communication's role within organizations has expanded.

As communication continues to evolve, it has become a pivotal organizational function, giving rise to specialized roles such as Communication Professionals (CPs). These roles have gained importance in industrial environments where interpersonal relations are increasingly critical to success. According to Fuller et al. (2018), these experts are essential in creating purpose-driven communication, whether it is through written, spoken or visual media, making sure that businesses communicate with their stakeholders in a clear and purposeful manner. The rising commercialization of communication as an asset that can be trained, purchased and sold is reflected in the development of communication competencies, which reflect investigation, analytical aptitude, and technical communication abilities (Fuller et al., 2018) which then help to navigate in rapidly changing/evolving environment.

Technological advancements have revolutionized communication, enabling businesses to connect with stakeholders more effectively. According to Basri & Siam (2019), digital platforms and tools like social media have made communication a service that can be 'bought'. Compared to more established communication channels like radio, television, and newspapers, social media is a relatively new medium for communication (Basri, Siam, 2019). Organizations may now contact their audiences in new ways thanks to social media, in particular. This allows for targeted messaging which can affect public image as well as company outcomes (Basri, Siam, 2019). However, the distinction between natural and commercialized communication is growing more blurred, as organizations increasingly turn towards technology to link up not just with co-workers inside the company but also viewers beyond their walls.

Regarding how important communication is to the success of a company, it is crucial to think about whether or not it can be 'bought' and how valuable it is in those situations. Advertising industries, where access to audience and messages are purchased and sold like goods as well as in consulting companies, where they pay for communication competence, the monetary value of communication is increasing. In efforts like the introduction of ERP

systems, where interaction among teams and stakeholders may have a significant impact on the project's success, and also, according to Barth & Koch (2019) and Koivumäki & Wilkinson (2020) there is a need of good communication techniques and interactions.

Moreover, the commercialization of communication raises ethical concerns, particularly regarding accessibility and equity across diverse cultural contexts. In collectivist societies, for example, the emphasis on harmony and social cohesion shapes how communication technologies are adopted and valued (Kalemci et al., 2019). These variations underline the challenges of applying commercialized communication practices across different regions, highlighting the need for culturally sensitive strategies (Kalemci et al., 2019).

The ethical and economic implications of communication's commercialization present both opportunities and challenges for organizations. While tools and services can be purchased, the intrinsic value of authentic, human-driven communication remains crucial. As businesses navigate the complexities of the digital era, their ability to balance natural and commercialized communication will be critical to their success.

This article investigates the commercialization of communication within organizations, focusing on its drivers, impacts, and ethical considerations. By analyzing cultural and technological influences, the study aims to provide a comprehensive understanding of how communication, as a measurable asset, shapes organizational interactions and performance. The research aims to address the following questions:

1. What are the drivers and impacts of the commercialization of communication in organizations?
2. How do cultural and technological factors shape the value of communication?
3. What ethical concerns arise from the increasing commercialization of communication?

## 2. Methods

The Critical Literature Review (CLR) was chosen as the methodology for this study to evaluate the existing body of knowledge on communication value in organizations. CLR allows researchers to systematically summarize, critique, and synthesize literature to identify gaps and areas requiring further exploration. This structured approach highlights strengths and weaknesses in prior research, providing a comprehensive understanding of the topic.

Publications on management, economics, and human resource management were sourced for this review from databases. The databases that were chosen were "GOOGLE SCHOLAR", "EMERALD", and "CAMBRIDGE JOURNALS". These databases were selected because they include one of the widest ranges of articles within the scientific field under analysis. The following keyword combinations were used in the search: "communication" /AND/ "value", "team", "team management", "communication efficiency", "work efficiency",

"performance". The keyword selection ensured that the search captured a broad spectrum of literature related to communication's role in organizational performance and efficiency. Boolean operators were used to refine search results and maintain focus on the study's scope.

The following criteria were used to choose papers relevant to the scope of this article: (1) communication was the main subject; (2) articles addressed communication issues and problems; (3) articles came from a variety of fields; (4) articles addressed recent work environment characteristics and were no older than fifteen years, with the majority of papers coming from the years 2017-2022, and (5) all articles had to be in English, since it is the most widely used language in scientific literature.

The initial search database consisted of **2872 results**, reflected the breadth of the inquiry. To refine this selection the following steps of analysis were employed:

- (1) Abstract and title screening:** Firstly, each title and abstract were reviewed to assess alignment with the research topic. This step excluded **2298 articles** deemed irrelevant due to peripheral topics or lack of focus on communication value.
- (2) Eligibility verification:** Then the remaining **574 articles** were evaluated based on the inclusion criteria. During this phase, **407 publications** were removed for being tangential to the core theme, such as general discussions of communication without a focus on its measurable value or organizational implications.
- (3) Full-text analysis:** The final **167 articles** underwent detailed examination to assess their contribution to the research question. Ultimately, **30 publications** were identified as most relevant for in-depth analysis due to their focus on communication's measurable value, organizational impact, and cultural considerations.

The methodology has certain limitations, including potential bias in database selection and reliance on English-language publications, which may exclude relevant studies in other languages. Future reviews could expand to additional databases and include multilingual searches to address these constraints.

### **3. Literature review – The Commercialization of Communication**

One of the keys to a successful organization in this complex business environment is communication. Effective communication provides a foundation for top performance and innovation, and is used to develop solid corporate identities, steer change, or boost teamwork among groups or within a team.

This literature review examines the commercialization of communication within organizations, focusing on its drivers, impacts, and ethical considerations. It explores how communication, as a measurable asset, influences organizational success, team dynamics, financial performance, technological integration, and cultural cohesion. By addressing these



interconnected themes, the review provides a foundation for understanding the factors shaping communication value and its broader implications.

The central theme of this review is that communication is not merely a functional process but a multidimensional construct. Its commercialization has transformed it into a strategic organizational asset, influencing outcomes across multiple domains. This review is structured to address the research questions through five thematic lenses.

### **3.1. Drivers and Impacts of Communication Commercialization**

Communication plays a significant role in shaping how organizations operate and succeed. The increasing commercialization of communication is driven by globalization, technological advancements, and growing organizational complexity. Communication is now seen as a measurable resource that enhances collaboration, innovation, and strategic decision-making.

Balmer (2017) emphasizes that Total Corporate Communication (TCC) integrates "controlled" and "uncontrolled" interactions to shape corporate identity and influence stakeholder behavior. This structured approach highlights communication's role as a driver of trust, loyalty, and employee engagement, which are critical for organizational success. Additionally, communication can enhance employee commitment by underlining the idea of corporate identity.

Melewar et al. (2017) describe corporate identity as an organization's unique qualities, which serve as a core component and unifying force within the company and its employees. They explain that communication influences organizational success by answering critical questions such as "who you are", "what work you do", and "how you perform it" (Melewar et al., 2017). Communication is thus a collection of messages delivered through a variety of mediums, both official and unofficial, that can affect employees' trust, loyalty, and overall commitment to the organization (Melewar et al., 2017). Also, managers are advised to ensure the consistency and clarity of communication strategies to maximize their influence across the organization (Melewar et al., 2017). However, to effectively engage with employees, it is essential to have the skills and resources directly tied to communication. However, acquiring these skills often necessitates undergoing specialized training or hiring additional experts in the field, which can lead to increased costs for the organization to employ multifaceted layouts.

Barth & Koch (2019) link this communication to the successful implementation of complex systems like enterprise resource planning (ERP). Effective communication during such projects promotes collaboration, mitigates misunderstandings, and ensures alignment among stakeholders. These impacts illustrate how communication commercialization supports organizational agility and adaptability (Barth, Koch, 2019). The creation of such culture enables efficient collaboration and allows organizations to adapt to changes and innovations more easily.

### **3.2. Cultural and Technological Influences on Communication**

Cultural and technological factors can influence how communication is valued and implemented within organizations. Kalemci et al. (2019) point out that collectivist cultures prioritize interpersonal harmony and group cohesion, whereas individualist cultures favor more autonomous and direct communication. Leaders must adapt communication strategies to bridge these cultural divides, fostering inclusivity and collaboration (Kalemci et al., 2019). Miszczak (2022) emphasizes that leaders have a duty to assist subordinates in achieving their professional and personal goals through effective communication, which, according to Portnova and Peiseniece (2017) fosters innovation and engagement within teams, as well as employment of specific technologies.

Sundram et al. (2020) emphasize that the transformative impact of Information and Communication Technology (ICT) tools improve communication efficiency and help organizations achieve higher performance levels by facilitating the sharing of information across departments and locations (Kashive et al., 2022). Additionally, according to Moura Dominguez & Varajão (2019), without effective communication, teams may become disoriented, leading to delays in achieving organizational objectives. They also introduce risks, such as misinterpretation and information overload, requiring careful management by communication professionals.

Moreover, social media is another key technological driver. Basri & Siam (2019) discuss the role of social media in corporate communication, noticing that it provides new opportunities for organizations to interact with stakeholders and the community. Social media allows for the open sharing of information, particularly regarding organizational changes, corporate sustainability, and new product development (Basri, Siam, 2019). This medium fosters transparency and community engagement but also demands a strategic approach to maintain clarity and relevance.

### **3.3. The Financial Impact of Organizational Communication**

Communication's financial value lies in its ability to drive efficiency, innovation, and employee satisfaction. Zientara & Kuczyński (2009) argue that job satisfaction, which is influenced by communication, minimize absence and turnover rates, leading to cost savings for organizations. Satisfied employees are less likely to leave their jobs, resulting in reduced recruitment and training expenses (Zientara, Kuczyński, 2009). Additionally, teamwork and knowledge sharing (good communication) are among the factors that contribute to positive job satisfaction. Poor communication, on the other hand, can lead to misunderstandings and errors, which may cause financial losses for organizations.

Sundram et al. (2020) note that Information and Communication Technology (ICT) plays a critical role in improving organizational performance, also, Renkema et al. (2018) suggests that frequent communication can enhance decision-making processes and collaboration

between employees. Investments in ICT tools allow for better communication, streamlining workflows and boosting productivity (Zhou et al., 2021). Moreover, Rathod (2022) further argues that encouraging employees to share ideas and capabilities can enhance team cohesion and performance. Additionally, Zanjirchi et al. (2019) highlight the value of communication in fostering innovations, with organizations that prioritize communication showing better performance outcomes through collaboration with external partners and stakeholders. Conversely, poor communication can lead to misunderstandings and errors, resulting in financial losses. These findings underscore the critical role of communication in maintaining operational efficiency and profitability.

### **3.4. Leveraging Communication Technologies in Organizations**

The adoption of communication technologies has revolutionized organizational operations, enabling seamless information sharing and enhanced collaboration. Sundram et al. (2020) emphasize that ICT tools improve communication efficiency, fostering transparency across departments and locations.

However, Koivumäki & Wilkinson (2020) highlight that although digital communication opens new ways for interaction, it may also lead to a lack of clarity. Communication professionals must manage these tools carefully to ensure that messages remain clear and effective, even in virtual settings (Koivumäki, Wilkinson, 2020). For example, virtual environments require clear protocols to prevent miscommunication and maintain consistency.

Furthermore, Barth & Koch (2019) argue that digital tools are particularly valuable in large-scale projects, ensuring that communication should remain consistent and transparent throughout the organization. Also, according to Raymundo (2020), project teams need clear and frequent communication, particularly when individuals are unable to meet face-to-face. Finally, modern professionals require communication skills that allow them to seek out and apply new information, while helping teams solve problems creatively while working together (Raymundo, 2020).

Moreover, social media platforms further enhance organizational communication. Basri & Siam (2019) highlight their role in disseminating information on corporate initiatives, sustainability efforts, and product innovations. These tools enable organizations to engage with stakeholders in real time, creating opportunities for transparency and relationship building.

### **3.5. Ethical Considerations and Cultural Impacts**

The commercialization of communication raises ethical concerns, particularly around equity, accessibility, and transparency. Lašáková et al. (2017) argue that ethical communication fosters employee satisfaction and engagement, enhancing organizational culture. Leaders who prioritize ethical communication are more likely to foster employee engagement and satisfaction, contributing to a positive organizational culture (Lašáková et al., 2017).

Cultural differences further complicate ethical considerations. Kalemci et al. (2019) note that collectivist cultures may struggle with communication technologies that prioritize individual autonomy, potentially leading to misunderstandings or exclusion. Leadership communication styles also play a critical role in team dynamics. Democratic leaders foster open dialogue and encourage team members to participate in decision-making, ultimately leading to more effective teamwork (Milewski, 2021). In this environment, ethical leadership involves adapting communication strategies to respect cultural norms while promoting inclusivity.

Finally, Melewar et al. (2017) and Portnova & Peiseniece (2017) emphasize the role of communication in fostering a shared organizational identity. This is closely tied to communication and serves as the foundation of an organization's success. Effective communication strengthens this identity and unifies employees around common goals, enhancing organizational cohesion (Melewar et al., 2017).

The selected literature highlights the multidimensional impacts of communication commercialization, shaped by cultural and technological factors and accompanied by ethical challenges. These findings provide a broad foundation for analyzing communication's role as a measurable asset within organizations, addressing the drivers, influences, and implications outlined in the research questions.

## **4. Discussion**

This part focuses on analyzing the study's objectives: to explore the drivers and impacts of communication commercialization, the influence of cultural and technological factors, and the ethical considerations involved. By synthesizing these dimensions, this section aims to establish a cohesive understanding of how communication shapes organizational dynamics and outcomes.

### **4.1. Drivers and Impacts of Communication Commercialization**

The commercialization of communication arises from its increasing value as a measurable and strategic asset in organizational success. Balmer (2017) highlights the role of Total Corporate Communication (TCC) in enhancing corporate identity, trust, and stakeholder loyalty. This aligns with the finding that communication influences not just employee engagement but also broader organizational outcomes, such as financial performance and innovation.

The practical impacts of communication commercialization are particularly seen in project management. For example, Barth & Koch (2019) connect communication to the successful implementation of complex systems like ERP, where collaboration and stakeholder alignment

are critical. This underscores the dual role of communication as both a functional tool and a strategic resource that organizations invest in to ensure operational efficiency.

However, the financial costs associated with acquiring communication competencies - through training or hiring experts - present challenges for some organizations. Balancing these investments with tangible outcomes remains a critical consideration for businesses navigating in this competitive environment.

#### **4.2. Cultural and Technological Influences**

Cultural and technological factors thoroughly shape the implementation and value of communication in organizations. The findings by Kalemci et al. (2019) highlight the influence of cultural contexts, where collectivist societies prioritize harmony and group cohesion, while individualist societies emphasize simplicity and autonomy. These differences demand adaptive communication strategies from leaders to foster inclusivity and mutual understanding.

Technological advancements, particularly ICT tools and social media, have transformed how communication occurs. Sundram et al. (2020) and Basri & Siam (2019) emphasize that these tools enable real-time information sharing and stakeholder engagement. However, challenges such as information overload and miscommunication in virtual environments remain. For example, Koivumäki & Wilkinson (2020) point that digital tools can introduce ambiguity if not managed effectively, highlighting the need for clear protocols and skilled communication professionals.

The findings suggest that while technology amplifies communication's reach and efficiency, its successful integration requires balancing speed and clarity, particularly in multicultural and remote settings.

#### **4.3. Ethical Considerations in Communication Practices**

The ethical dimensions of communication are increasingly significant, particularly regarding accessibility, equity, and transparency. Effective communication fosters trust, as emphasized by Lašáková et al. (2017), who argue that ethical communication practices contribute to a positive organizational culture. Transparent dialogues build trust and cooperation, creating an environment where employees feel appreciated and needed.

Cultural sensitivity further highlights ethical considerations. In diverse teams, where language and cultural barriers may exist, managers must actively recognize and address different perspectives. For instance, Kappagomtula (2017) highlights the importance of cultural awareness in ensuring accurate communication and fostering understanding in multicultural teams.

Moreover, ethical leadership in communication involves creating spaces for innovation and collaboration. Portnova & Peiseniece (2017) underline the role of leaders in enabling open communication, which serves as a foundation for fostering creativity and long-term organizational development.

#### **4.4. The Role of Communication in Team Dynamics and Innovation**

Effective communication is a key of team performance and innovation. Dusenberry & Robinson (2020) link open communication to enhanced team satisfaction, which positively impacts productivity and creativity. A culture of communication not only helps resolve conflicts but also promotes collaboration, allowing team members to share ideas and expertise.

Meanwhile, leadership communication styles are particularly important in team settings. Milewski (2021) contrasts autocratic and democratic leadership styles, showing that open and participatory approaches lead to better teamwork and decision-making. This finding aligns with Vardiashvili (2022), who argues that leaders must go beyond traditional management tasks to create supportive environments that encourage innovation and engagement.

In innovative organizations, communication serves as a catalyst for growth. Buzamăt (2022) emphasizes that creativity thrives in environments where open communication supports the exchange of fresh ideas. This further underscores the role of communication as not only an operational tool but also a driver of long-term strategic success.

#### **4.5. Communication as a Strategic Asset in Modern Organizations**

The findings collectively demonstrate that communication is a multidimensional asset, influencing leadership, team dynamics, financial outcomes, and organizational culture. As emphasized by Wallace et al. (2020), ensuring that the team is prepared, highly motivated, and has the opportunity to fully engage in team activities is another responsibility of the team head, all of which depends on the team leader's communication abilities. Organizations that prioritize communication practices are better prepared for today's global and multicultural business environment.

For example, Klein, Beuren & Dal Vesco (2019) emphasize that participatory communication aligns teams with strategic goals while fostering continuous improvement. Similarly, Zientara & Kuczyński (2009) argue that communication reduces turnover and absenteeism by enhancing job satisfaction, leading to cost savings and improved performance.

By synthesizing these insights, it becomes clear that communication's role extends beyond routine operations - it is integral to foster trust, innovation, and collaboration, ultimately shaping the organization's identity and success.

This study highlights the role of communication in modern organizational success, by addressing the study's research questions by exploring its drivers, cultural and technological influences, and ethical implications. Communication is not only a functional process but also a strategic part of leadership, teamwork, and innovation. With the employment of digital communication, leaders can "pass through the digital environment" by closing the gap between innovation, technology, and people (Ngayo Fotso, 2021). As organizations continue to adapt to technological and cultural changes, their ability to balance the natural and commercialized aspects of communication will determine their capacity to seek for competitive and dynamic environments.

## 5. Summary

In the evolving business landscape, communication has transformed from a natural human function into a strategic organizational asset. This article explores the interplay between communication's intrinsic interpersonal value and its commercialization as a measurable resource. The findings highlight communication's complex role in organizational success, emphasizing its impact on leadership, team dynamics, innovation, and financial performance.

The commercialization of communication, driven by globalization, technological advancements, and organizational complexity, has elevated its status as a critical factor in shaping corporate identity, stakeholder engagement, and operational efficiency. Tools such as social media platforms and ICT's enable real-time collaboration and stakeholder interaction, but they also present challenges such as information overload and the risk of miscommunication. As noted by Sundram et al. (2020) and Koivumäki & Wilkinson (2020), organizations must carefully balance the speed and clarity of communication in these contexts to maximize effectiveness. As noted by Rowe (2019), modern workplaces now expect more from their employees, including problem-solving and resilience, all of which are underpinned by strong communication skills.

Ethical and cultural dimensions further complicate communication strategies. The article underscores the importance of cultural sensitivity and fairness in diverse teams, where leadership must adapt strategies to foster inclusivity and mutual understanding (Kalemci et al., 2019; Kappagomtula, 2017). Ethical considerations, such as transparency and accessibility, are also vital in ensuring trust and cooperation within organizations, as highlighted by Lašáková et al. (2017).

Leadership communication emerges as a cornerstone of organizational success, influencing employee engagement, innovation, and crisis management. Effective leaders create environments of trust and mutual respect, facilitating open dialogue and encouraging creative problem-solving (Domínguez-Escrig et al., 2021; Kashive et al., 2022). The ability to inspire and empower teams through communication becomes particularly critical in the context of globalization and digital transformation. In many organizations, communication is no longer just a soft skill; it has become a strategic asset that can be bought, sold, and optimized through digital tools and professional expertise. The advent of new technologies and innovative behaviors, has amplified this trend, making communication a critical factor in shaping public image, corporate culture, and organizational success (Domínguez-Escrig et al., 2021; Hess, 2018; Zientara, Kuczyński, 2009).

While many aspects of communication - such as tools, platforms, and professional expertise - can be commercialized, the human-driven essence of communication remains invaluable. Employee engagement, team cohesion, and organizational culture rely on authentic, interpersonal interactions. Additionally, giving constructive feedback can improve dialogue and

enhance team dynamics, as highlighted by Klein, Beuren & Dal Vesco (2019), who found that constructive criticism leads to higher respect and appreciation within teams. Also, Zientara & Kuczyński (2009) emphasize that job satisfaction and reduced turnover are tied to the quality of workplace communication, underscoring its role in sustaining organizational success.

This article also examines the ethical consequences of shaping communication as a commercialized asset. Larger organizations often face greater challenges in maintaining fairness and transparency compared to smaller firms, where informal and direct communication methods may be more effective (Zientara, Kuczyński, 2009). Moreover, leaders of large, multicultural teams must navigate the complexities of differing cultural perspectives to ensure inclusivity and equity.

In conclusion, communication is both a natural human function and a strategic organizational asset. Its commercialization reflects its growing importance, but organizations must prioritize integrating commercialized tools with authentic, human-driven interactions. Future success depends on the ability to balance these dimensions, fostering environments that support creativity, innovation, and collaboration. As emphasized by Camp, Young & Bushardt (2022), continuous development of communication skills and self-improvements are essential for navigating in the complexities of modern business.

## **6. Limitations**

A number of limitations should be noted, even if this study provides insightful information about the commercialization of communication in business contexts. Firstly, the study only uses a Critical Literature Review (CLR), which could not include the most recent empirical data or practical advancements in contemporary business settings. Furthermore, more recent developments in communication technology and their effects on enterprises can be overlooked by the selection of literature from 2009 to 2022. Finally, the lack of primary data in the study restricts its capacity to test the theoretical ideas in practice or give real-world applications. The issue would be better understood with more study, especially empirical investigations.

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## ENERGY SECURITY OF POLAND – ENERGY EFFICIENCY AND DEPENDENCE COMPARED TO THE EUROPEAN UNION

Karolina CZERWIŃSKA<sup>1</sup>, Ryszard RADWAŃSKI<sup>2</sup>, Andrzej PACANA<sup>3\*</sup>

<sup>1</sup> Rzeszow University of Technology, Faculty of Mechanical Engineering and Aeronautics;  
k.czerwinska@prz.edu.pl, ORCID: 000-0003-2150-0963

<sup>2</sup> Association of Veterans and Reservists of the Polish Army in Warsaw; ryszard.radwanski@vip.onet.pl,  
ORCID: 0000-0002-2100-6845

<sup>3</sup> Rzeszow University of Technology, Faculty of Mechanical Engineering and Aeronautics; app@prz.edu.pl,  
ORCID: 0000-0003-1121-6352

\* Correspondence author

**Purpose:** The aim of the study was to present the issue of energy efficiency and dependency as key factors in the country's energy security and to diagnose the current state of Poland's energy security against the background of the European Union.

**Design/methodology/approach:** The paper uses a descriptive and explanatory research method, primarily analysis of Eurostat data, as well as causal analysis based on a literature review.

**Findings:** The study presents quantitative ways of determining the level of energy security of a country and also presents rankings of EU countries in the context of energy efficiency and energy dependency. The study presents recommended development actions for Poland and the European Union to increase energy security.

**Research limitations/implications:** Constraints in the implementation of the research included difficult access to complete and adequate data or a complete lack thereof. Future research will concern the diagnosis and analysis of the energy mixes of CEE countries in the context of their energy security.

**Practical implications:** Development recommendations for the EU and Poland are presented (reducing the level of network losses in energy transmission and distribution, building highly efficient generation units, increasing the level of use of high-efficiency cogeneration and increasing end-use energy efficiency).

**Originality/value:** The analyses presented fill the research gap concerning the diagnosis of the level of efficiency and energy dependence (of Poland in comparison with EU countries) in the context of ensuring Poland's energy security.

**Keywords:** energy security, energy efficiency, energy mix, European energy policy, energy diversification.

**Category of the paper:** Research paper.

## 1. Introduction

Energy security is an important value in any country and is an end in itself. For many years, the issue relating to the future of energy has been one of the most significant issues considered within national and global politics (Belch et al., 2024). This is related to the energy sector's responsibility for progressive climate change, as well as to the concern to provide adequate amounts of energy for the years to come (Hajduk-Stelmachowicz, 2018). Long-term projections indicate that in 2050, humanity will consume energy at a level two or three times that recorded in 2010. During the 20th century, humanity's energy needs were mainly met by fossil fuels. However, depletion of deposits has contributed to a decline in the importance of fossil fuels (Wolniak et al., 2020; Esfahani et al., 2021).

Energy efficiency is an important pillar for maintaining energy security and increasing the competitiveness of the economy. This type of efficiency is a measure that indicates how efficiently energy is being managed. The most common measure of energy efficiency is the energy intensity of GDP. This figure expresses the ratio of energy consumption expressed in tonnes of oil equivalent (toe) to a country's gross domestic product (Pacana, Czerwińska, 2020). In Poland, the essence of energy efficiency is becoming increasingly important, resulting in the Energy Efficiency Act, which defines: the tasks of public sector entities in the field of energy efficiency, the rules for the implementation of the obligation to achieve energy savings, the rules for carrying out energy audits in enterprises and the rules for keeping a central register of final energy savings (Dyczkowska et al., 2024). In Poland, as of 22 May 2021, the provisions of the Act on amending the Energy Efficiency Act (Act of 20 April 2021 on amending the Energy Efficiency Act and certain other acts) entered into force. The Act implements a provision of the Directive of the European Parliament and of the Council (EU) on energy efficiency (Directive of the European Parliament and of the Council (EU) 2018/2002 of 11 December 2018 amending Directive 2012/27/EU on energy efficiency). The aforementioned law aims to adapt Polish law to the solutions provided for in the Directive, amended in 2018, which imposes increased obligations on Poland regarding the degree of final energy savings at the end of 2030 of 5580,000 toe. The primary target in the area of efficiency in addition to the targets set out in the European Union's efficiency directives is to achieve a 32.5 per cent reduction in energy consumption compared to 2035 projections as a result of energy efficiency improvements. Poland's energy efficiency in 2022. increased by 0.9 per cent in relation to 2021, while the annual cumulative growth rate of energy efficiency between 2012 and 2022 was 0.9 per cent. During this period, primary energy intensity of GDP was reduced by an average of 2.6% per year and final energy intensity of GDP by 2.4%. Industry saw the fastest rate of improvement in energy efficiency (up 1.9%). The level of total primary energy consumption increased between 2012 and 2022 from 92.8 Mtoe to 98.6 Mtoe (cumulative annual growth rate of 0.6%). Final energy consumption also increased in the period under

review from 64.4 to 72.4 Mtoe (cumulative annual growth rate of 1.2%). Total consumption reached its highest value in 2018 (104.1 Mtoe), and final energy consumption in 2021 (75.2 Mtoe) ([www.ec.europa.eu/eurostat](http://www.ec.europa.eu/eurostat)). However, despite systematic growth, the level of energy efficiency of the Polish economy is still not at a satisfactory level - it is approximately three times lower than the efficiency of economies in the most developed European countries and at the same time approximately twice as low as the average in European Union countries.

The current state of energy security within the Polish energy sectors varies significantly (Czerwińska, Pacana, 2019). In terms of heating and electricity based on its own hard coal and lignite resources, Poland is self-sufficient (Grebski, Ulewicz, 2022; Kwiatkowska et al., 2021). The gas and liquid fuels sector, is heavily dependent on imports, mainly from Russia. Poland has considerable renewable energy resources, but their use is at a relatively low level (Orłowska et al., 2024; Wolniak, Skotnicka-Zasadzień, 2022). Based on the country's fuel and energy balances, it becomes necessary to develop a long-term energy strategy that takes into account the growing needs of consumers (individual, industrial) and at the same time ensures energy security (Orman et al., 2020; Jursova et al., 2014). Therefore, attempts are being made to develop a new, adequate energy mix model that takes into account the needs of consumers and responds to the environmental challenges posed by the European Union. With regard to Poland, the new energy mix model should be largely based on high self-sufficiency. The current state of energy security within the Polish energy sectors varies significantly (Czerwińska, Pacana, 2019). In terms of heating and electricity based on its own hard coal and lignite resources, Poland is self-sufficient (Grebski, Ulewicz, 2022; Kwiatkowska et al., 2021). The gas and liquid fuels sector, is heavily dependent on imports, mainly from Russia. Poland has considerable renewable energy resources, but their use is at a relatively low level (Orłowska et al., 2024; Wolniak, Skotnicka-Zasadzień, 2022). Based on the country's fuel and energy balances, it becomes necessary to develop a long-term energy strategy that takes into account the growing needs of consumers (individual, industrial) and at the same time ensures energy security (Orman et al., 2020; Jursova et al., 2014). Therefore, attempts are being made to develop a new, adequate energy mix model that takes into account the needs of consumers and responds to the environmental challenges posed by the European Union. With regard to Poland, the new energy mix model should be largely based on high self-sufficiency.

Rational and responsible energy management improves energy security, translates into reduced pollutant emissions (especially carbon dioxide) and reduced expenditure on the purchase of renewable and non-renewable energy carriers (Czerwińska, Pacana, 2021; Orman et al., 2020). Measures that enhance energy security are now an essential determinant of a country's security and an objective of its security policy. The aim of this article was to present the issue of energy efficiency and dependence as key factors in the state's energy security and to diagnose the current state of Poland's energy security against the background of the European Union.

## 2. Concept of Polish energy security

Energy security is a concept that is complex and difficult to define unambiguously, however, in general terms it can be said to be about access to a variety of energy carriers and ensuring the continuity of their supply. The key to achieving energy security is to diversify sources of supply, use domestic resources, rationalise energy consumption, protect the environment, increase energy efficiency through the use of the latest technologies (Streimikiene, 2023; Kilinc-Pala, 2021).

The concept of energy security is defined in the Energy Law, which indicates that energy security is a state of the economy that makes it possible to cover the current and prospective demand of consumers for fuels and energy in a technically and economically justified manner, while maintaining the requirements of environmental protection (Law of 10 April 1997 Energy Law. Dz.U. 1997, No. 54, item 348, as amended, art. 3, p. 16). The most important entity to which the term energy security should apply to the greatest extent is the energy consumer. To a certain extent, consumers should be guaranteed energy at the required time, in the required quantity and form, and at an available price. The priority activity in terms of conducting energy policy is to take care of stable and uninterrupted supplies of energy carriers based on long-term contracts thanks to an independent industrial infrastructure that directly connects supply sources (including deposits) with the territory of Poland (Rosicki, 2023).

The main tasks of the state within the energy sector are considered to be ensuring a significant degree of energy security, which is understood as (Czerwińska, Pacana, 2024):

- security of supply by ensuring a certain quality and continuity of energy supply at a level that is determined by social and economic needs,
- economic security meaning that the cost of purchasing energy will not lead to energy poverty and will not create obstacles to economic development,
- environmental security, which ensures that energy generation will not contribute to excessive pollution and environmental degradation.

The level of energy security of a country depends on a considerable number of factors among which the key ones are (Fouladvand et al., 2024):

- balancing supply and demand for fuels and energy,
- diversification of supply sources (degree of dependence on imports),
- diversification of the structure of energy carriers making up the national fuel balance,
- economic conditions of energy companies, including their financial results,
- technical condition (efficiency) of power equipment and installations,
- size of fuel reserves,
- the state of regional energy security, i.e. the ability to satisfy energy needs at the level of local communities.



Energy security has an impact on almost every segment of the proper functioning of the state, as energy resources affect the ability of state bodies to carry out functional activities in the political, economic and environmental areas (Gitelman et al., 2023).

The political aspect involves the need for the state to carry out actions leading to the elimination or reduction of the possibility of political influence by entities that have the status of energy suppliers. The aim of the measures outlined is to achieve permanent access to energy resources by ensuring correct political relations with the states that have the resources of energy carriers and those states through whose territory they are transported (Aykin, 2024).

The economic context of energy security is largely concerned with features that indicate the proper functioning of the energy sector, which is linked to the health of the national economy and development. In this aspect, there is a correlation: the higher the level of energy security, the stronger and more stable the economy. Energy security is of strategic importance for each state in the aspect of broadly understood internal and national security and continuous economic development (and including changes in production capacity, economic relations, production, structure and mechanism of functioning of the economy, consumption and the environment) (Czerwińska, Pacana, 2022).

The environmental aspect concerns the minimisation of the negative consequences of the energy sector's impact on the natural and natural environment (Iyke, 2024). It refers to the energy management stage, which includes: acquisition of energy carriers, processing, transport and their use. Within each stage, there are specific risks that require the implication of adequate countermeasures. In this area, energy security is combined with environmental security (Grebski et al., 2022; Pacana, Czerwińska, 2023).

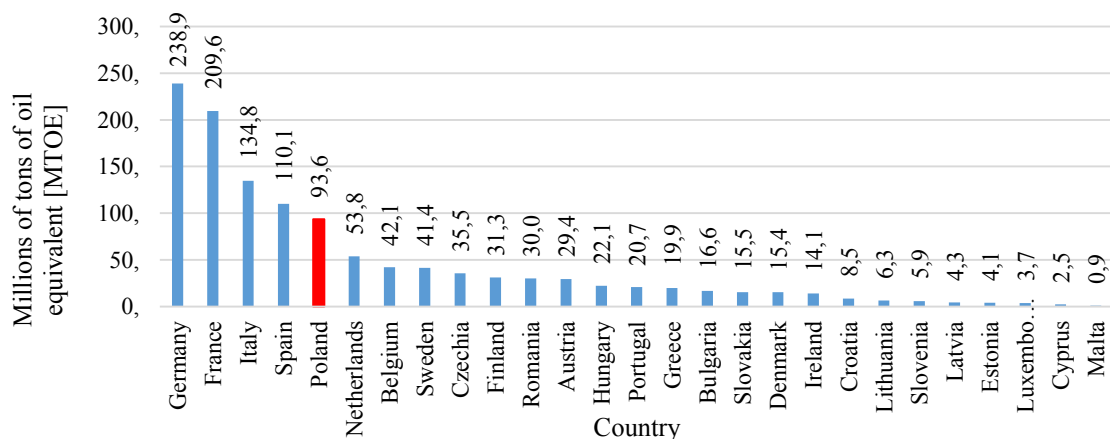
The European Union's climate and energy policy has a significant impact on the development and shape of the Polish energy sector in the run-up to 2050. This applies to conventional energy, renewable energy and prospective nuclear energy (Deirmentzoglou et al., 2024). The implementation of the 3×20 energy package and the EU ETS (European Emissions Trading Scheme) is closely linked to large capital expenditures in the area of modernising conventional energy sources (especially investments in low-carbon technologies), promoting the use of renewable energy sources, and considering the creation of nuclear energy (Pereira et al., 2024). Taking these actions is important with regard to meeting the stringent emission requirements of the IED (Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) and improving the level of energy efficiency.

### 3. Energy security of the Polish economy in relation to the EU-27 economy

#### 3.1. Energy efficiency of the Polish economy compared to the EU economy

Energy efficiency is an integral part of energy security, sustainable development and belongs to modern energy policy. Improving energy efficiency means improving the energy intensity of the economy at the same time, as more final products can be obtained from a given amount of resources (Pacana et al., 2023). Therefore, the levels of primary energy consumption, final energy consumption, energy efficiency and energy self-sufficiency were analysed.

The primary energy consumption indicator measures a country's total energy demand, excluding any non-energy use of energy carriers (e.g. natural gas used not for combustion but for the production of chemicals). In 2023, the level of primary energy consumption in the EU was 1211 million tonnes of oil equivalent (Mtoe). The figures presented show a decrease of 3.9% compared to 2022. In 2023, the EU was still approaching the 2030 target of 992.5 Mtoe, currently the gap has narrowed to 22.0%. Figure 1 shows the level of primary energy consumption in EU countries in 2023.



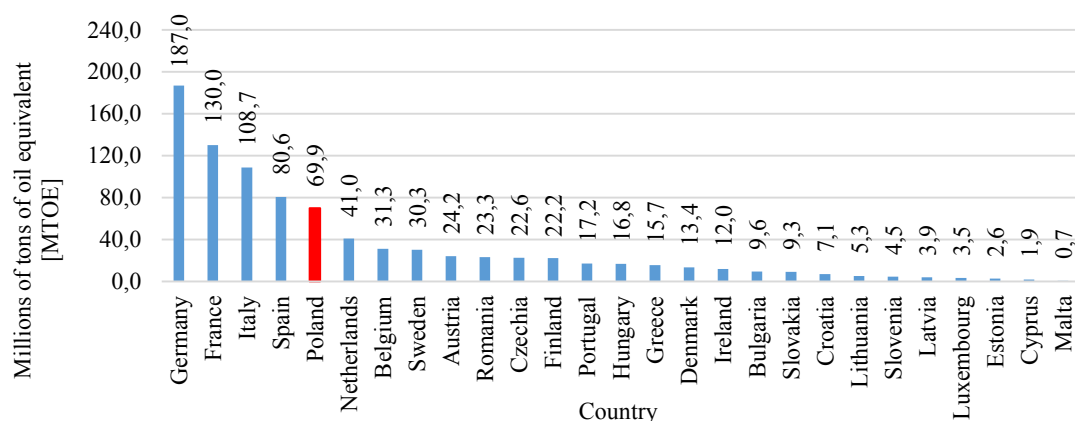
**Figure 1.** Primary energy consumption of European Union countries – 2023.

Source: Own elaboration based on: [www.ec.europa.eu/Eurostat](http://www.ec.europa.eu/Eurostat), 24.01.2025.

Among EU-27 countries, Poland ranked fifth in terms of primary energy consumption in 2023. This was a decrease in the level of consumption by 5.07% compared to 2022. The highest level of energy consumption (2.55 times higher than in Poland) was recorded in the German economy.

The final energy consumption indicator, only includes energy consumed by end users (industry, transport, households, services and agriculture) and does not include energy consumption in the energy sector or losses that occur during energy processing and distribution. The Council of the European Union has legislated to reduce final energy consumption at EU level by 11.7% in 2030. This means that a cap on EU final energy consumption of 763 million tonnes of oil equivalent will apply. Between 2024 and 2030, Member States will provide new annual savings averaging 1.49% of final energy consumption, until reaching 1.9% on

31 December 2030. Figure 1 indicates the level of final energy consumption of EU countries in 2023.

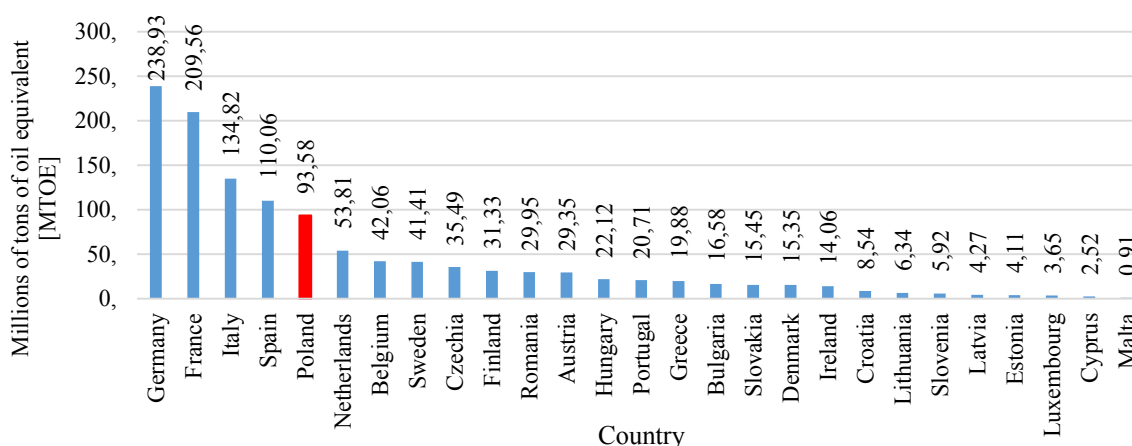


**Figure 2.** Final energy consumption of European Union countries – 2023.

Source: Own elaboration based on: [www.ec.europa.eu/Eurostat](http://www.ec.europa.eu/Eurostat), 24.01.2025.

The EU's final energy consumption was 894.4 Mtoe, a reduction of 3% compared to 2022. The EU has therefore moved closer to achieving the target listed in the Energy Efficiency Directive (EED) [Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC]. - 763 Mtoe in this case. The result of 894.4 Mtoe in final energy consumption was the second lowest since 1990, when data on this subject began to be collected. The level of Poland's final energy consumption was 69.9 Mtoe which contributed to the 5th place among EU countries. In relation to 2022, this level decreased by 2.23%.

In the context of energy efficiency, the values achieved by the EU countries do not show significant differences from the primary energy consumption data (Figure 3). EU energy efficiency in 2023 was 1210.77 Mtoe, a decrease of 3.89% on 2022 and 7.79% on 2021, respectively.



**Figure 3.** Energy efficiency of EU countries – 2023.

Source: Own elaboration based on: [www.ec.europa.eu/Eurostat](http://www.ec.europa.eu/Eurostat), 24.01.2025.

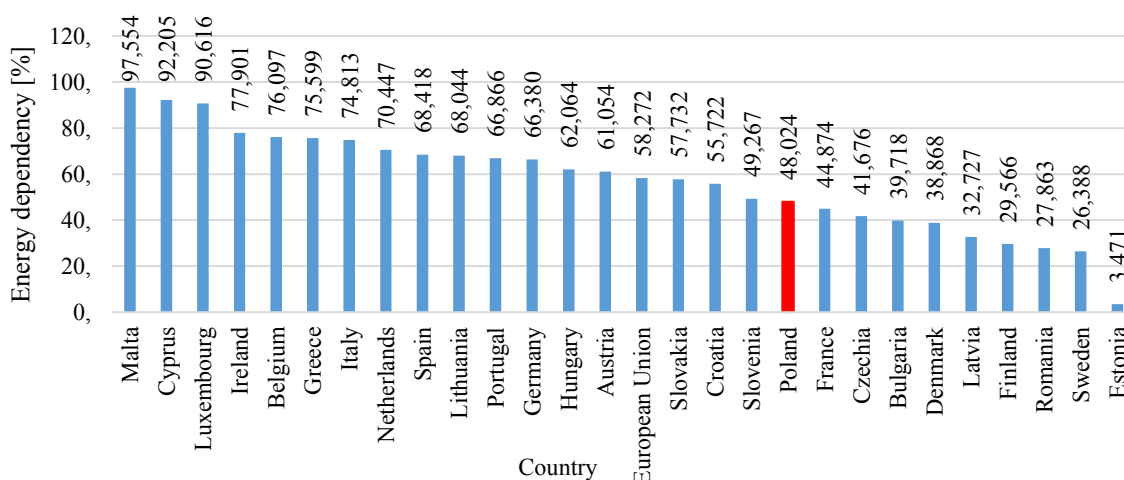
Poland has made significant progress in improving energy efficiency over the past 20 years, but further steps are necessary to achieve the efficiency levels recorded in the leading Western European countries. Poland's energy efficiency in 2023 osiagnene 93.58 Mtoe, the fifth highest among EU countries.

Considering energy efficiency, there is still a lot to be done in this area, especially in the case of Poland. Improving the level of energy efficiency will contribute to reducing the energy intensity of the economy and increasing energy stability and security.

### 3.2. Energy dependence of the Polish economy towards the EU economy

In order to diagnose the level of energy security, the energy dependency index was also used. This indicator is interpreted as follows: the higher the level of the energy dependency index, the lower the level of energy security in a given country. With the increase in the share of net energy imports in gross domestic energy consumption increased by stored energy, the level of energy security therefore decreases. Dependence on energy imports indicates the share of the country's total energy demand that is met thanks to imports from other countries (Elustu, 2021). This means that the indicator shows the proportion of energy that the economy must import.

The European Union's dependence on single suppliers is of concern and an important component of energy security. The EU seeks to improve the level of energy security by constructing a resilient, consolidated and open internal market, while exercising a multilateral and rules-based development perspective (Novikau, 2022; Elustu, 2021). Current geopolitical efforts and activities highlight the key role of controlling and minimising import dependency. Energy dependence on imports of energy carriers is associated with an increased exposure of the EU economy to the risk of supply shortages AND volatile world market prices. The risk increases with dependence on individual countries, for example determined by supply infrastructure. The level of energy dependency of EU countries in 2023 is shown in Figure 4.

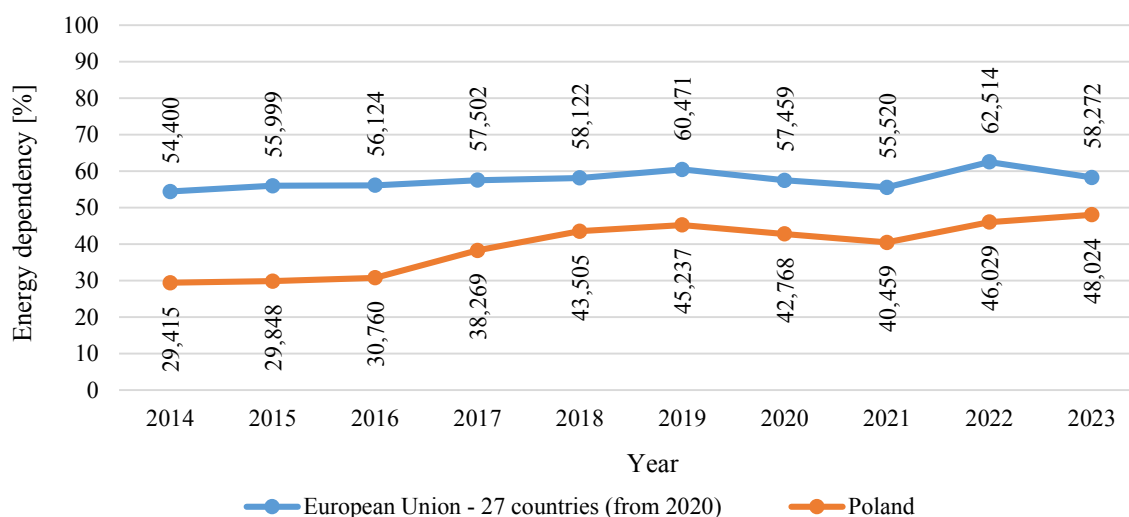


**Figure 4.** Energy dependency of EU countries – 2023.

Source: Own elaboration based on: [www.ec.europa.eu/Eurostat](http://www.ec.europa.eu/Eurostat), 24.01.2025.

Based on Figure 4, it can be concluded that Poland is one of the less dependent countries in terms of energy imports in Europe. A lower level of the energy dependency indicator in 2023 was only recorded in France, the Czech Republic, Bulgaria, Denmark, Lithuania, Finland, Romania, Sweden and Estonia. This shows that Poland is characterised by a relatively high level of energy security in relation to EU countries. This is due to the possession of a rich resource base and coal and lignite deposits that are important in this context.

The development of Poland's and the European Union's energy dependence in 2014-2023 is presented in Figure 5.



**Figure 5.** Energy dependency of Poland of the EU countries.

Source: Own elaboration based on: [www.ec.europa.eu/Eurostat](http://www.ec.europa.eu/Eurostat), 24.01.2025.

For the years 2014 to 2023 under consideration, the EU's energy dependency level oscillates between 54,400% and 62,514% (Figure 5). The lowest value of the EU indicator was reached in 2014, while the highest value was reached in 2022. In 2023, the EU recorded an indicator value of 58.727% (a decrease of 6.78% compared to the previous year). Poland shows a lower level of energy dependence on the EU over the analysed period, but a worrying increasing trend is noticeable. The range of values of the indicator for Poland was 29.415% (2014) - 48.024% (2023). Since 2021, Poland has seen an increase in the level of energy dependency every year. In 2022 an increase of 13.76% (compared to 2021) and 2023 an increase of 4.33% (compared to 2021).

In order to accelerate Poland's transition to a relatively inexpensive, reliable and sustainable energy system, and thereby increase energy independence and energy security, the country should conduct intensive research on clean energy, promote investment in energy infrastructure, and promote clean energy technology.

#### 4. Conclusions and recommendations

In a globalized world, the proper functioning of countries is highly dependent on energy security. It is one of the conditions for the economic and technological development of a particular country. Therefore, the purpose of the article was to present the issue of energy efficiency and dependence as key factors in the energy security of the country, as well as a diagnosis of the current state of energy security of Poland against the background of the European Union.

Increasing energy efficiency in energy generation, transmission and use is key to the implementation of a sustainable energy policy, which is also expressed by national and EU legal regulations and through actions taken by national and EU institutions.

Improving the level of Poland's energy efficiency is crucial to achieving all national and EU energy policy goals and a significant number of environmental and climate policy goals. Therefore, improving energy efficiency should be a priority in modernizing the national economy. This is achievable by, among other things: reducing the level of network losses in energy transmission and distribution, building highly efficient generating units, increasing the level of application of high-efficiency cogeneration and increasing the efficiency of energy end-use.

In recent years, Poland has achieved a relatively low rate of energy dependence in relation to other European Union countries, which indicates a relatively high level of energy security. The key factors that affect the achieved level of energy dependence are the degree of diversification of sources of supply (domestic and foreign) of energy resources, the size and diversity of the domestic fuel base, the possibility of fuel storage, the technical condition and forms of ownership of infrastructure, and the development of national and international energy policy.

EU countries, in order to achieve the expected level of energy security, are forced to develop and undertake a number of specific measures. To a large extent, they should be oriented towards increasing the competitiveness of the EU energy sector. A requirement of which is to ensure identical operating conditions for all countries of the EU energy market. At present, the key seems to be to increase the security of energy supply, which is related to ensuring stable conditions allowing to cover the current and future demand of EU economies.

Future research will deal with the diagnosis and analysis of the energy mixes of Central and Eastern European countries in the context of their energy security.

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## THE IT PROJECT LIFECYCLE IN R&D: AN ADAPTIVE APPROACH TO PROJECT MANAGEMENT

Maria ECKES-KONDAK<sup>1\*</sup>, Jacek DAJDA<sup>2</sup>

<sup>1</sup> AGH University of Krakow, Faculty of Computer Science; meckes@agh.edu.pl,  
ORCID: 0000-0002-9049-4440

<sup>2</sup> AGH University of Krakow, Faculty of Computer Science; dajda@agh.edu.pl, ORCID: 0000-0001-8617-4981

\* Correspondence author

**Purpose:** This article examines a structured framework for the IT research and development (R&D) project lifecycle, focusing on critical phases of effective project management and success.

**Design/methodology/approach:** This study examines project cycle management (PCM), project management institute (PMI), and PRINCE2 methodologies through a detailed literature review and comparative analysis of these frameworks about a project in the IT R&D sector. The focus is on adapting the life cycle to the specifics of an IT R&D project, taking into account classic and agile methods, and analyzing the variability of resource utilization at different stages of these projects.

**Findings:** The results indicate that dividing IT R&D projects into clearly defined phases promotes effective control and adaptive management. Each phase is also characterized by different relevance and resource utilization, which influences the need to adjust management actions depending on the stage of the IT R&D project. In addition, some phases are iterative, which harmonizes with the tenets of agile management of this type of project.

**Research limitations/implications:** To achieve optimal project results, it is recommended to adapt the life cycle to the specifics of the IT R&D project, emphasizing the importance of its different phases in the context of adaptive management. The article proposes a project management approach that combines the structured phases of PCM with the adaptability of PMI and PRINCE2 methodologies and agile methods to better suit R&D objectives.

**Practical implications:** The research highlights the need to adapt traditional project management models to the specific nature of IT R&D projects by incorporating iterative processes and greater flexibility. The proposed hybrid project lifecycle model enhances management efficiency, optimizes resource allocation, and enables quicker responses to changing conditions and stakeholder needs. Applying this approach can contribute to shorter development cycles, reduced risks, and faster market introduction of innovations. The findings have significant practical implications, supporting organizations in achieving better project outcomes and gaining a competitive advantage.

**Originality/value:** By focusing on the unique needs of IT R&D projects, this paper contributes valuable insights to the field of project management, highlighting the role of structured life cycles in maximizing the effectiveness of IT R&D projects.

**Keywords:** adaptive project management, project life cycle, IT R&D projects.

**Category of the paper:** research paper and viewpoint.

## 1. Introduction

Information Technology (IT) research and development (R&D) projects are central to driving innovation, technological advancements, and scientific discovery across industries. However, the management of these projects presents unique challenges due to the inherently uncertain nature of R&D activities (Flitz Turkmen, Topcu, 2021). Unlike more predictable, linear projects, IT R&D initiatives often operate in complex environments where project goals may evolve in response to emerging findings, stakeholder feedback, or external pressures (Wang et al., 2007). In these projects, there is also iteration in the solution design (Beck et al., 2001) phase which affects the need to develop a less linear cycle. Effective management of these projects thus requires a structured yet adaptable approach to ensure alignment with broader organizational objectives, efficient resource utilization, and successful solutions generation (Kerzner, 1981).

The tools that support the management efficiency of projects in the organization are methodologies and project life cycle (Kostalova, Tetreva, 2016). Project management is based on the assumption that projects are cyclical in nature, that is, they are closed wholes consisting of recurring phases and stages (Project Management Institute, 2013). Especially in research and development projects, the life cycle of a project is highly visible, as each phase of the project ends with some documented checkpoint (Li et al., 2020), representing a tangible result of the work carried out, this may be a proposal for an application for funding, an implementation contract, or a final project report. In addition, these projects are typically cyclical in nature, as the result of one project, can directly contribute to the start of another.

Separate phases play an important role in IT R&D projects; they are almost separate, closed phases that merge into a complete cycle. The various phases of a project differ in terms of duration, degree of resource commitment, and the methods used for guidance, planning, and control. Phases are usually time-bound, with a start and end point or control point. In addition, when planning the assumptions of each process in an IT R&D project, it is necessary to detail the scope of activities that will go into a phase in order to move on to the next phase (PMBOK® Guide). During each phase, the content of the project documents can be analysed and revised and then moved to the next phase. Such a system makes the project concept and the context in which it is implemented transparent, allowing more effective monitoring and evaluation of a given project. Each stage in the life cycle of a project is important and should not be overlooked, as the overall goal of the project may change depending on the phase the project is in (de Wit, 1988).

Defining the cycle of an IT R&D project, identifying its important and resource-intensive phases, and using the life cycle of that project in a disciplined way can help managers manage it effectively. It will also overcome two key technical problems: the late identification or abandonment of key project elements (such as risks, tasks, functions, resources needed,

contractor roles and responsibilities, and stakeholder influences) and the unwarranted continuation of the project in the event of failure (Kloppenborg, Petrick, 1999).

The purpose of the article is to analyse existing project life cycles based on selected methodologies and management frameworks - Project Cycle Management, PRINCE2, and PMI - and adapt them to the specifics of an IT R&D project. The analysis identifies and evaluates the role and value of project phases. The correlation between these phases and the number of resources used in them was also examined. Next, three phases of the IT R&D project life cycle that are critical to the project were identified.

Based on this analysis, the paper proposes a generic approach tailored to R&D projects in the IT department which offers adaptability through iterative cycles and continuous feedback. The article concludes with a summary of the results, recommendations for IT R&D project managers, and a brief discussion of the study's limitations and potential directions for further research.

## **2. Literature review**

The literature on project life cycle management often overlooks the specific requirements of IT R&D projects, where high degrees of uncertainty, the need for iteration at the product stage, and the need for stakeholder alignment complicate traditional project management practices. Studies indicate that while standard frameworks such as Project Cycle Management (PCM), the Project Management Institute (PMI) standards, and PRINCE2 are widely used in various industries, their application in R&D remains under-explored and requires modifications to fit the dynamic nature of research environments (Kerzner, 2017). PCM, for example, provides a highly structured approach with defined phases that facilitate accountability and resource allocation, making it suitable for projects requiring rigorous oversight. However, its rigid structure can pose challenges in highly flexible environments like IT R&D, where project goals may shift as research progresses. Similarly, PMI's framework supports adaptability and resource optimization, which aligns with the needs of R&D projects but may lack the necessary focus on iterative evaluation which is critical in IT scientific research (Project Management Institute, 2013).

One major challenge in IT R&D project management is the coordination and engagement of diverse stakeholders, including funders, researchers, industry partners, and end-users, who each bring different expectations and requirements (Smith, Johnson, 2022). Stakeholder engagement is particularly crucial in R&D, as projects often involve significant public or private investment, and their outcomes have implications for innovation, policy, and societal benefits. An effective project life cycle approach must integrate stakeholder input at every stage

to ensure that the project remains aligned with external expectations and is capable of generating impactful results (Pinto, Slevin, 1988).

This study seeks to bridge the gap in the literature by examining how established project management methodologies PCM, PMI, and PRINCE2 can be adapted to meet the unique needs of IT R&D projects. The aim is to understand how these frameworks align with R&D's iterative and high-stakes environments, where project goals, deliverables, and success metrics are often fluid rather than fixed (Meredith, Mantel, 2011). By analysing the strengths and limitations of each framework, this paper addresses the following research questions:

- **Q1: How do PCM, PMI, and PRINCE2 align with the demands of IT R&D projects?**
- **Q2: What modifications can improve the effectiveness of these frameworks in IT R&D contexts?**

Ultimately, this study aims to contribute to the growing body of knowledge on IT R&D project management by offering a model of the IT R&D project lifecycle aimed at increasing efficiency, accountability, and success rates in these projects (Kerzner, 2019). The role of the Project Life Cycle framework in IT R&D

The project life cycle is foundational in traditional project management and typically includes phases such as initiation, planning, implementation, monitoring, and closure (Turner, Müller, 2003). In general industry settings, this life cycle structure helps in organizing resources, defining deliverables, and tracking progress. However, in R&D environments, project goals often evolve in response to findings, leading to a need for flexible, adaptive management structures. IT R&D lifecycle frameworks must therefore accommodate feedback loops, iterative processes, and frequent evaluations to guide decision-making effectively (Kerzner, 2019).

IT R&D projects are distinct from traditional projects due to their exploratory nature and iterative nature (Hevner et al., 2004). Often operating with high uncertainty, these projects rely on a phased approach to break down complex tasks, assess progress at each stage, and enable decision points where changes to scope, methodology, or objectives may be necessary. PCM, PMI, and PRINCE2 each provide phase-based structures that can support this adaptive approach but differ in their level of flexibility and focus on stakeholder engagement. The literature indicates that these adaptations are crucial, as IT R&D projects require ongoing adjustments that traditional life cycle frameworks may not fully support (Turner, 2014).

## **2.1. Project Cycle Management (PCM) in IT R&D projects**

Project Cycle Management (PCM) is one of the earliest frameworks for structuring projects, and it is particularly recognized for its application in the European Union's funded projects, where transparency and accountability are paramount (European Commission, 2004). PCM divides projects into six stages: planning, identification, formulation, financing, implementation, and evaluation. Each stage is defined by distinct objectives and deliverables,

making PCM suitable for projects requiring structured oversight. Its emphasis on progressive assessment and defined checkpoints aligns well with IT R&D projects, as these stages facilitate controlled decision-making and resource allocation (Basu, 2015).

However, PCM's highly structured approach can pose challenges in the flexible IT environment of R&D, where the scope of research projects may change as new information emerges. The structured nature of PCM can sometimes hinder rapid adaptation, a critical aspect of scientific research. Literature suggests that modifications to PCM may be necessary, particularly in the development and implementation stages, to allow for iterative assessments and the incorporation of real-time feedback from stakeholders (Pinto, Slevin, 1989).

## **2.2. Project Management Institute (PMI) framework and its application to IT R&D**

The PMI framework, outlined in the Project Management Body of Knowledge (PMBOK® Guide), is one of the most widely used project management standards globally. PMI emphasizes five core processes: initiation, planning, execution, monitoring and control, and closing. PMI's flexibility and focus on resource optimization make it a robust choice for IT R&D projects, where project requirements may shift as new discoveries are made. PMI's framework also incorporates risk management strategies, which are essential in R&D settings, where uncertainty is a significant factor (Kerzner, 2017).

In IT R&D projects, the monitoring and control phase of PMI plays a key role, providing continuous oversight that is consistent with the iterative nature of these projects. The adaptability of this structure allows project managers to adjust resources and schedules based on emerging needs. However, some researchers argue that PMI could benefit from an expanded emphasis on iterative assessments, as traditional PMI practices may not fully address the ongoing needs of assessing and revising IT R&D projects (Smith, 2010). Integrating feedback loops at key milestones within PMI could increase its applicability to IT R&D, allowing project managers to refine goals and adjust stakeholder expectations as the project evolves (López et al., 2021).

## **2.3. PRINCE2 and its suitability for IT R&D projects**

PRINCE2 (Projects in Controlled Environments) is a process-driven project management methodology that segments projects into preparation, initiation, execution, and closure phases, with a strong emphasis on business justification and risk management (Smith, Brown, 2020). Initially developed for government projects in the United Kingdom, PRINCE2 has gained global recognition for its structured, process-based approach. This methodology's focus on business case justification and stakeholder involvement makes it particularly well-suited for projects with high external visibility and funding requirements, common traits of many IT R&D initiatives (Young, 2016).

PRINCE2's emphasis on stakeholder engagement and justification aligns with the needs of IT R&D projects, where external partners, including funding agencies and industry collaborators, play a critical role in defining project success. The methodology's structured phase-gate approach provides clear decision points, enabling ongoing stakeholder engagement and iterative project evaluations. PRINCE2's "manage by stages" principle is particularly valuable in IT R&D, where each stage can be evaluated to determine if the project should continue, pivot, or conclude (Zwikael, Smyrk, 2019). However, PRINCE2's structured nature can sometimes limit flexibility, and IT R&D project managers may need to modify PRINCE2's rigid phase transitions to better accommodate iterative scientific exploration (Cleland, 2007).

#### **2.4. Adaptation of life cycle models for IT R&D**

The literature emphasizes that IT R&D projects benefit most from project management frameworks that include adaptability, iterative phases of product development, and stakeholder alignment (Miller, Hobday, 2020). PCM, PMI, and PRINCE2 offer benefits when applied to IT R&D but also require specific adaptations to meet the iterative and evolving needs of these projects. Many researchers advocate a hybrid approach that incorporates elements of PCM structure, PMI flexibility, and PRINCE2 stakeholder alignment to better meet the demands of IT R&D projects, especially those in high-stakes, innovation-driven environments (Crawford, Pollack, 2004).

#### **2.5. Agile methods in IT R&D Projects**

Agile methods have emerged as a popular approach to managing IT R&D projects, particularly due to their focus on adaptability and responsiveness in uncertain and dynamic environments. These methods prioritize iterative development cycles and continuous stakeholder feedback, enabling teams to adjust to changing requirements and unforeseen challenges effectively (Beck et al., 2001). Agile's flexibility makes it well-suited for projects where innovation and exploration are key drivers, as it allows project teams to refine objectives and outcomes throughout the development process.

However, despite these strengths, agile methods often lack the structured planning and financial frameworks required for managing large-scale IT R&D projects, especially those reliant on external funding. Unlike traditional methodologies such as PCM or PRINCE2, Agile does not inherently include defined mechanisms for resource allocation, business justification, or stage-gate reviews, which are critical in high-stakes R&D environments (Smith, Johnson, 2022). The absence of these elements can pose significant challenges in securing and managing funding, as well as in maintaining accountability to stakeholders, including funders, regulators, and end-users.

For IT R&D projects, which often operate under strict financial constraints and high levels of scrutiny, the lack of formalized planning processes in agile can hinder its effectiveness. These projects require not only adaptability but also clear frameworks for resource



commitment, risk management, and progress evaluation. To address this gap, hybrid approaches that combine agile's iterative and adaptive principles with the structured oversight of traditional methodologies are increasingly recommended. Such integrations aim to provide the flexibility needed to navigate the uncertainties of R&D while ensuring the accountability and resource efficiency demanded by stakeholders (Kerzner, 2019).

This perspective underscores the necessity of refining existing methodologies to better align with the unique requirements of IT R&D projects, balancing the agility needed for innovation with the structure required for project governance and success.

## **2.6. Summary of Literature Insights**

The adaptation of PCM, PMI, and PRINCE2 for IT R&D projects highlights the need for a tailored approach to project management. By incorporating elements from each framework, project managers can develop a life cycle structure that promotes accountability, stakeholder engagement, and flexibility. Research emphasizes that such a hybrid approach allows IT R&D managers to meet project goals effectively while accommodating the iterative and uncertain nature of scientific research (Meredith, Mantel, 2011). The insights from this literature review provide a foundation for the proposed methods in this study, which will analyse the application of these frameworks to the life cycle stages of IT R&D projects.

In summary, PCM, PMI, and PRINCE2 each provide valuable contributions to IT R&D project management when applied adaptively. This study seeks to refine these insights by examining how each framework aligns with IT R&D's unique requirements, identifying potential adaptations, and proposing an integrated life cycle approach that maximizes project success and stakeholder engagement (Patanakul, 2010).

## **3. Research method**

In This study uses a qualitative approach to analyse the application and adaptability of three core project management methodologies - Project Cycle Management (PCM), the Project Management Institute (PMI) framework, and PRINCE2 - in the context of IT R&D projects. The goal is to assess how these frameworks meet the unique requirements of this type of research, including the need for iteration of certain phases, flexibility of resources, and active stakeholder involvement. The method includes a literature review, a comparative study of lifecycle frameworks, and a viewpoint analysis based on benchmarking IT R&D projects. The viewpoint analysis incorporated qualitative perspectives gathered during the benchmarking process, providing deeper insights into the strengths and limitations of each framework in practical applications. The final stage of the study is to design an IT project lifecycle that is tailored to the specifics of this type of project and addresses its needs. The author's IT R&D

project life cycle is designed to apply adaptive management methods to the various phases of the project, which can influence its successful completion.

The study evaluates the life cycles of PCM, PMI, and PRINCE2 according to four basic criteria:

- **Adaptability:** this criterion assesses the framework's ability to adapt to changes in project scope, objectives, and resource needs that are typical of R&D projects as new findings emerge. Adaptable frameworks are essential in R&D for IT projects, where rigid structures can hinder necessary adjustments (Jetter, Albar, 2016).
- **Stakeholder engagement:** effective stakeholder management is critical in IT R&D projects because of the involvement of various stakeholders, such as researchers, funders, industry partners, customers, and regulators. This criterion assesses the extent to which each structure facilitates stakeholder inclusion in decision-making processes, ensuring alignment with evolving project goals (Urbinati et al., 2021; Hooge, Dalmaso, 2015).
- **Iterability:** IT R&D projects often require iterative processes and continuous evaluation to refine methods, validate findings, and adjust objectives. This criterion examines the extent to which a given project lifecycle supports iterability, enabling the project to respond effectively to new data and stakeholder feedback (Wynn, Eckert, 2017).
- **Resource Allocation:** R&D resource management in IT projects is challenging due to changing requirements and the need for expertise. This criterion focuses on each framework's approach to resource allocation, including flexibility in reallocating resources (Toppila et al., 2011).

Data collection included an extensive literature review of academic publications, project management textbooks, and institutional guidelines on PCM, PMI, and PRINCE2 methodologies. Benchmarking techniques were used to highlight the strengths and weaknesses of each framework as applied to IT R&D projects. The approach provided a detailed understanding of how each methodology supports or constrains IT R&D project management, particularly in terms of adaptation to dynamic research processes and integration of feedback mechanisms (Mahindra, Srivastava, 2019).

To evaluate the effectiveness of PCM, PMI, and PRINCE2, a benchmarking process was conducted. This involved:

- Comparing the incidence of each phase using in IT R&D projects across case studies.
- Mapping the key strengths and weaknesses of each framework in the context of the four criteria.

Additionally, project lifecycle phases identified in the selected frameworks were analyzed for their relevance and effectiveness in IT R&D settings. For example, phases such as planning, implementation, and deployment were scrutinized for their adaptability to iterative processes.

## 4. Results

The first stage of the research was to identify potential phases of an IT R&D project based on the selected three methodologies of PCM, PRINCE2, and PMI, and to evaluate them taking into account the developed criteria for: adaptability, stakeholder involvement, and iterability (Table 1). Based on the research, six phases were identified: planning, financing, implementation, deployment, monitoring and control, and evaluation. These phases are important for IT R&D projects because they take into account specific aspects of these ventures, such as the need to use agile management methods and the need for adaptability, iteration, and stakeholder participation in the project process.

The next stage of the research included an assessment of resource utilization in each phase of the life cycle of the methodologies under consideration, along with an assessment of resource utilization in terms of the IT R&D project (Table 2). At this stage, only the phases of the IT R&D project that scored highest in the previous survey were considered. The research results show that most resources are used in the implementation phase of the project, but they are also used significantly in the planning and deployment phases. This indicates the high importance of these phases in the process of managing an IT R&D project and the focus on the need for iteration, stakeholder engagement, and continuous evaluation and adaptation.

**Table 1.**

*Determination of the most important phases of the IT R&D project life cycle on the basis of exemplary management methodologies (PCM, PRINCE2, PMI)*

No.	Mapped project phases (PCM, PRINCE2, PMI)	Relevance of phase occurrence in an IT R&D project	Relevance of phase occurrence in PCM	Relevance of phase occurrence in PRINCE2	Relevance of phase occurrence in PMI	Total points
1.	Preparation	1	0	3	0	4
2.	Initiation	1	2	0	2	5
3.	Planning	3	3	0	3	<b>9</b>
4.	Identification	1	2	0	0	3
5.	Appraisal	2	2	0	0	4
6.	Funding	3	3	0	0	<b>6</b>
7.	Implementation <sup>1</sup>	3	0	3	3	<b>9</b>
8.	Deployment	3	3	0	0	<b>6</b>
9.	Monitoring and control	3	0	0	3	<b>6</b>
10.	Closing	1	0	2	2	5
11.	Evaluation	3	3	0	0	<b>6</b>

Note. 3 - decisive/key, 2 - significant, 1 - irrelevant, 0 - not present.

Source: own study.

<sup>1</sup> Implementation is often understood as the deployment of a solution. However, in this context it refers to its execution of the IT R&D project.

**Table 2.**

*Use of resources in the different phases of the designated R&D project life cycle with reference to selected management methodologies (PCM, PRINCE2, PMI)*

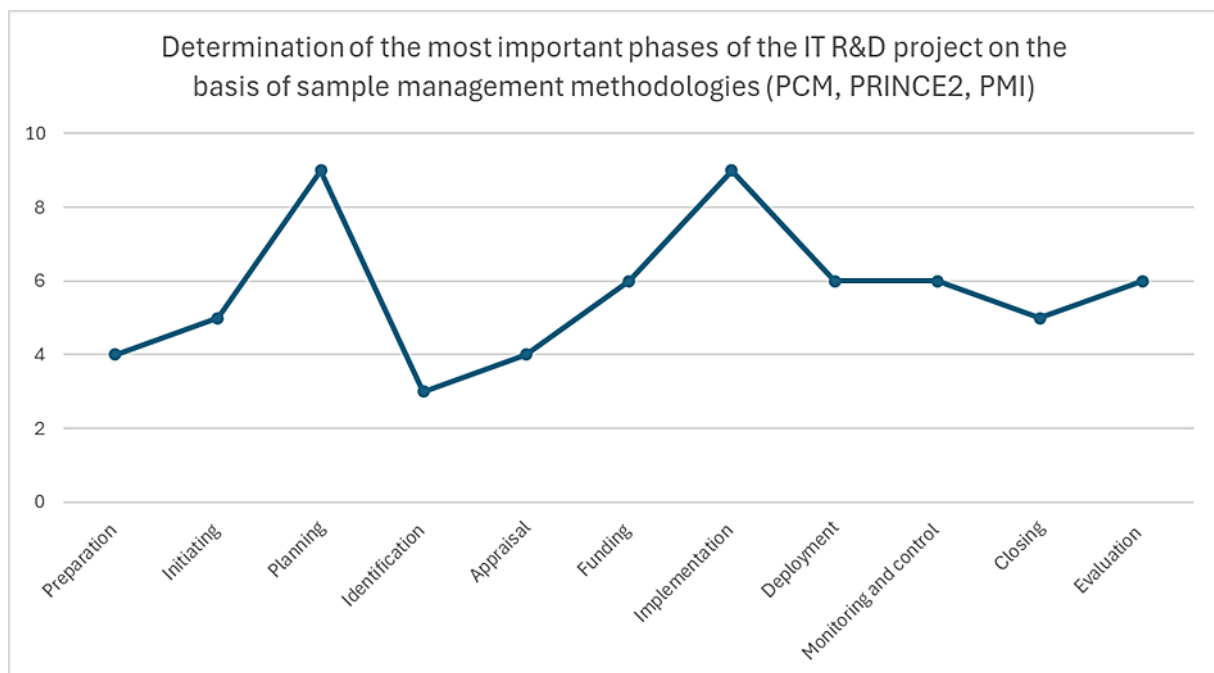
No.	Mapped project phases (PCM, PRINCE2, PMI)	Resource intensity of phase occurrence in an IT R&D project	Resource intensity of phase occurrence in PCM	Resource intensity of phase occurrence in PRINCE2	Resource intensity of phase occurrence in PMI	Total points
1.	Planning	2	2	0	2	6
2.	Funding	1	1	0	0	2
3.	Implementation	3	0	3	3	9
4.	Deployment	3	3	0	0	6
5.	Monitoring and control	2	0	0	1	3
6.	Evaluation	1	1	0	0	2

Note. 3 - large, 2 - medium, 1 - small, 0 - not present.

Source: own study.

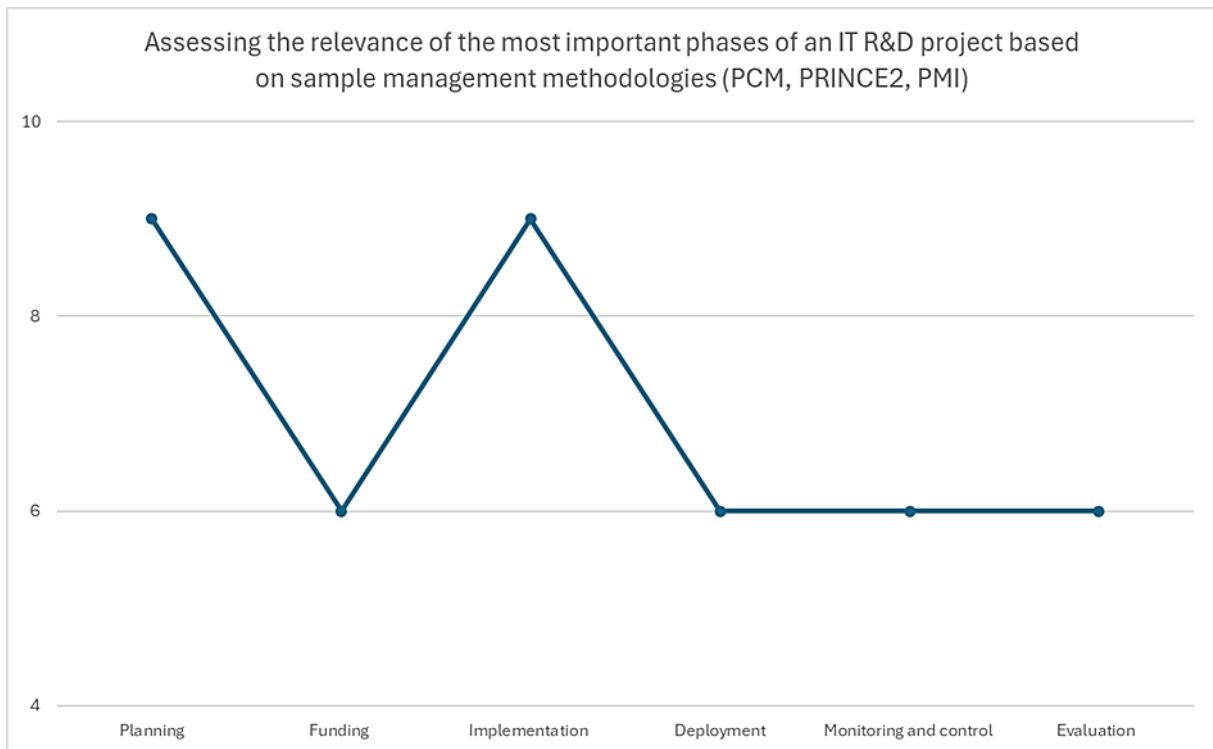
Figure 1 and Figure 2 in addition to Table 1 indicate how the relevance of the phases is shaped for all the phases designated by the selected methodologies (Figure 1) and for the selected, more important phases of the IT R&D project. The planning and implementation phases play the largest role. It was also found that the identification, preparation, and appraisal phases are the least frequent in this type of project.

Figure 3 shows the use of resources in selected phases of an IT R&D project. The implementation and planning phases represent moments of increased use of project resources.



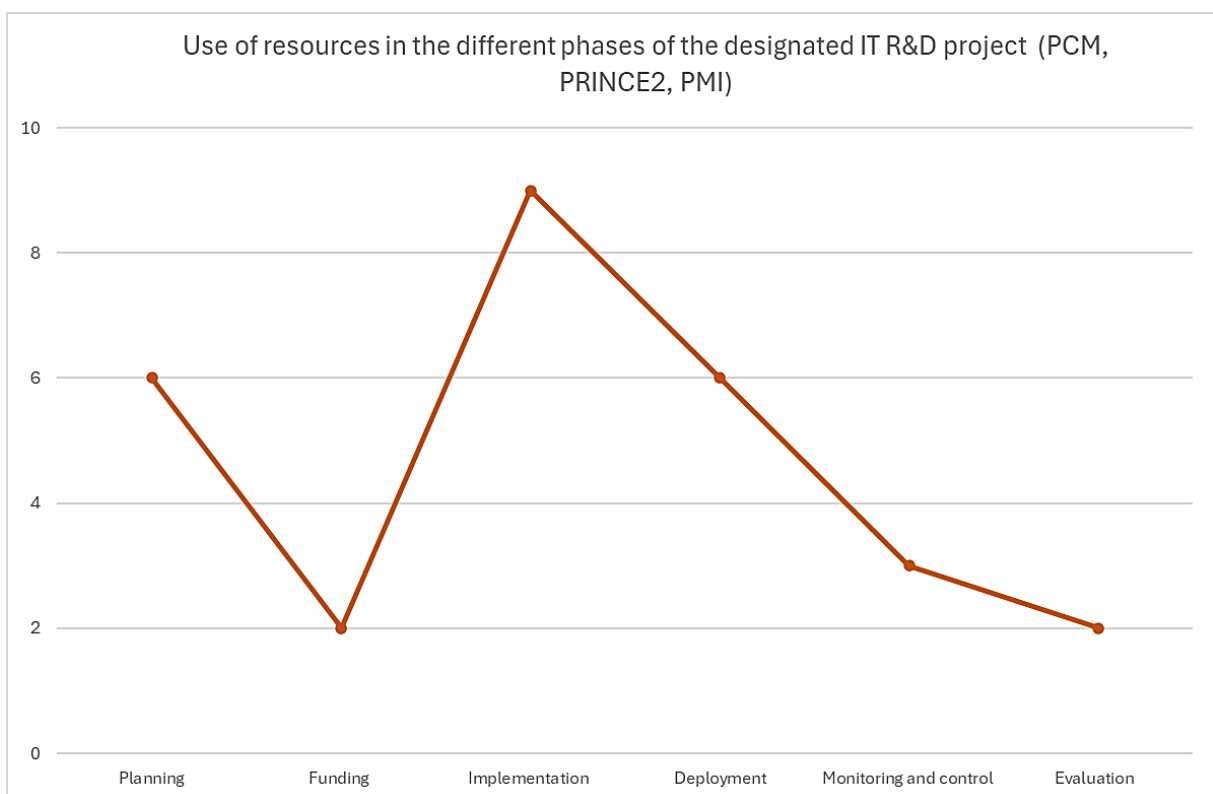
**Figure 1.** Indication of the relevance of the different phases of the IT R&D project life cycle using selected management methodologies (PCM, PRINCE2, PMI).

Source: own study.



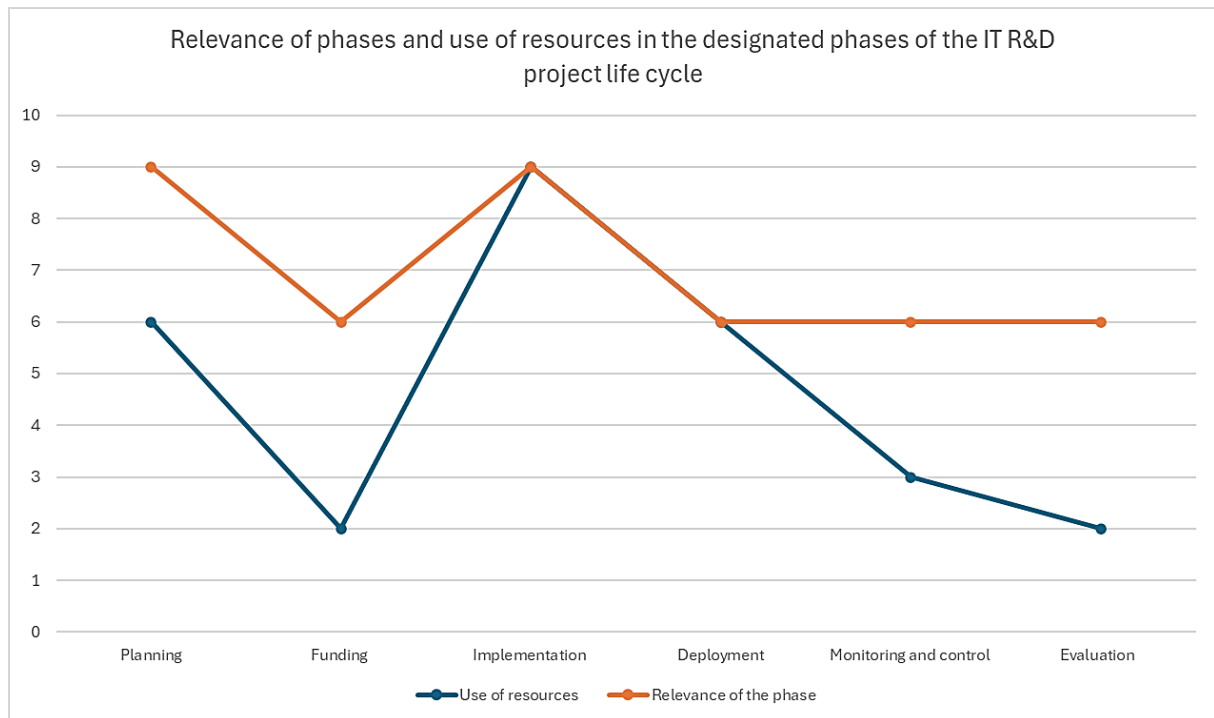
**Figure 2.** Assessing the relevance of different phases of the IT R&D project life cycle using selected management methodologies (PCM, PRINCE2, PMI).

Source: own study.



**Figure 3.** Use of resources in the different phases of the IT R&D project life cycle using selected management methodologies (PCM, PRINCE2, PMI).

Source: own study.



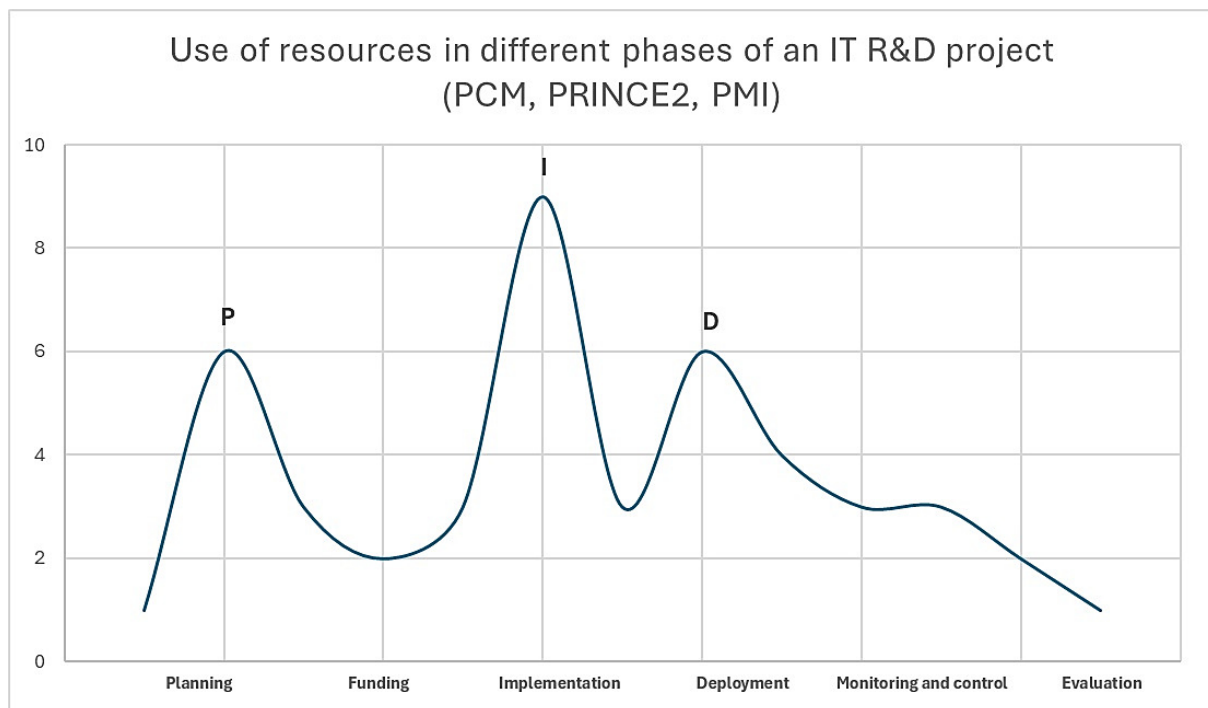
**Figure 4.** The importance of the different phases of the IT R&D project and the use of resources in the design life cycle phases.

Source: own study.

After analysing the relevance of the phases of the IT R&D project and determining the use of resources in each phase, the results are summarized in Figure 4 to show the relationship between them. Considering the results obtained, it can be seen that the implementation phase is characterized by high materiality as well as significant resource utilization. This indicates that there is a great need to support management processes in this phase and their adaptation. High use of resources in relation to the importance of the phase also occurs in the planning and deployment phases. All of these phases are important points for the project that can determine its success.

It can also be seen from the figure that the evaluation monitoring and control phases, despite their importance, do not require the use of too many resources. In IT R&D projects, evaluation is very important, especially when iterations are made, stakeholder involvement is strong, and resource use is variable. In addition, when running this type of project, it is necessary to keep in mind its high risk and constantly monitor and control it. In the case of IT R&D projects, monitoring and control should be carried out at all relevant stages of the project. And it is necessary to remember to prepare a risk analysis in the initial phases of this project.

The research conducted gives an understanding of the formation of the main project phases, which have a significant impact on the success of an IT R&D project due to their relevance and use of resources.



**Figure 5.** The importance of the different phases of the IT R&D project and the use of resources in the design life cycle phases.

Source: own study.

Figure 5 shows a breakdown of the resource intensity of the various phases of an IT R&D project in relation to their importance. It can be observed that the implementation phase is characterized by both high importance and resource use. The planning (P) phase, on the other hand, is just as important as the implementation (I) phase but uses far fewer resources. By this, we mean how important the planning phase is for the project, when with little cost in terms of resource utilization we can develop a highly relevant plan of action for the IT R&D project. Also important for the IT R&D project is the deployment (D) phase of the technology, and in this case also needs to use significant resources, however not as many as in the case of the implementation phase.

The results show the high relevance of three project phases in terms of resource commitment: planning, implementation, and deployment (PID). These phases require targeted management methods to take care of their positive implementation and incorporate their high risk into the project process.

## 5. Discussion

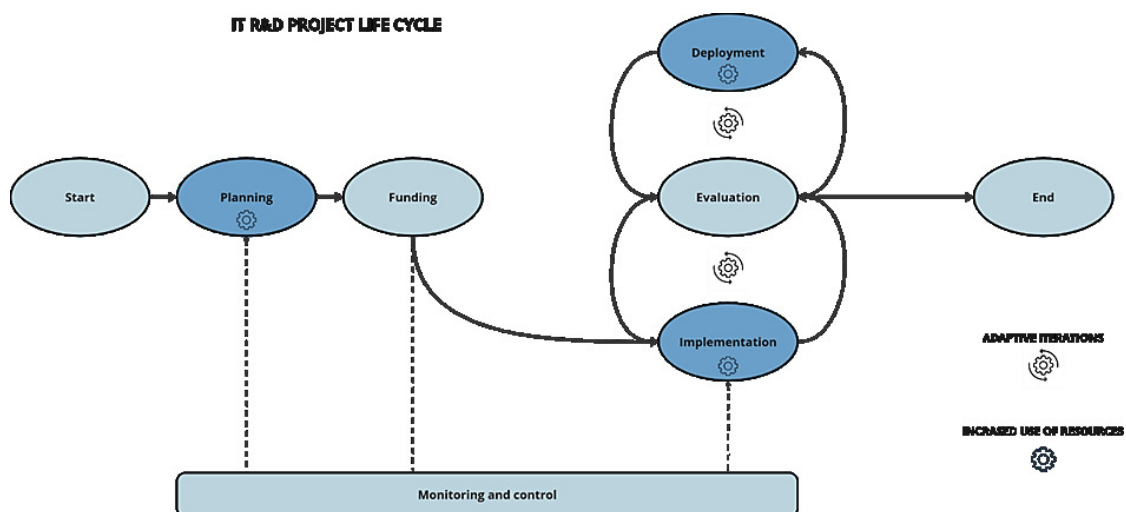
Traditional project management frameworks, with their structured phases, have long provided a stable foundation for managing projects across various industries. However, the dynamic nature of IT R&D projects presents unique challenges that traditional models

struggle to address effectively. These projects are characterized by high levels of uncertainty, frequent shifts in objectives, and the need for iterative development cycles. Moreover, the involvement of diverse stakeholders ranging from funders and researchers to industry partners and end-users requires constant coordination and alignment of expectations throughout the project lifecycle.

In addition to stakeholder complexity, IT R&D projects face inherent risks, such as technological uncertainty, evolving resource requirements, and the need for rapid adaptation to new discoveries or external changes. These factors demand a more flexible approach to project management, one that integrates the structured reliability of traditional frameworks with iterative, adaptive processes.

Given the research findings, this paper proposes an IT R&D project lifecycle model to address these needs by combining traditional project management phases with iterative cycles of implementation, evaluation, and deployment. This hybrid approach ensures continuous stakeholder engagement, risk management, and the ability to align resources while maintaining the overarching structure necessary to maintain project integrity. In this way, it provides a robust method for navigating the uncertainty and complexity of IT R&D projects, paving the way for more efficient and innovative results. The designed model reflects the growing realization that success in IT R&D depends not only on technical expertise but also on the ability to adapt and evolve in an ever-changing project environment.

The project lifecycle model illustrated in Figure 6 highlights the key integration of iterative phases in a traditional project management framework. Beginning with planning, financing, implementation, deployment, evaluation, and monitoring and control, the model highlights the importance of flexibility and adaptability in modern IT R&D projects. Incorporating adaptive iterations between the implementation, deployment, and evaluation phases ensures that projects can respond dynamically to emerging challenges of resource utilization, risk, and stakeholder feedback.



**Figure 6.** IT research and development project life cycle considering adaptive iterations.

Source: own study.



Monitoring and control serve as the backbone of this lifecycle, providing continuous oversight and enabling adaptation at each stage. This iterative and adaptive approach fits well with the unique requirements of IT R&D projects, where evolving goals, stakeholder engagement, iterability, resource variability, and risk management require a departure from rigid methods. Ultimately, the model demonstrates that combining traditional structure with iterative adaptability is essential for successful outcomes in complex and exploratory project environments.

The IT R&D project lifecycle model illustrates various decision-making pathways depending on the outcomes of each phase. Possible scenarios include: (1) terminating the project after the implementation phase if insurmountable technical challenges are encountered or the project loses relevance; (2) completing the project after execution and evaluation without deployment, in cases where the sole objective was to validate a technology; (3) implementing the solution and concluding the project; and (4) implementing, evaluating, and potentially further developing the project through adaptive iterations. This approach enables dynamic adjustments to change circumstances, allowing for iterative returns to earlier phases, such as implementation or evaluation, to improve outcomes, mitigate risks, or respond to stakeholder feedback. Adaptive iterations, characterized by their flexibility in strategic decision-making, support both the innovation process and efficient resource management.

The proposed hybrid project lifecycle model addresses many of the gaps identified in traditional frameworks, particularly when applied to IT R&D projects. Traditional methodologies such as PSM, PMI, or PRINCE2 provide a structured approach to project management, emphasizing sequential processes and business justification (Wrona, Ladwig, 2020). However, as highlighted in the literature, these methodologies often lack the flexibility to handle the iterative and exploratory nature of IT R&D projects (Hevner et al., 2004). The new model builds on prior research by integrating adaptive iterations and stakeholder engagement, drawing inspiration from agile methods, which prioritize adaptability and responsiveness (Chin, Spowage, 2010).

Previous studies have also emphasized the critical role of iterative feedback loops in complex projects (López et al., 2021). For instance, frameworks incorporating iterative phases have been shown to improve project outcomes by allowing teams to reassess objectives and align stakeholder expectations regularly. This iterative approach is especially relevant to IT R&D projects, where innovation cycles and resource requirements are highly variable (Smith, Johnson, 2022). By incorporating adaptive iterations into the traditional project lifecycle, the proposed model bridges the gap between structured processes and the need for flexibility in dynamic environments.

However, this model is not without limitations. One potential drawback is its increased complexity compared to linear frameworks, which may require additional training and resources to implement effectively. Furthermore, the model assumes that organizations have

the capacity to manage iterative processes and maintain continuous stakeholder engagement, which may not always be feasible in resource-constrained settings (Concannon et al., 2014).

One significant challenge lies in resource constraints, particularly during the planning, deployment, and implementation phases, which are resource-intensive and critical for project success. In the planning phase, insufficient resources can hinder the development of a robust project roadmap, leading to inefficiencies and gaps in aligning objectives with available capabilities. Similarly, the implementation phase often requires substantial investments in personnel, equipment, and expertise, which may strain budgets and lead to bottlenecks if resources are not managed effectively. The deployment phase, which involves transitioning project outcomes into practical use, is equally demanding, as it often requires additional funding and technical support to address unforeseen challenges or modifications.

Additionally, the model's success depends on the commitment of all stakeholders to participate actively throughout the project's duration, which can be challenging in large, multidisciplinary projects with competing priorities. IT R&D projects typically involve a wide array of stakeholders, including researchers, industry partners, funders, and end-users, each with distinct goals, priorities, and expectations. This diversity can lead to conflicting interests and resistance to change, especially when new management approaches or workflows are introduced. Ensuring consistent engagement and alignment among stakeholders is a complex task that demands substantial time and effort, as well as effective communication strategies. Without proactive management of these issues, stakeholder resistance can undermine the hybrid model's effectiveness, delaying progress and impacting project outcomes.

This study addresses the research questions by analyzing how PCM, PMI, and PRINCE2 align with the demands of IT R&D projects and proposing modifications to improve their effectiveness. PCM's structured approach supports oversight but struggles with flexibility, PMI provides adaptability yet requires stronger iterative processes, and PRINCE2 emphasizes stakeholder engagement but benefits from adaptations for iterative phases.

The proposed hybrid lifecycle model responds to these challenges by integrating adaptive iterations, continuous stakeholder engagement, and flexible phase transitions. This combination enhances resource utilization, risk management, and adaptability, ensuring the model meets the dynamic needs of IT R&D projects.

In response to the first research question (**Q1**), this study analyzed how PCM, PMI, and PRINCE2 align with the demands of IT R&D projects. PCM offers strong accountability and structured phases but struggles with the flexibility required for dynamic R&D environments. PMI provides adaptability and resource optimization but lacks sufficient iterative mechanisms, crucial for continuous improvement. PRINCE2 emphasizes stakeholder engagement and risk management, making it suitable for externally funded projects, but its rigid phase transitions limit its application to iterative scientific exploration. These findings underscore the need to adapt this framework to better meet the iterative and adaptive requirements of IT R&D projects.

Addressing the second research question (Q2), the proposed hybrid lifecycle model integrates adaptive iterations, continuous stakeholder engagement, and flexible resource allocation. It incorporates iterative feedback mechanisms in key phases like implementation and evaluation, enhances stakeholder involvement throughout the project lifecycle, and ensures resource adaptability to evolving needs. This tailored approach supports critical phases such as planning, implementation, and deployment, improving project responsiveness and alignment with dynamic objectives.

The implications of this model are significant for both practice and research. For practitioners, it provides a roadmap for managing IT R&D projects in a way that accommodates uncertainty and promotes collaboration. By fostering continuous evaluation and adjustment, the model ensures that project goals remain aligned with stakeholder expectations and emerging findings. For researchers, the model highlights the importance of further exploring hybrid approaches that combine traditional and iterative elements, as well as examining their applicability across different project types and industries.

## 6. Conclusions

This study offers an in-depth analysis of IT R&D project management, emphasizing the critical need to adapt traditional project lifecycle frameworks to meet the unique demands of IT R&D environments. By examining established methodologies such as PCM, PMI, and PRINCE2 through the lenses of adaptability, stakeholder engagement, iterability, and resource allocation, as well as conducting a benchmark analysis of IT R&D projects, the research identifies key areas where these frameworks excel and where they fall short in addressing the dynamic nature of IT R&D projects. The benchmarking provided a comparative perspective, highlighting practical successes and challenges in real-world applications, which further informed the evaluation of these methodologies and their suitability for iterative and resource-intensive environments.

The findings underscore that traditional methodologies provide a strong foundation for accountability and resource allocation. However, they often lack the flexibility required to accommodate the iterative processes and evolving objectives inherent in IT R&D projects. PCM's structured phases ensure transparency and oversight but struggle with rapid adaptation. PMI offers flexibility and resource optimization yet requires stronger iterative mechanisms to align with ongoing research. PRINCE2 excels in stakeholder engagement but benefits from more fluid phase transitions to support iterative evaluations and adjustments. On the other hand, agile methods provide some complement to classical methods and help adjust management activities at certain stages of an IT research and development venture.

The proposed hybrid IT R&D project lifecycle model integrates the strengths of this framework while addressing its limitations using agile methods. Adaptive iteration, continuous stakeholder engagement, and flexible resource allocation are the cornerstones of this model, enabling it to respond dynamically to changing research conditions, feedback, and emerging challenges. In particular, the planning, implementation, and deployment phases prove critical, requiring significant resources. In contrast, the implementation, deployment, and evaluation phases use iterations to adapt to high-stakeholder impact and minimize project risk.

The developed model serves as a generalized framework that combines key elements of various project management methodologies, such as PCM, PMI, PRINCE2, and agile approaches, to meet the specific needs of IT R&D projects. Its structured but flexible design harmonizes traditional project management phases with the iterative and exploratory nature of R&D. Agile methods are particularly valuable within adaptive iterations that occur between critical phases such as implementation, evaluation, and deployment. These methods, which emphasize incremental progress and continuous feedback, blend seamlessly with the iterative aspects of the model. By incorporating agile principles, the model enhances its ability to respond dynamically to changes made by project stakeholders, optimize resources, and adapt to changing project goals. This unified perspective ensures that the lifecycle model provides a practical and comprehensive tool for managing the complexity of IT R&D projects while maintaining consistency and adaptability.

The proposed model offers a practical framework for IT R&D project management that enhances efficiency, accountability, and success rates. For practitioners, this model provides a roadmap for balancing the structured reliability of traditional frameworks with the flexibility needed to navigate the uncertainties of IT R&D projects. It ensures that projects remain aligned with evolving objectives while optimizing resource utilization and mitigating risks.

Future research should focus on validating the hybrid model across diverse industries and project scales to assess its adaptability and scalability. Additionally, exploring strategies to streamline its implementation, particularly in resource-constrained settings, will be critical. Further investigations could also delve into the integration of emerging technologies, such as AI and machine learning, to enhance iterative decision-making and stakeholder collaboration in IT R&D projects.

This study contributes to the growing body of knowledge on adaptive project management by proposing a model that addresses the critical needs of IT R&D projects. By emphasizing adaptability, stakeholder engagement, iterability, and resource allocation, it lays a foundation for future advancements in managing high-stakes, innovation-driven initiatives.

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## ASSURANCE OF WORK QUALITY THROUGH ONBOARDING PROCESS IN TEMPORARY EMPLOYMENT

Patryk FELICZEK<sup>1\*</sup>, Paweł NOWICKI<sup>2</sup>, Piotr KAFEL<sup>3</sup>

<sup>1</sup> Uniwersytet Ekonomiczny w Poznaniu; patryk.feliczek@ue.poznan.pl, ORCID: 0000-0002-1209-9613

<sup>2</sup> Department of Quality Management, Krakow University of Economics; nowickip@uek.krakow.pl,  
ORCID: 0000-0002-7496-0157

<sup>3</sup> Department of Quality Management, Krakow University of Economics; kafelp@uek.krakow.pl,  
ORCID: 0000-0002-4140-8366

\*Corresponding authors

**Purpose:** The aim of this article is to analyze and evaluate practices related to onboarding process of temporary employees in companies in the logistics and warehouse industry (services). Additionally, the purpose of this article is to recommend activities, that can be implemented in the organizations in order to achieve better quality of work and ultimately increased quality of services, provided by the temporary employees.

**Design/methodology/approach:** The study was preliminary and based on conducting a pilot qualitative study using the method of individual in-depth interview (IDI). The study covered the subject of the onboarding process of temporary employees in logistics and warehouse organizations operating in the Great Poland region. The article presents the results of the study conducted among temporary employees.

**Findings:** The main aspects, covered in the study, regarding onboarding process are related to the way the onboarding process has been performed, what information has been passed to the temporary newcomers and how they have been welcomed and trained. Authors suggests recommendations to the organizations to improve this process.

**Research limitations/implications:** The limitation of the study was the analysis of the practice of just 25 employees in 3 companies. The results of the initial study might be subjected to further study, in a full scope. At the same time competences' development process for temporary employees may be also examined. Collecting the data from different HR processes, applied within the temporary employees' community, will make it possible to build a full picture of the practices used in organizations. This picture together with the analysis and recommendations will help companies, using temporary form of employment, to improve their process to achieve desired results in terms of quality.

**Practical implications:** The results of the study might be used by the companies interested in the form of temporary work and companies struggling with lowering quality of products or services as a result of employing temporary employees.

**Originality/value:** As the temporary work in Poland usage is important and this importance has increased companies need to understand the factors influencing the quality of temporary employees' work. This area has not been explored enough through research study.

**Keywords:** temporary employment, onboarding, agency, quality.

**Category of the paper:** Research study.

## 1. Introduction

Temporary work, regulated in Polish legislation, is an important form of providing human resources for work in various industries. In Poland, the logistics and warehousing industry uses temporary work to the greatest extent, and the main work then includes sorting, packaging and packaging. A significant share of temporary work in the logistics and warehouse industry is due to the high seasonality of work performed in this form of activity.

The main feature of temporary work is high flexibility in recruiting employees and resigning from their services. Temporary work is characterized by the presence of three entities - a temporary worker, a user employer and a temporary employment agency. A temporary employment agency acts as an official employer however the main role is at the employer-user side, as this is the company that needs such employment form.

In addition to the positive aspects of using a temporary form of work, there are also elements that can negatively affect the organization. These aspects are mainly related to the temporary employees themselves, whose involvement may be lower than in the case of permanent employment. This, in turn, can affect the quality of their work, and consequently affect the quality of products or services offered by the organization.

According to the research, that can be found in the literature, increasing the number of temporary employees, in an organization, causes the decrease in the quality level of manufactured products and provided services.

Organizations take various actions aimed at minimizing the negative effects of temporary work. The main activities certainly include those that occur in the area related to human resources management. It is this organizational area that is responsible for shaping the processes occurring in the employee life cycle. These processes include recruitment and hiring, onboarding of new employees, development of their competences and offboarding. After the phase of selecting and hiring an employee (in the case of temporary employees, employment is carried out by a temporary employment agency), a very important process is to introduce (onboard) the new person to work so that the person finds himself properly in the new environment as soon as possible and acquires the competences that are necessary to perform the tasks. So in this paper the focus has been put on the onboarding process.

Based on the above, the aim of this article is to analyze and evaluate practices related to onboarding process of temporary employees in companies in the logistics and warehouse industry (services). Additionally, the purpose of this article is to recommend activities, that can be implemented in the organizations in order to achieve better quality of work and ultimately increase quality of services, provided by the temporary employees.

## 2. Onboarding process characteristic

The next stage, after the recruitment process and selection of a candidate for work, is the process of its onboarding. Onboarding has been considered as one of the human resource practices and one of the important processes in the organization. It serves vital role in assuring competent manpower to complete organizational tasks and achieve competitive advantage (Jeske, Olson, 2021). During the onboarding process, a new employee is introduced to the position and given an overview of the company's principles, objectives, guidelines, procedures, and organizational culture (Pinco, Salanta, Beleiu, Crisan, 2024). For employees, onboarding process plays a significant role as they join new organization and new team, move into new work settings, and assume new responsibilities (Adler, Castro, 2019). Ultimately, through onboarding process, employees should feel valued and equipped with all the necessary tools to be able to complete their tasks (Kowtha, 2018).

Bauer and Erdogan (2010) have been widely cited, within years, with their definition of onboarding. The authors have suggested that the onboarding process is like a process of socialization and can be understood as transition from being outsiders in a company to insiders. This definition is a very general one and within 14 years there have been many changes also to human resources processes and how they have been performed. Following that there have been many other definitions proposed highlighting broader scope of the onboarding process. Basing on the definitions, the onboarding is not only the process of introducing newcomer to the organization and the tasks but assuring that the newcomer understands the organization's values, goals, policies, processes and organizational culture (Caldwell, Peters, 2018). This is aimed to achieve required level of engagement, work quality, productivity and lowering the attrition rate (Kumar, 2017).

The content of the onboarding process will definitely depend on the type of organization (e.g. production company or service provider), level of the position in the organization structure and the position itself (Klein, Polin, 2012). On the other hand, in many organizations the onboarding process is being divided into two parts. First part, very general, does not depend on the position or position level in the organization structure, and it consists basic information to be passed to all the newcomers. Second part has been usually more specific, to the position being fulfilled by employed person.

The effectiveness and efficiency of the onboarding process depend on both the candidate and the organization. In terms of the candidate, the result of the onboarding process certainly depends on the competences acquired so far, predispositions to acquire new elements of knowledge and then use them within a specific job position (Ciekanowski, 2012). The candidate's approach to work and his or her employee duties also seems to be no less important. On the part of the organization, in turn, it is expected to provide the necessary implementation tools and conduct theoretical and practical training.

In the context of this publication and the research carried out, the focus should be on the organization's approach to the implementation of the employee onboarding process. On the one hand, it is important to provide the necessary information about the organization, the prevailing rules, and working conditions so that the employee can move comfortably in the new work environment. On the other hand, without providing substantive information about the work performed, in the form of on-the-job training, it is also impossible to expect the correct performance of tasks and obtaining the required level of quality of the work performed. Of course, it can be stated that conducting on-the-job training in the form of on-the-job training is an obligation of the employer, resulting from the provisions of the labor law, and in this respect, it is not voluntary (Act of 27 July 2004). However, in practice, organizations represent different approaches to the implementation of the employee onboarding process. This diversity, in the opinion of the authors of the publication, is one of the elements causing the level of quality of work provided to be different in an organization that has only conducted mandatory training, e.g. on work instructions for a given position, and different in an organization that has a standardized and extensive employee onboarding plan (Gajda, 2019). Such a plan can cover a wide range of aspects related to the work to be performed. Moreover, the implementation process can be carried out by various functions in the organization, depending on the topic discussed (e.g. quality, technology, maintenance). In this way, you can provide a broader perspective in learning about the specifics of the organization.

### **3. Relation between onboarding process and temporary work quality**

Employees, by default, shall make sure that the products and services the company delivers to its customers are in accordance with the specification. This statement requires of course the assumption that the specification is also correct, and its quality has been assured. There are many factors influencing the product and service quality however here, in this article, we focus purely on the manpower performance in this scope. Line employees can assure the product and service conformance by carrying out their duties in line with the policies and guidelines, that have been established by the management and included in work procedures and instructions (Feliczek, 2024).

As the available research shows, increasing the number of temporary employees, in an organization, causes the decrease in the quality level of manufactured products and provided services (Wiengarten, Onofrei, Fynes, Humphreys, 2020).

When discussing the relationship between the process of onboarding a new employee and the quality of temporary work, a key question should be asked (Antenor, 2021). The question is whether the way and scope of the implementation of a temporary employee should differ from that which takes place in relation to employees employed in the organization on the basis

of an employment contract (in the same positions). Assuming that temporary employees are required to have the same level of quality of work (which in turn will translate into the quality of products and services) as employees employed under an employment contract, the answer to the question seems to be negative in principle. Of course, there are some elements in which this process may differ, and these elements can be reduced to formal aspects (Radzividlo, 2020). According to the applicable legislation, the employer-user is not a formal employer, therefore the issues of concluding a temporary employment contract, making the required registrations of the employee in various organizations, remain the responsibility of the temporary employment agency (Act of 9 July 2003). Otherwise, contingent employees still need to be treated with the same level of attention and care during the onboarding process.

Given the characteristics of temporary work, onboarding a temporary employee can seem like a time-consuming step for an organization that can be skipped (Gultom, Liyas, 2023). Such an approach may be supported by the temporality of the work performed. One of the main reasons why proper onboarding is important is that it impacts the entire employment experience. A properly structured induction program can help temporary employees feel welcome, appreciated, and prepared for their new role, even for a defined period of time. This, in turn, can lead to increased productivity, commitment and job satisfaction, which will be expressed by following the rules of the organization and following instructions and guidelines containing requirements or good practices for manufacturing products or providing services (Cillo, Garcia-Perez, Del Guidice, Vicentini, 2019). Not having a proper onboarding process can lead to feelings of confusion, confusion, and disengagement, which can negatively impact the quality of work provided (Murgosky, 2023).

Certainly, an effective process for the induction of a temporary employee, as well as an employee employed under an employment contract, is to provide a comprehensive orientation program. In addition to the standard elements of the onboarding process found in organizations, it is increasingly important to provide temporary employees with a direct supporter in the organization (the so-called buddy), who will be a kind of shadow of the new employee (Ashurst, 2020). The onboarding process is an ongoing process that doesn't end on the first day. The onboarding process, depending on the organization, may last for a different period of time, until the employee can be considered independent to perform tasks as required.

## **4. Temporary employees' onboarding process based on companies from logistics and warehouse industry**

### **4.1. Metod of the study**

The subject of the pilot preliminary study were temporary employees working in logistics and warehousing companies in Great Poland. The study was aimed at obtaining information on

how the personnel management processes, towards temporary employees, have been performed by the employer-users. The intention was to gather information which can be used to understand, why the temporary employment has caused lowering level of quality of products and services (via lower level of quality of work). Basing on the information gathered it would be also possible to suggest the recommendations to the companies using the temporary form of employment.

As it has been mentioned above in the study broader scope of personnel management processes have been considered (such as recruitment, pre-boarding, onboarding, competence development as well as working conditions). However, in this text the authors focus only on the onboarding process.

The study itself was based on the In-Depth Individual Interview (IDI) method, which covered 25 temporary employees in 3 companies. The interviews have been conducted with the use of particular form. The interview form has been divided into 4 categories, reflecting different processes of personnel management, and followed by the survey metrics. IDI have been conducted with the employees by one of the authors personally during the period of November 2023 till February 2024.

The analysis of the data obtained, which is discussed later in this chapter, consisted in the assessment of the possible impact of practices concerning the process of onboarding a temporary employee on the quality of work performed by employer-users and, consequently, on the quality of services.

As previously specified, the study included 25 temporary employees. The survey was intended for employees who met the following requirements:

- have at least two years of experience as temporary employees in the logistics and warehousing industry or in the production of products, and
- have at least six months of experience working for an employer-user in the logistics and warehousing industry.

The temporary employees who were subjected to the IDI study came from four companies located in the Poznań area.

The study included both men and women, with 52.6% of women and 47.4% of men participating. Half of the survey participants (50%) are young people aged 25-31. 20% of the respondents are aged 39-45, while 15% of the participants represent the 18-24 and 32-38 age groups. The presence of different age groups indicates a diverse approach to the subject of the study, which can lead to richer and more diverse results. The majority of the survey participants, as many as 65%, are of Polish nationality. The second largest group, accounting for 20% of the respondents, were employees from Ukraine. A smaller percentage of respondents were represented by citizens of Belarus (10%) and Georgia (5%).

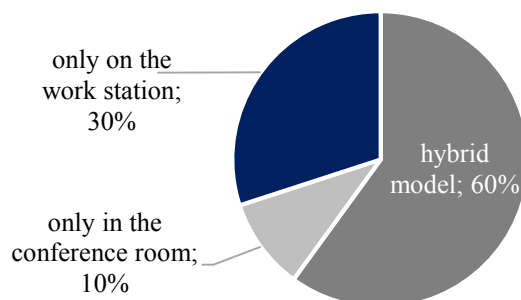
In the process of identifying the surveyed group, temporary employees, they were asked about the number of employer-users for whom they had worked in the last two years. The vast majority of respondents (75%) had worked for one or two employer-users, while the remaining 25% had experience working for three or four employer-users.

#### 4.2. Results of the study

During the in-depth interview, the temporary employees were asked to answer questions about the course of the onboarding process in their current workplace, at the employer-user. Questions about the implementation process were based on elements such as: where the implementation process was carried out, what elements of knowledge about the organization and quality aspects were transferred, what support they received in this process and what are the directions of improvement of this process.

In the first place, the temporary employees were asked where their onboarding process took place. The authors' experience shows that companies use three approaches to this process, in this respect. The first solution is to carry out the onboarding process directly at the workplace (dedicated training for a given employee), and the second solution is based on training conducted in a conference room. The third solution is a hybrid solution, consisting in organizing implementation in a conference room, and then continuation at the workstation. Part of the process, carried out in the conference room, includes general aspects, such as: information about the company, personnel topics, vision and mission of the organization, general quality aspects, environmental aspects, aspects related to safe and healthy work. The second part of this hybrid model is carried out at the workplace – then the training is usually dedicated to a specific employee and the scope of their responsibilities.

Based on the results of the survey, 60% of respondents received training in a hybrid form (as defined above), 30% directly at the workplace, and only 10% had training only in a conference room. The results of this part of the study are presented in Figure 1.



**Figure 1.** Place of onboarding process.

Source: Own study.

Taking into account the fact that 90% of employees have undergone on-the-job training, including 60% additionally in the conference room, in the opinion of the authors of the publication, there is a good signal and such a practice should be continued in enterprises. This increases the likelihood that employees will acquire the necessary knowledge in a practical way, which will allow them to perform their work in accordance with instructions, ensuring a high level of quality of work, and thus the implementation of the required level of service.

In the next part of the in-depth interview, the respondents were asked what aspects were raised as part of the process of introducing them to work. This question was asked separately in relation to the implementation of the induction process in the conference room and at the workplace (depending on where the implementation process took place). The aspects about which the respondents were asked are as follows:

- regulations at the Employer (e.g. work regulations, monitoring regulations, GDPR),
- health and safety rules,
- Employer's clients,
- quality management systems implemented at the Employer (np. ISO 9001),
- quality objectives at the Employer,
- consequences of quality errors for the Employer,
- consequences of quality errors for the customer,
- specific customer requirements,
- work instructions.

Figure 2 presents the results of the study on these aspects of implementation, in total in relation to implementation in the conference room and at the workplace.

When discussing the results presented in Figure 2, it is necessary to focus in particular on questions and answers related to qualitative aspects.

In the field of systemic quality management (including the quality management systems implemented by the organization), a significant number of respondents (76% and 59%) answered that they were not familiarized with such topics either in the conference room or at the workplace. At the same time, a small proportion of respondents (35% for both the conference room and the workstation) confirmed that they were familiar with the quality objectives of the organization.

In the case of familiarizing employees with the consequences of quality errors for the organization in the conference room, this was raised only in the opinion of a small percentage of respondents (12%), while the situation is much better in the case of the workplace, where 53% of respondents declare obtaining information in this area. The temporary employees were also asked whether the organization informed them, during the implementation process, about the consequences of quality errors (that they may make) for the client, which is the risk of receiving a complaint. In this case, the results show that the organization pays more attention to it, but only in part of the implementation process (in the Conference Room). As many as



76% of respondents confirmed that they received information about the consequences of quality errors for the customer in the conference room. At the workplace, it was a much smaller percentage and amounted to only 35%.

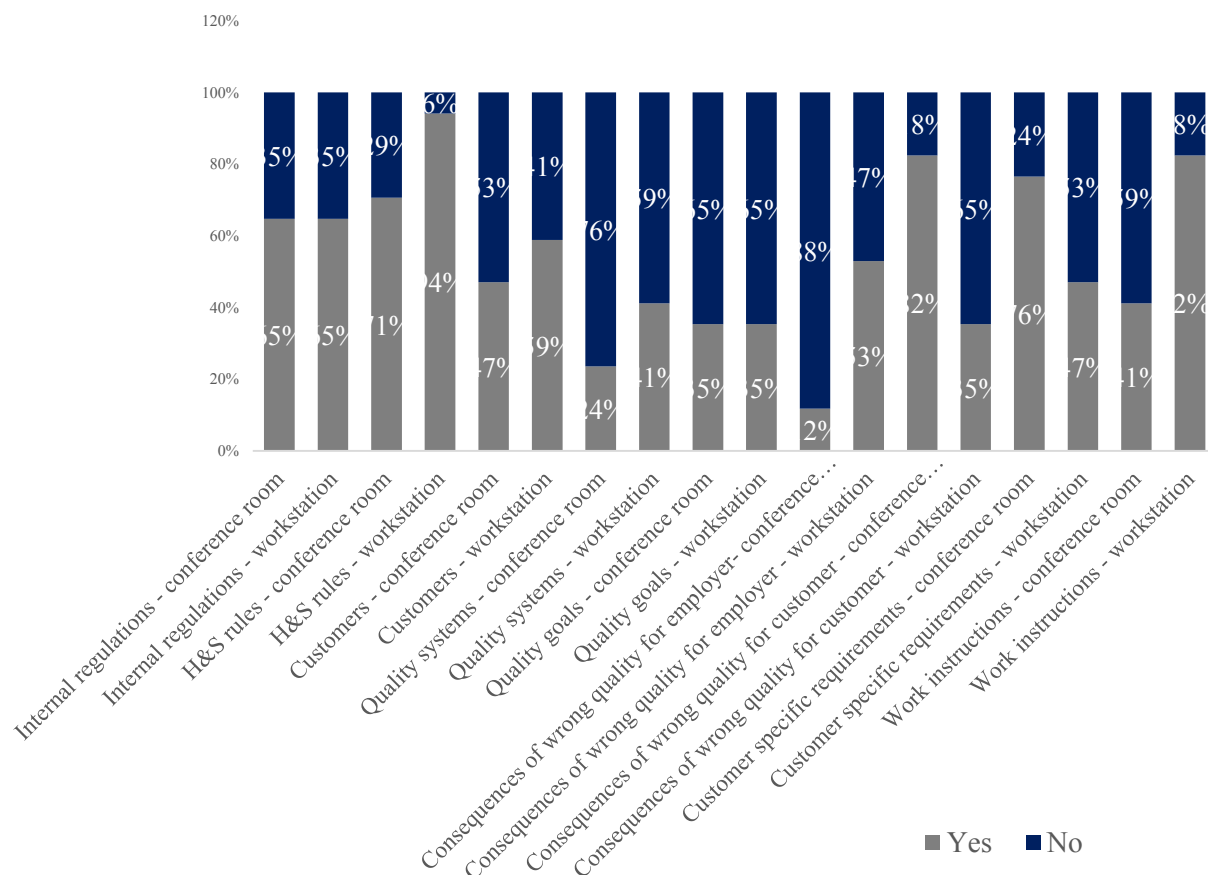
To a similar extent (47% and 41%), employees were familiarized with the specific requirements of customers in the so-called room and at the workplace.

In terms of familiarizing employees with work instructions, over 80% of employees confirmed that they had been familiarized with them, as part of the onboarding, at the workplace.

To sum up this rather broad question, it can be said that there is still a lot of work ahead of organizations in familiarizing new employees with elements related to broadly understood quality management. In my opinion, the results in this area (quality management system, quality objectives, internal consequences of quality errors, etc.) are far from expected for organizations that want to minimize the number of internal and external quality errors and use a temporary form of employment.

On the one hand, of course, organizations may not have provided this information at all (and this is where the results come from), but there may also be a situation that employees did not remember all the information provided to them as part of the onboarding process.

In the context of the first assumption, it would be necessary to think about the content provided during the implementation process (assuming that it occurs), namely what reasons cause the quality management aspects to be missing. With regard to the second assumption, it would be necessary to think about how the implementation process is planned in time and what information the organization prioritizes to provide. If quality information is treated superficially, among other topics, it may be treated as irrelevant and not remembered by employees as expected. This state of affairs can be confirmed by one of the answers given in the survey (as an opportunity to indicate comments) that there is an overload of information as part of the implementation process, considering the time that is devoted to it.

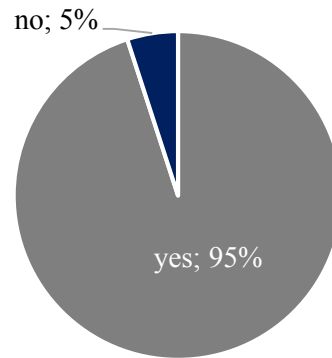


**Figure 2.** Content and place of onboarding process.

Source: Own study.

A good practice, used by some organizations when introducing a new employee to work, is to assign another employee with experience working for the employer (such a person is often referred to as a buddy). In the first phase of onboarding a new employee, the so-called buddy is a person who will be followed (by shadow) by observing how the buddy performs the work. After a defined time of such a process, the roles are reversed and it is the so-called buddy who observes how the onboarded person performs tasks at their workplace. The period of implementation of such a process can be very different, and it depends on the organization itself and the level of complexity of the tasks performed. In practice, it is usually a period of one to three months.

95% of the surveyed employees, when asked about the so-called buddy institution, confirmed that they received such a person during the implementation, which is presented in figure 3.



**Figure 3.** Presence of buddy.

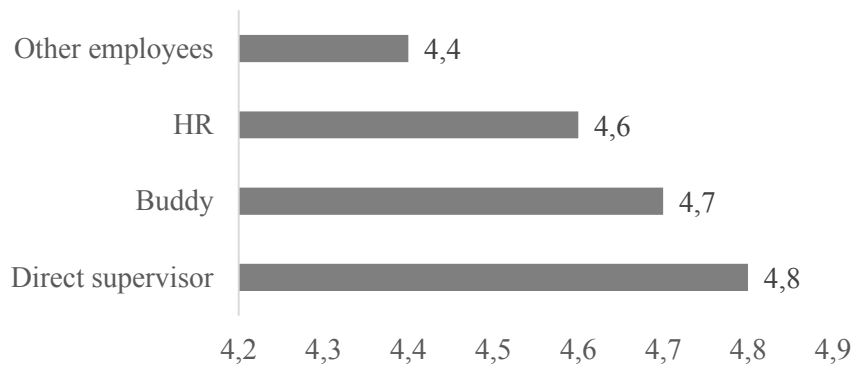
Source: Own study.

The process of onboarding a new employee usually involves a number of functions in the organization, not only the so-called buddy mentioned above. Of course, the implementation itself (as a process in the organization) is usually established and coordinated by human resources functions, with the supervisor playing the main role. However, from the point of view of establishing an effective and efficient implementation process, this will not take place without the participation of people managing employees, employees of occupational health and safety, quality, environment, technology, maintenance, etc. It is all these functions that should actively participate in establishing the program of such an implementation process and then carry out the individual modules of the implementation process.

In connection with this assumption, the surveyed temporary employees were asked about their assessment of the involvement of selected functions in the organization in the implementation process. Of course, this engagement refers to what the conservation employees were able to observe during their onboarding process (e.g., they were unable to observe engagement during the creation of the onboarding program). These functions include:

- human resources (HR),
- direct supervisor,
- buddy,
- other employees in the organization.

Figure 4 presents engagement indicators, measured by a weighted average (on a scale of 1-5).



**Figure 4.** Engagement in onboarding process.

Source: Own study.

As can be seen, through the data from Chart 4, the results of the involvement of individual functions in the process of onboarding a new employee are very similar and are characterized by a high level. This means that the indicated functions in the organization (HR, supervisor, buddy and other employees) were involved in the process in a similar way, in the opinion of the respondents. At the same time, the lowest engagement score was achieved by other employees of the organization, and the highest by superiors. A high result of supervisors' engagement shows that they are aware of the importance of their role in the onboarding of a new employee, which should later be reflected in fewer mistakes made during the performance of tasks. This, in turn, should translate into fewer qualitative internal and external inconsistencies. From the point of view of other employees in the organization and their involvement in the onboarding of a new employee, in the opinion of the authors of the article, the level of this commitment depends strongly on the employer's initiatives to appreciate the effort of onboarding new people. We are talking here, for example, about motivating bonuses for the onboarding of a new employee, for the effectiveness and efficiency of this onboarding, or joint bonuses depending on the result of the entire team, including new people. Individual allowances or team bonuses can certainly have a positive impact on the willingness and commitment to onboarding a new person.

As part of the possibility of submitting additional comments on the process of onboarding a temporary employee, the respondents indicated, in addition to the information overload mentioned above:

- communicating clear goals and expectations from superiors,
- too many explanations in specialist language, which is not clear to the new person,
- the need to adapt the onboarding process individually to a given person.

## 5. Summary

The implementation stage, as the next stage in the process of providing adequate human resources to perform the organization's tasks, is based on providing the employee with the first information about the organization and details of the work performed. The onboarding process usually takes place in the conference room, where the first information is provided (usually at a higher level of generality) and subsequently at the workstation. More detailed information is usually provided at the workplace and a practical implementation is also initiated. Various functions in the organization are involved in the onboarding process for a new employee, from human resources through engineering to the direct supervisor. The involvement of all functions affects the effectiveness and efficiency of this process. The aim is to introduce the temporary employee in such a way that he or she performs his or her work as required and thus ensures compliance of services for customers.

Based on the conducted research, the following aspects of the implementation process can be indicated:

- Taking into account the fact that 90% of the respondents underwent on-the-job training, including 60% additionally in the conference room, this is a good signal and such a practice should be continued in enterprises.
- The declared level of familiarization of a temporary employee with various aspects of quality management (both in the conference room and at the workplace) is not high and requires further analysis. On the one hand, the organizations may not have provided this information at all, and this is the result of the results obtained. On the other hand, there may be a situation that employees have not remembered all the information provided to them as part of the onboarding process (too large a set of information in a short time). You should think about the content you provide during the onboarding process, how the onboarding process is timed, and what information your organization prioritizes to convey.
- A good practice, used by some organizations when introducing a new employee to work, is to assign another employee with experience working for the employer (such a person is often referred to as a buddy). 95% of the surveyed employees, when asked about the so-called buddy institution, confirmed that they received such a person during the implementation.
- The results of the involvement of individual functions in the process of onboarding a new employee are very similar and are characterized by a high level. This means that the indicated functions in the organization (HR, supervisor, buddy and other employees) were similarly involved in the process in question. At the same time, the lowest engagement score was achieved by other employees of the organization, and the highest by superiors. From the point of view of other employees in the organization and their

commitment to the onboarding of a new employee, I believe that the level of this commitment depends strongly on the employer's initiatives to appreciate the effort of onboarding new people, and this is an area that the organization's representatives can work on.

In the literature one can find results of the research regarding the products or services quality and manpower influencing this level. However not so much focus has been put on the temporary employment. Considering that form of temporary employment is significant for Poland and other European countries (14.1% of workers aged 15-64 in the European Union were temporary workers while in Poland it was 26,9% in 2018) it means that this is an area worth of exploring (Eurostat, 2024). As it has been already mentioned the research conducted covered more processes of personnel management, that are subjected for further publishing, still this has been initial study. Thus, the results of the initial study might be subjected to further study, in a full scope. It can concern not only the polish labor market but also more European countries, where the share of temporary employment is significant. The limitation of the study was the analysis of the practice of just 25 employees in 3 companies. This also confirms that the full study will be worth of conducting.

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## PEST CONTROL IN THE ASPECT OF THE REQUIREMENTS OF SELECTED FOOD SAFETY MANAGEMENT STANDARDS

Justyna GÓRNA<sup>1\*</sup>, Adam BRZECHWA<sup>2</sup>, Anna KOWALCZYK<sup>3</sup>

<sup>1</sup> Poznań University of Economics and Business; justyna.gorna@ue.poznan.pl, ORCID: 0000-0002-2763-5810

<sup>2</sup> Bureau Veritas Polska Sp. z o. o.; adam.brzechwa@bureauveritas.com

<sup>3</sup> Unilever Poznań Sp. z o.o.; a\_kowalczyk@onet.eu

\* Correspondence author

**Purpose:** The aim of this article is to present the method of pest control in the aspect of ensuring food safety and the requirements of selected standards in this area.

**Design/ methodology / approach:** An analysis of the functioning of pest control principles in selected food chain enterprises was carried out in the context of meeting the requirements of applicable standards and generating recommendations for other enterprises.

**Findings:** Based on the standardization guidelines, the most important requirements for the prevention of pests in enterprises operating in the food chain were identified. Basic guidelines for enterprises were formulated, based on which it will be possible to design an effective pest control system.

**Originality/value:** The article indicates the most common non-conformities that occur in the area of pest control and monitoring. The article can help companies operating in the food chain to improve this area of their activities and thus reduce the risk of non-conformities during certification audits, and most importantly, ensure a reduction in the risk of threats to the production process.

**Keywords:** pest control, non-compliance, food chain, standards.

**Category of the paper:** Case study.

### 1. Introduction

An indispensable attribute of food quality is its safety throughout the food chain. The food chain consists of operators within primary production (plant cultivation, animal breeding), food processors, wholesale and retail trade operators and food services, as well as producers/suppliers/service providers cooperating with the above-mentioned operators (Górna, Kaźmierczak, Zapłata, 2021). All entities participating in the so-called "food chain are obliged to apply good manufacturing practices (GMP) and good hygiene practices (GHP). In accordance with the definition according to art. 3 point 9 of the Act on Food and Nutrition

Safety, good manufacturing practice (GMP) - in relation to food production means actions that must be taken and conditions that must be met in order for food production to take place in a manner that ensures food safety, in accordance with its intended purpose (Act of August 25, 2006). On the other hand, in accordance with the definition according to art. 3 point 8 of the Act on Food and Nutrition Safety, good hygiene practice (GHP) means actions that must be taken and hygiene conditions that must be met and controlled at all stages of production or trade to ensure food safety (Act of 25 August 2006).

GMP/GHP requirements concern (Berdowski, Turlejska, 2003; Kołożyn-Krajewska, Sikora, 2010):

- ensuring hygienic environmental conditions,
- preventing insects, birds and other animals from entering the plant from outside,
- appropriate storage conditions for food products and auxiliary materials,
- ensuring adequate space for the deployment of production and storage equipment,
- proper ventilation of the plant,
- maintaining infrastructure in good technical condition,
- lighting efficiency,
- water and sewage management,
- washing and disinfection procedures,
- employee control related to preventing food contamination.

The principles of supervising the use of raw materials and their handling are defined by legal requirements. This is primarily aimed at preventing, minimizing or eliminating the occurrence of microbiological, chemical and physical hazards. The extent to which an enterprise implements legal requirements and ensures proper handling of raw materials, finished products or the manufacturing process depends on the management system adopted for use in the organization and its culture. A very important link in ensuring the safety of manufactured products are, among others, suppliers, including service and product providers. The role of service providers in the DDD area (Pest Control/Disinfection) consists, among others, in providing services mainly to food processing, feed, packaging or cosmetic companies.

The above-mentioned industries are interconnected, the activities of each industry are regulated by mandatory requirements, but also voluntary (management standards) (Górna, 2019). In the food industry, companies can implement standards such as ISO 22000:2018 Food safety management systems – Requirements for any organization in the food chain, FSSC 22000 Food Safety System Certification, BRC Global Standard Food Safety, IFS Food Standard, GLOBALG.A.P The Worldwide Standard for Good Agricultural Practices, QS Quality scheme for safe food, The AiB International Consolidated Standards for Inspection Prerequisite and Food Safety Programs. In the industry of production of packaging materials and products dedicated to food and other hygienically sensitive products, the following are implemented: BRC Packaging Materials, IFS PACsecure. In the production of cosmetic

products, standards such as ISO 22716 Good Manufacturing Practices for Cosmetics (GMP), BRC CP Global Standard Consumer Products, IFS HPC Household and Personal Care Standard are implemented. All of these standards specify requirements for ensuring proper pest control.

Selecting an appropriate pest control strategy requires estimating all risks for the company, not only those related to the business profile, but also those resulting from the type of pest control methods selected (Kloosterman, Mager, 2014).

Companies that decide to use the services of an external supplier in the field of pest control and monitoring can, when qualifying such a service provider, be guided by whether they are certified for compliance with the European standard PN-EN 16636:2015-03 Pest control services. Requirements and competences. By using the services of a certified supplier, the company ordering the supervision is sure that the contractors of these services (PN-EN 16636:2015-03):

- are competent to sell and perform the services they offer, maintaining minimum standards of knowledge, skills and practical competence,
- offer the best advice available on preventing pest problems in a client's environment,
- offer an effective and efficient service that will eliminate the root cause of the identified problem,
- will provide safe services that minimise risk to customers and society as a whole, while minimising possible negative impacts on the environment and animal welfare.

## **2. Requirements of selected pest control standards**

According to the requirements of the BRC Global Standard Food Safety version 9, the company must have an effective pest control program in place to eliminate the risk of contamination of raw materials, packaging and finished products. The standard requires that the company outsource pest control to a qualified entity or rely on qualified employees. In the case of the latter option, employees involved in pest control must meet legal requirements for training (such as are required when using professional plant protection products). Most rodenticides are PBT substances (P – Persistent, B - Bio-Accumulative, T - Toxic) and pose a significant risk to our environment. These substances are controlled by the ECHA (European Chemicals Agency), and all rodenticide treatments must include risk mitigation measures to avoid secondary poisoning of non-target animals in the environment (IFS Pest Control, 2022). If the company uses the services of an external company, then the scope of work must be precisely defined, namely the responsibilities of the company's management and the service provider must be defined. Most often, the scope of services is specified in the DDD agreement and program. The documentation and records maintained should include (BRC GS Food Safety, 2022):

- a risk assessment, which must be reviewed whenever changes are made to the buildings or production process that may affect the pest control programme, or whenever a significant pest problem occurs,
- an up-to-date plan of the entire facility, indicating where pest control equipment is located,
- identification of rodent control stations and/or monitoring equipment at the plant,
- detailed information on pest control measures used, including instructions on their proper use and procedures to follow in the event of an emergency,
- record of all observed pest activity,
- details of actions taken to control pests.

Bait stations or other devices used for monitoring or controlling rodents must be positioned and maintained so as to avoid the risk of product contamination. If a bait station is lost, this must be recorded and the cause of the loss established. Toxic rodent baits must not be used in production or storage areas where open product is present, except for the purpose of pest control. In such cases, toxic baits may be introduced for use inside buildings, but the entire process must be carefully supervised and monitored.

Insect killers, pheromone traps and/or other insect monitoring devices must be in good working order and in the appropriate location. If there is a risk of insects being thrown from the insect killer and thus contaminating the product, other systems and equipment must be used. If pests or signs of pest activity are present, immediate action must be taken to identify the products at risk and to minimize the risk of product contamination. All potentially contaminated products must be subjected to the non-conforming product procedure.

All inspections must be recorded, including information on any pest control measures implemented, hygiene recommendations, and actions to be taken to prevent pests.

The company is responsible for ensuring that all appropriate recommendations made by the service provider or specialists employed at the facility are implemented in a timely manner.

To verify the effectiveness of pest control measures used on the site, a thorough and documented review of pest control measures must be conducted by an expert at a risk-based frequency, but no less than once per year.

The review should:

- include a thorough inspection of the facility for pests,
- include an overview of the pest control measures used and any recommendations for changes.

The results of pest control inspections must be regularly evaluated and analyzed for trends, at least annually or whenever pest infestations occur. The analysis must include monitoring results from traps and monitoring devices to identify problem areas. Above all, the analysis must provide a basis for improving pest control procedures.

The standard also requires that employees be able to recognize signs of pest activity and know that they should report such situations to their superiors. For this purpose, training is carried out in plants, the implementation of which is most often outsourced to a company providing pest control services (BRC GS Food Safety, 2022).

The IFS standard requires that the production company has a pest control system that complies with legal requirements and that when establishing such a system it takes into account at least: the environment of the plant (potential pests); a plan of the plant with the location of traps (trap map); marking of traps on the premises; responsible persons, from among the staff; products/means used and instructions for their use and safety; frequency of inspections. The pest control system must be based on a hazard analysis and an assessment of the associated risks. The company should have qualified and trained staff and/or hire a competent external company. In the case of hiring an external company, all necessary activities to be carried out on the plant should be recorded in the contract. Pest control inspections and actions resulting from these inspections must be documented and the implementation of the activities should be monitored and recorded. Baits, rodent traps and insect traps must be in adequate numbers and must be placed in an appropriate position. They must be made and placed so as not to cause a risk of contamination. The effectiveness of pest control should be monitored through regular trend analyses (IFS Food, 2023).

### **3. Good practices in pest control in terms of meeting the requirements of standards**

A professional service provider should (PN-EN 16636:2015-03):

- document the type of service that should be provided to the customer and retain the documentation for a minimum of one year or longer as required by customer and legal requirements,
- record evidence of actions performed and results achieved, to include the date of intervention, type of pest, infestation, techniques and pesticides used and any other relevant information,
- provide information on the specific risk-based pest management plan necessary to establish agreed control processes, including the responsibilities, rights and obligations of each party to the agreement,
- formally review and evaluate the results, including making any further recommendations to the client.

Table 1 shows an example of a pest risk assessment for storage facilities.

**Table 1.**  
*Pest Risk Assessment – Example*

Location	Threat/ Group pests	Rate threats			Activities preventive	Activities Corrective	Methods Combating
		AND	B	AxB			
Rooms warehouse	Rodents	3	2	6	Regular trimming of greenery, designation of three zones A, B, C	Installation of feeders in the plant area	Catchers live
	Insects flying	2	1	2	Compliance with general principles of GMP, GHP	Application preparations insecticides	Insect killer lamps, attractant lamps - sticky ones
	Insects running	3	1	3	Compliance with general principles of GMP, GHP	Application of preparations on flat surfaces	Mechanical sticky traps with attractant
	Pests warehouse	3	3	9	Observance FIFO, FEFO rules	Application of preparations on flat surfaces	Insect killer lamps, mechanical pheromone traps - sticky

Source: Documentation of pest control of a food production enterprise, 2024.

In the above example (Table 1), a methodology was used to assess the probability of pest occurrence (A) using a three-point scale, where 1 means a low probability of occurrence, 2 - possible, 3 - high probability of occurrence, and to assess the effects related to the occurrence of pests (B), where 1 - means the effects are difficult to estimate, 2 - significant, 3 - very high effects of pest occurrence. Based on the risk assessment, the procedures should be determined preventive, for the implementation of which are the responsibility of employees providing DDD services and/or internally, employees of the company where the business is conducted. In order to be able to respond appropriately to changes in pest population activity trends, the effectiveness of previous activities and treatments should be monitored based on cyclical measurements and observations. This is usually done on the basis of determining the collection of attractant, catches, feeding traces. Monthly monitoring is a good practice, which will allow for immediate observation of an increase or decrease in pest population activity and timely implementation of appropriate corrective, corrective, preventive actions, e.g.:

- increasing the amount of safety equipment (insect lamps, traps),
- sealing the building (mosquito net, door sealing rubber),
- spraying with a chemical agent.

Observations should be supplemented with important information that will help find the cause of the increase or decrease in pest activity, i.e. average monthly temperature, amount of rainfall, important internal factors (e.g. renovation works), or changes in the building's surroundings, e.g. harvest season, changes in neighbouring buildings (Table 2):

**Table 2.***Example of monitoring a monthly trend of pest activity*

	June	July	August	September	October	November	December
<b>Activity [%]</b>	36.6	36.6	46.2				
<b>Temperature [°C]</b>	19.9	20.2	23.2				
<b>Precipitation [mm]</b>	63.4	22.7	22.5				
<b>Internal factors (e.g. renovation works, services, etc.)</b>	Works renovation	Works renovation	Works renovation				
<b>Environment (field work, farmers' activity, mowing)</b>	lack (growth corn)	lack (growth corn)	lack (growth corn)				
<b>Additional pest control treatments (additional/intervention)</b>	2 sprays	1 spray 2 lamps blatant	Exchange glue in lamps				
<b>Additional Recommendations DDD companies</b>	-	-	-				
<b>Comment</b>	Lack	Replacing 2 sticky insect killer lamps with bright ones	Lack				

Source: Documentation of pest control of a food production enterprise, 2024.

The DDD program and all observations, measurements, implemented actions should be documented. In addition, companies should implement a procedure in the event of a pest infestation and determine their activity thresholds, which result in the implementation of actions corresponding to the identified scale of the threat / problem. Usually, companies set three levels of response: low (pest population activity up to 25%), medium (pest population activity from 25% to 50%) and high (pest population activity above 50%). The indicated threat levels should be identified in three zones: internal and two external (around the building and around the perimeter fence), which limit the possibility of pest invasion into the building. Therefore, companies are required to have a map of the building and its surroundings with the location of equipment (the map legend identifies the type of equipment). An important element of the DDD system assessment is to conduct a biologist audit at least once a year. This is part of the assessment of the quality of work performed by the pest control technician. The audit should include a detailed inspection of hard-to-reach areas such as voids, cable runs, mezzanines. The auditor will also determine the current level of pest activity on the premises and propose alternative approaches to resolving the problems (BRCGS Guidance document, 2020).

The pest control program should be in line with the requirements of the standard for which the company for which the DDD company provides services is certified. The requirements of the standards are more or less detailed, but each company operating on the DDD services market should develop its own code of good practice. Fulfilling the following requirements for the pest control program and information recorded as a result of inspections will satisfy most companies

using the services of DDD companies, regardless of the standard in the given company (Table 3).

**Table 3.**

*Example of the contents of a pest control program and monitoring reports*

PEST CONTROL PROGRAM	PERIODIC MONITORING REPORTS
<ul style="list-style-type: none"> <li>• pest control program provider details</li> <li>• contact details of people to be called in emergency situations (pest invasion)</li> </ul>	<ul style="list-style-type: none"> <li>• any observations of pests and their activity</li> </ul>
<ul style="list-style-type: none"> <li>• indicating the persons responsible in the plant for supervising DDD activities</li> </ul>	<ul style="list-style-type: none"> <li>• recommendations for the plant regarding actions to be taken, including hygiene and security measures, as well as any outstanding recommendations from previous inspections</li> </ul>
<ul style="list-style-type: none"> <li>• pest control program provider training certificates</li> </ul>	<ul style="list-style-type: none"> <li>• information on chemicals used (type, quantity and location)</li> </ul>
<ul style="list-style-type: none"> <li>• description of raw materials/finished products present in the plant in terms of their impact on the existence of pests,</li> <li>• pest risk assessment,</li> <li>• description of pests covered by the program (description/photos)</li> </ul>	<ul style="list-style-type: none"> <li>• reports on access issues and lost baits</li> </ul>
<ul style="list-style-type: none"> <li>• frequency and type of inspections (based on documented risk assessment)</li> <li>• frequency of replacing fluorescent lamps from insect killers</li> </ul>	<ul style="list-style-type: none"> <li>• signature of designated manager or deputy</li> </ul>
<ul style="list-style-type: none"> <li>• pest control methods and procedures and equipment used</li> </ul>	<ul style="list-style-type: none"> <li>• updated analysis trends</li> </ul>
<ul style="list-style-type: none"> <li>• site plan identifying program area and pest monitoring points (e.g. toxic/non-toxic baits)</li> </ul>	
<ul style="list-style-type: none"> <li>• follow-up inspection procedures after a pest infestation has been detected,</li> </ul>	
<ul style="list-style-type: none"> <li>• Material Safety Data Sheets for all chemicals used</li> </ul>	
<ul style="list-style-type: none"> <li>• DDD documentation and records supervision procedure</li> </ul>	

Source: Own research.

Based on many years of auditing experience of the authors of this article, the most common non-compliances in the area of pest control in enterprises have been identified:

- failure to include all pests in the control program, e.g. insects, storage pests, wild animals, pets (cats, dogs), birds,
- differences between the plan for the deployment of rodent or live traps and reality (numerical/location discrepancy/lack of numbering on the device),
- lack of safety data sheets (this happens when there is a change in legal measures or requirements and the company providing DDD services does not update the documentation),
- outdated DDD program – should be reviewed and approved with a date and signature once a year,
- live traps not attached to the floor,
- dirty, uncleaned insect killer lamps,
- set rodent control traps,
- no traps for crawling insects, e.g. in staff canteens or changing rooms,



- lack of compliance with the scope of services defined in the contract with the DDD company in comparison to the DDD program or vice versa – a wider scope in the contract and no reflection in the activities,
- rodent control traps not permanently closed,
- unsealed/unprotected buildings against pests,
- open gates/doors,
- lack of activities/procedures for analyzing the trend of pest movement. There are no defined threshold values that initiate corrective actions,
- no evidence of replacing fluorescent tubes in insect killer lamps,
- failure to include newly constructed facilities on the company's premises in the DDD protection program, e.g. a new tent warehouse.

It is worth paying attention to the above-mentioned inconsistencies in terms of improving the service provider's procedures in the field of pest control and the company's activities, because some of these inconsistencies, e.g. related to the lack of tightness of the plant, are the fault of the company's employees.

#### **4. Conclusions**

Improvement activities are an essential element of management systems, which is why DDD companies must consider that the requirements of the standards will evolve. Each standard is subject to update at least every 3 to 5 years. The update of the requirements is based, among other things, on new threats that will be observed on the market and the results of certification audits. Effective pest control is one of the elements of the food safety management system. Activities in this area are most often outsourced to specialist companies, because a production company usually does not have staff with the appropriate qualifications to use pesticides in pest control and staff with the appropriate skills in this area. In turn, companies specializing in providing DDD services to companies operating in the food chain must be aware of the standardization requirements that apply to their customers. Effective communication between the DDD company and the company ordering the DDD service is key in this aspect. A company purchasing a DDD service should inform the DDD company about its requirements, the standard it is certified for and the processes it performs. In turn, the DDD company should be aware of the requirements of the applicable standard and provide its service in a professional manner. In addition, the DDD company should periodically review the pest control program in terms of its relevance and respond to any comments/non-compliances in this area. Only reliable cooperation between both entities can ensure effective pest control and reduce the risk of non-compliance, which will contribute to reducing the risk of loss of safety of manufactured products.

## Acknowledgements

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## IDENTIFICATION OF OCCUPATIONAL HEALTH AND SAFETY AREAS SUPPORTING THE DEVELOPMENT OF A CULTURE OF FOOD QUALITY AND SAFETY

Justyna GÓRNA<sup>1\*</sup>, Joanna SADŁOWSKA-WRZESIŃSKA<sup>2</sup>

<sup>1</sup> Poznań University of Economics and Business; justyna.gorna@ue.poznan.pl, ORCID: 0000-0002-2763-5810

<sup>2</sup> Poznań University of Technology; joanna.sadlowska-wrzesinska@put.poznan.pl,  
ORCID: 0000-0003-1335-6738

\* Correspondence author

**Purpose:** The aim of the article is to identify areas of occupational health and safety that can support the development of a culture of food quality and safety.

**Design/ methodology / approach:** A study was conducted in the surveyed enterprise to determine the level of food quality and safety culture, and then to assess the possibility of using the occupational health and safety system in terms of the possibility of developing solutions supporting the development of food quality and safety culture.

**Findings:** Key areas have been identified, such as training, hygiene, risk and crisis management, work ergonomics, communication and reporting, and supervision of chemical agents, which can mutually positively influence the culture of occupational health and safety and food quality and safety.

**Originality / value:** The article presents an assessment of the level of food quality and safety culture in the surveyed enterprise. Common areas in the field of occupational health and safety culture were also identified, which can strengthen the development of food quality and safety culture. The article can be an element influencing the improvement of activities in the discussed areas in other enterprises, which can contribute to the development of their food quality and safety culture.

**Keywords:** food quality and safety culture, occupational health and safety culture, development and improvement.

**Category of the paper:** Case study.

## 1. Introduction

Safety is a key element of broadly understood quality of life – quality of the economic entity, quality of products and services, quality of processes, quality of interpersonal and inter-organizational relations, quality of infrastructure and others. All these aspects allow specific groups of stakeholders to function with a sense of certainty, peace and lack of threat (Wiśniewska, Grudowski, 2019). Quality culture – and in a broader context, culture of excellence – can be treated as a set of various subcultures influencing the functioning of the organization, especially in the aspect of its pro-quality strategy. Therefore, if we assume that the most important feature of quality is safety, then it will be equally important – within the culture of excellence – to shape a culture of safety (Sadłowska-Wrzesińska, 2023). Shaping a culture of safety requires constant focus not only on the behavior of employees, but also on the physical work environment (technology, equipment, procedures) and individual characteristics of employees (skills, predispositions, experience). It is therefore not surprising that at the level of operational activities, enterprises expect specific guidelines that will help them design and then implement the concept of occupational health and safety culture (Sadłowska-Wrzesińska, 2018).

Griffith et al. (2010) have long pointed out that the concept of workplace culture influencing employee behavior in the food industry has been largely ignored, while it has been studied in many other industries (e.g. aviation, nuclear industry, etc.). Many industries around the world are interested in safety culture as a way to reduce the risk of disasters and accidents. Griffith et al. noted the need for more detailed research on food safety culture, as the concept and its importance were poorly understood at all levels of management in the food industry (2010). The importance of food safety culture has finally been recognized and emphasized in legal requirements. The 2020 update of the Codex Alimentarius was the reason for introducing a change through Commission Regulation (EU) 2021/382 to the content of Regulation (EC) No 853/2004 on food safety culture. The Codex Alimentarius Commission has determined that food safety culture increases food safety by increasing awareness and improving employee behavior in food establishments (Regulation 2021/382). The law does not define food safety culture, but specifies the obligations of food businesses in this area. The definition of this concept can be found in the so-called private standards, which extend the spectrum of food safety culture to include quality. An overview of the concepts and obligations related to this issue is presented in Table 1.

**Table 1.***Food safety culture requirements based on selected standards*

Standards	Requirements of food safety culture
Commission Regulation (EU) 2021/382 of 3 March 2021 amending the Annexes to Regulation (EC) No 852/2004 of the European Parliament and of the Council on the hygiene of foodstuffs as regards food allergen management, redistribution of food and food safety culture	<ol style="list-style-type: none"> <li>1. Food business operators shall establish, maintain and provide evidence of an appropriate food safety culture by fulfilling the following requirements:               <ol style="list-style-type: none"> <li>a) commitment of the management, in accordance with point 2, and all employees to the safe production and distribution of food;</li> <li>b) leadership towards the production of safe food and to engage all employees in food safety practices;</li> <li>c) awareness of food safety hazards and of the importance of food safety and hygiene by all employees in the business;</li> <li>d) open and clear communication between all employees in the business, within an activity and between consecutive activities, including communication of deviations and expectations;</li> <li>e) availability of sufficient resources to ensure the safe and hygienic handling of food.</li> </ol> </li> <li>2. Management commitment shall include:               <ol style="list-style-type: none"> <li>a) ensuring that roles and responsibilities are clearly communicated within each activity of the food business;</li> <li>b) maintaining the integrity of the food hygiene system when changes are planned and implemented;</li> <li>c) verifying that controls are being performed timely and efficiently and documentation is up to date;</li> <li>d) ensuring that the appropriate training and supervision are in place for personnel;</li> <li>e) ensuring compliance with relevant regulatory requirements;</li> <li>f) encouraging continual improvement of the food safety management system of the business, where appropriate, taking into account developments in science, technology and best practices.</li> </ol> </li> <li>3. The implementation of the food safety culture shall take account of the nature and size of the food business.'</li> </ol>
IFS Food version 8, 2023	<p><b>Definition food safety culture:</b> Shared values, beliefs and norms that affect mindset and behavior toward food safety in, across and throughout an organization. Elements of food safety culture are those elements of the food safety management which the senior management of a company may use to drive the food safety culture within the company.</p> <p>These shall include, at a minimum:</p> <ul style="list-style-type: none"> <li>• Communication about food safety policies and responsibilities.</li> <li>• Training.</li> <li>• Employee feedback on food safety related issues.</li> <li>• Performance measurement.</li> </ul> <p><b>Requirements-point. 1.1.1:</b> The senior management shall develop, implement and maintain a corporate policy, which shall include, at a minimum:</p> <ul style="list-style-type: none"> <li>• food safety, product quality, legality and authenticity</li> <li>• customer focus</li> <li>• food safety culture</li> <li>• sustainability.</li> </ul> <p>This corporate policy shall be communicated to all employees and shall be broken down into specific objectives for the relevant departments. Objectives about food safety culture shall include, at a minimum, communication about food safety policies and responsibilities, training, employee feedback on food safety related issues and performance measurement.</p>

Cont. table 1.

BRC Global Standard Food Safety Issue 9, 2022	<p><b>Definition food safety and quality culture:</b> The attitudes, values and/or which beliefs are prevalent at the site, relating to the importance of product safety and the confidence in the product safety systems, processes and procedures used by the site.</p> <p><b>Requirements - point. 1.1.2:</b> The site's senior management shall define and maintain a clear plan for the development and continuing improvement of a food safety and quality culture. The plan shall include measures needed to achieve a positive culture change. This shall include:</p> <ul style="list-style-type: none"> <li>• defined activities involving all sections of the site that have an impact on product safety.</li> </ul> <p>As a minimum, these activities shall be designed around:</p> <ul style="list-style-type: none"> <li>• clear and open communication on product safety,</li> <li>• training,</li> <li>• feedback from employees,</li> <li>• the behaviors required to maintain and improve product safety processes,</li> <li>• performance measurement of activities related to the safety, authenticity, legality and quality of products,</li> <li>• an action plan indicating how the activities will be undertaken and measured, and the intended timescales,</li> <li>• a review of the effectiveness of completed activities.</li> </ul> <p>The plan shall be reviewed and updated at least annually, at a minimum.</p>
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Source: Regulation 2021/382, BRC, IFS.

When analysing the presented requirements of standards and EU law, certain common features can be noticed, namely references to the need to:

- ensuring open and clear communication with employees regarding food safety,
- providing training to employees.

However, legal requirements do not specify how to implement a food safety culture in an enterprise, but only specify that the nature and size of the enterprise should be taken into account when implementing it. In turn, in the requirements of private standards, we will find suggestions on how to build a plan for the development of a food quality and safety culture in an enterprise, and above all, how to measure its effectiveness. The basic thing is to measure the current state, i.e. assess the current level of culture in the enterprise and plan further actions on this basis.

Understanding and measuring the culture of food quality and safety is extremely important – it is a key success factor for any food company (Emond, Taylor, 2018; Nyarugwe et al., 2016). Increasing attention is being paid to employee behavior and such significant elements of food safety culture as leadership, commitment, communication, risk awareness, work environment, and management system (Zanin et al., 2021).

## 2. Measuring the culture of food quality and safety in an enterprise

The company where the survey was conducted in 2024 is located in Poland and is involved in the production of ready meals. It belongs to the medium-sized enterprise sector. The survey aimed at assessing the culture of quality and food safety was conducted using:

- a self-assessment questionnaire on the culture of excellence, which was addressed to management staff (Table 2),
- food safety culture self-assessment questionnaire, which was dedicated to production workers (Table 3).

**Table 2.**  
*Culture of Excellence Self-Assessment Questionnaire*

	1	2	3	4	5
1. NO I definitely don't agree					
2. NO I don't agree					
3. And so, and NO					
4. I agree					
5. I absolutely agree					
<b>Strategic leadership</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1 Top management creates strategy with an emphasis on improving products/services.					
2 Top management creates conditions in which all employees identify with the idea of continuous improvement.					
3 Top management actively promotes and communicates the concept of continuous improvement.					
4 Top management treats its employees as strategic resources deserving of development.					
<b>Customer focus</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
5 All employees demonstrate excellence in meeting customer needs every day.					
6 The organization strives to continually improve its ability to meet customer needs.					
7 The results of the customer satisfaction measurement prove that the organization is continuously improving its ability to meet customer needs.					
<b>Engagement of the employees</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
8 Every day, employees are eager to introduce improvements and innovations in their workplace.					
9 Every day, employees are eager to share their ideas for improvement.					
10 Employees are eager to participate in improving their qualifications.					
11 Employees are interested in how the results of their work contribute to the improvement of the organization.					
<b>Human resources management</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
12 Employee recruitment is based on the principle of "the best man in the right place".					
13 The best employees and their talents are appreciated and supported within the organization.					
14 The organization nurtures student-master relationships.					
15 The promotion system in the organization is based on the criterion of excellence, from the perspective of the results achieved in a given position.					
16 The organization ensures good communication between employees in order to introduce ideas for improvement.					
<b>Management processes</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
17 Goals are established for processes that take into account the highest standards of performance.					
18 Excellence in work performance is a fundamental principle of functioning in an organization.					
19 The processes are monitored on an ongoing basis to assess compliance with adopted standards.					
20 Employees do not allow any deviations from the accepted standards.					
21 Processes are continually improved taking into account the best available technologies.					
22 There are no errors in the process.					

Cont. table 2.

<b>Continuous improvement and learning</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
23	There is a belief within the organization that continuous improvement pays off.					
24	The organization allocates resources for continuous improvement.					
25	The organization uses continuous improvement methods and techniques.					
26	The organization involves its suppliers and partners in the process of continuous improvement.					
27	Continuous improvement efforts produce measurable results.					
28	Education and training at all levels is a priority in the organization.					
<b>Good practices production</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
29	The organization practices ongoing modeling on good manufacturing practices from outside the enterprise.					
30	The organization practices ongoing modeling on good manufacturing practices from within the company.					
31	Actions towards good manufacturing practices bring tangible results.					
<b>Power of attorney and Work team</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
32	Employees are always encouraged to submit ideas for improvement.					
33	Employee ideas for improvement will certainly be considered.					
34	Employees are aware of their influence on improvement in the organization.					
35	Employees receive full support when they propose specific improvements, either as a team or individually.					
36	Employees are encouraged to work as a team.					
<b>Creativity and innovations</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
37	The organization rewards employees for their creativity.					
38	The organization constantly monitors various innovations that may affect it.					
39	The organization cooperates with various research and development institutions.					
40	Innovations of various nature are introduced on an ongoing basis within the organization.					

Source: Wiśniewska, Grudowski, 2019.

**Table 3.**  
*Food Safety Culture Self-Assessment Questionnaire*

<b>1 – Definitely YES 7 – definitely NO</b>								
<b>Support management and co-workers</b>		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
1	Management inspires me to follow food safety and quality practices.							
2	My manager actively ensures that food safety and quality practices are followed.							
3	There is good cooperation between departments, ensuring that the consumer receives food prepared in a safe manner.							
4	New employees and experienced employees work together to implement good manufacturing and hygiene practices in the field of food safety and quality.							
5	Management consistently enforces food safety and quality policies among all employees.							
6	When work needs to be done quickly, employees work together as a team to ensure tasks are completed safely.							
7	My manager always ensures that employees follow safe food handling practices.							
8	My colleagues always support each other in implementing good manufacturing and hygiene practices for food safety and quality.							
9	All employees remind each other to follow good manufacturing and hygiene practices regarding food safety and quality.							
10	Employees are disciplined and reprimanded if they do not follow good manufacturing and hygiene practices regarding food safety and quality.							

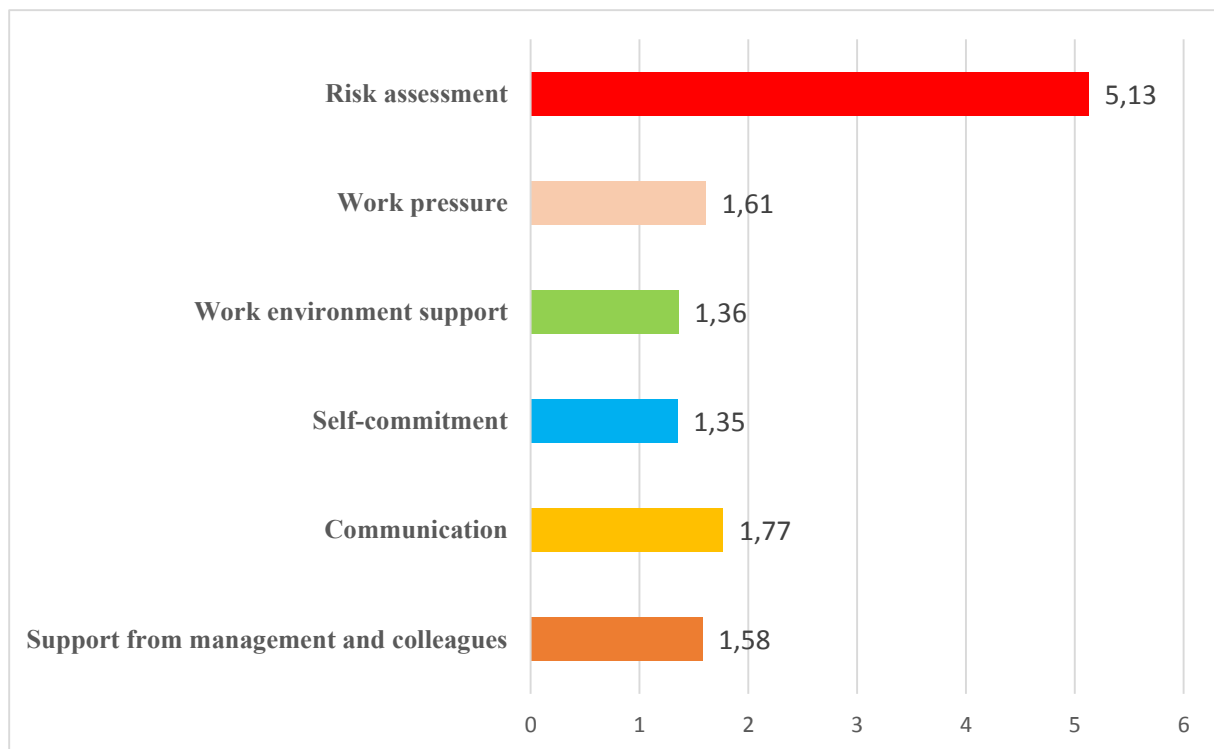


Cont. table 3.

	<b>Communication</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
11	I can speak up freely if I see something that may impact food safety and quality.							
12	My manager provides instructions on food safety and quality.							
13	All necessary information regarding safe food handling is available at my workstation.							
14	Management provides timely and accurate information on current food safety policies and laws.							
15	I am encouraged to provide suggestions on how to improve good manufacturing and hygiene practices for food safety and quality.							
16	All managers provide consistent messaging about food safety and quality.							
	<b>Self-commitment</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
17	I follow food safety and quality rules because it is my responsibility.							
18	Food safety and quality are a high priority for me.							
19	I follow food safety and quality rules because I think they are important.							
20	I am committed to food safety and quality.							
21	I keep my workstation clean because I don't like mess.							
	<b>Support Environment work</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
22	Required equipment for safe food preparation is available and accessible (e.g. hand washing sinks).							
23	Adequate resources are readily available to enable safe food handling.							
24	The equipment is of appropriate quality to enable safe food processing practices.							
25	I am equipped with appropriate resources to easily comply with good manufacturing and hygiene practices in the safe handling of food.							
	<b>Pressure work</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
26	The workload does not affect my ability to follow good manufacturing and hygiene practices in the safe handling of food.							
27	I always have enough time to follow good manufacturing and hygiene practices in safe food handling, even in a rushed situation.							
28	The number of workers assigned to a given shift is adequate to enable me to do my job properly and ensure safe food handling.							
	<b>Risk assessment</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
29	I am convinced that documented policies and procedures are nothing more than a cover-up in the event of a lawsuit.							
30	Sometimes I am asked to "cut corners" so that we can save on food production costs.							
31	When there is pressure to complete production on schedule, sometimes managers tell us to work faster, "cutting corners" on food safety and quality.							

Source: Wiśniewska, Grudowski, 2019.

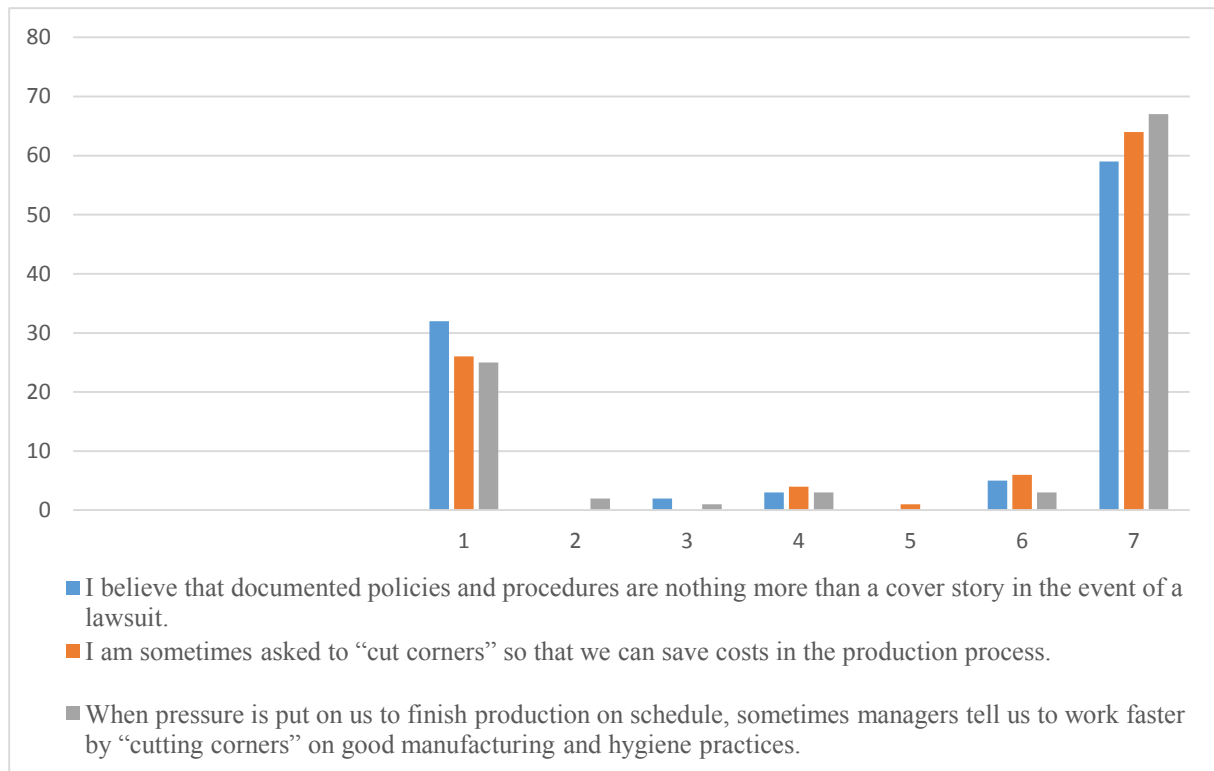
The study covered 26 management staff and 101 production workers, which together constituted 50.8% of the entire population. The average assessment of the results of the study conducted on a group of 101 people among production workers in individual areas is presented in Figure 1.



**Figure 1.** Assessment of food quality and safety culture – production workers (average results).

Source: Own research.

For the adopted criteria such as: management support, communication, self-commitment, work environment support, work pressure, the obtained results are satisfactory. Employees confirmed that they receive support from management and co-workers in terms of support in the implementation of good production and hygiene practices and that they work as a team for safe production in terms of ensuring the safety of manufactured products. In addition, the studies confirmed that employees are disciplined and reprimanded if they do not follow good practices. The study confirmed effective communication among employees and that they have the necessary instructions at their workstation. In addition, employees are encouraged to provide suggestions on improving good production and hygiene practices in terms of product quality and safety. The area of **"self-commitment"** and **"work environment support"** were **rated very high**. Employees rated partial statements (statements 17-21) in terms of their involvement in the implementation of GMP/GHP at a level of 1.32 to 1.37. The infrastructure was rated equally high (statements from 22 to 25), employees have access to equipment ensuring hygiene, the devices they use are properly maintained and of appropriate quality. The next area of the study concerned the opinions of employees regarding the assessment of **"work pressure"**, employees assessed that the number of employees per shift is appropriate for the work they do properly and they always have time to comply with GMP/GHP requirements. The last area of the study concerned **"risk assessment"**, in this area there are 3 statements (Figure 2).

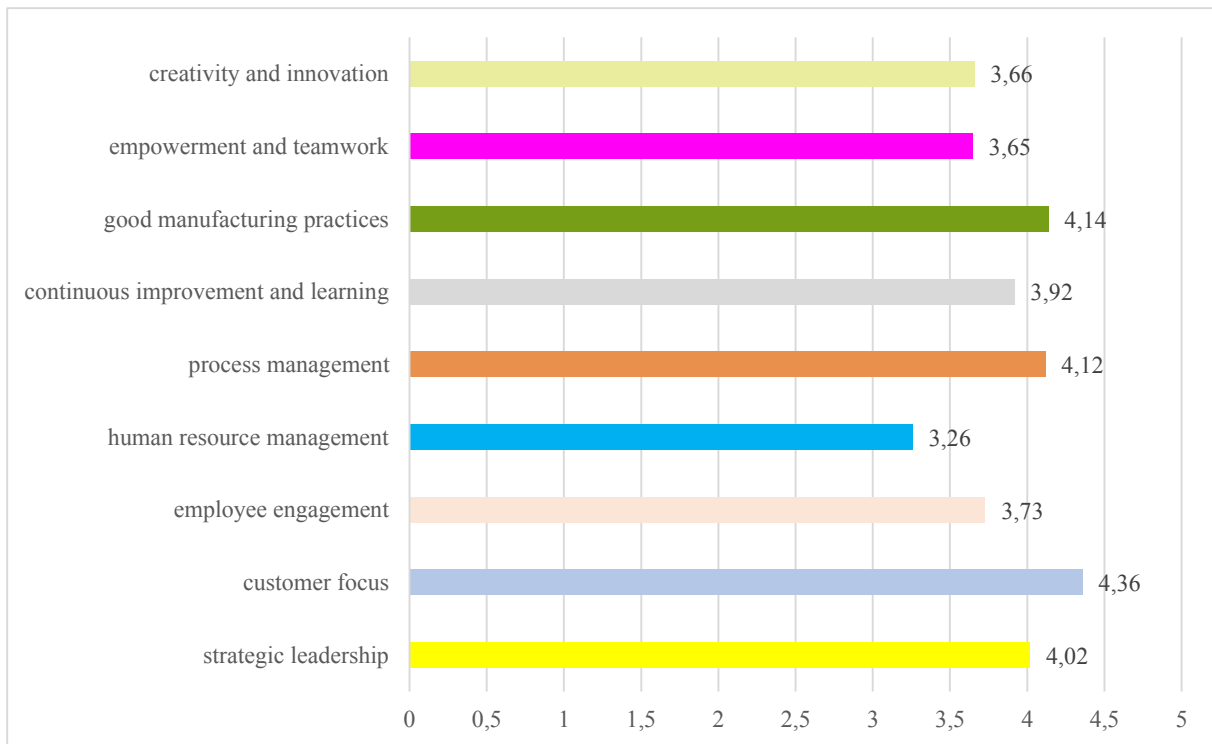


**Figure 2.** Risk assessment - measurement of food quality and safety culture among production workers (where 1 - definitely YES; 7 - definitely NO).

Source: Own research.

The analysis of responses in this area indicates that the largest percentage of employees (30%) believe that the procedures are in place to ensure that the company does not have problems in the event of a court case and that it is acceptable to violate GMP/GHP rules in the event of a situation involving time pressure (25% of respondents). It is particularly worrying that employees indicate that they are encouraged by their managers to break GMP/GHP rules in situations involving time pressure. The company under review should plan actions aimed at, among others, eliminating such a feeling in the scope of the above issues among employees and strengthening actions in the scope of improving the awareness of the management staff.

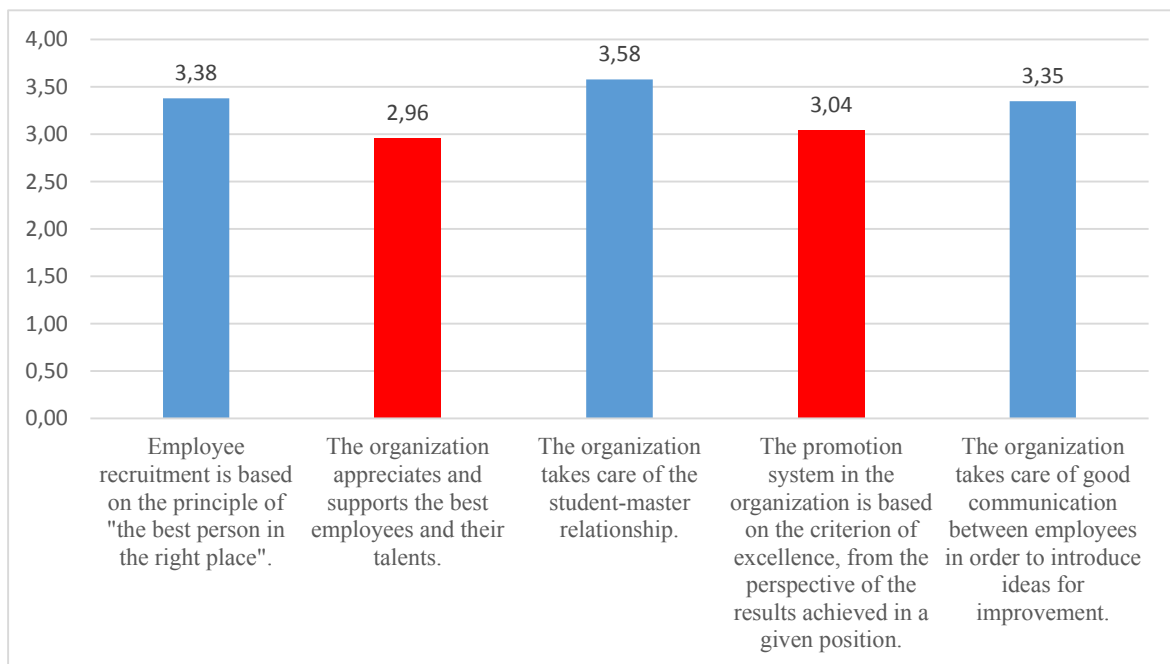
The average results of the survey conducted on a group of 26 people among management staff in individual areas are presented in Figure 3.



**Figure 3.** Assessment of the culture of excellence – management staff (average scores).

Source: Own research.

The average results achieved in the areas studied can be considered satisfactory. Only the area of "**human resources management**" was rated the lowest (3.26). Analyzing the distribution of responses (Figure 4) in this area, it can be seen that employees rated two statements the lowest.



**Figure 4.** Assessment of the culture of excellence – management staff (average scores).

Source: Own research.

Top management should take care of improving the promotion system in the company and build a system that promotes the best employees.

### 3. Identification of occupational health and safety areas supporting the development of a culture of food quality and safety

In the audited enterprise, an analysis of the functioning occupational health and safety management system was carried out in terms of the possibility of using it to strengthen the development of the culture of quality and food safety. Based on the observations made during the audit and analysis of the enterprise documentation, the following common areas of occupational health and safety and the food safety management system were distinguished, which can interact with each other, resulting in the improvement of both the culture of occupational health and safety and the culture of quality and food safety:

- training,
- maintaining hygiene,
- protective clothing,
- risk management and crisis management,
- reporting culture and open communication,
- work ergonomics,
- supervision of chemical agents.

Table 4 presents proposed actions that can be taken in the above-mentioned areas.

**Table 4.**

*Common areas for improving occupational health and safety culture and food quality and safety culture*

Area	Actions to strengthen the improvement of occupational health and safety culture and food quality and safety culture
Training	During occupational health and safety and food safety training, common issues such as proper hand washing technique, wearing protective clothing or following sanitary instructions that apply on the production floor can be discussed. In addition, during training on the operation of machinery and equipment, employees can be reminded that by acting correctly during operation, they reduce the risk of accidents that may affect the safety of food production.
Maintaining hygiene	Employees should be made aware that by ensuring the cleanliness and hygiene of their workplace, they reduce the risk of accidents at work and thus minimise the risk of contamination of the food produced.
Protective clothing	Employees should be made aware that the protective clothing they use not only protects them against potential threats (e.g. burns, cuts), but also protects the manufactured products against contamination. At the same time, employees should be made aware that by wearing protective clothing they protect themselves against contamination, e.g. with pathogenic microorganisms originating from raw materials, where they can become infected through cross-contamination.

Cont. table 4.

Risk management and crisis management	Systematic identification and analysis of occupational health and safety hazards can help anticipate and avoid problems that could affect food quality and safety, e.g. hazards related to the operation of machinery/equipment, use of chemicals, etc. The culture of health and safety also supports the creation of crisis management systems that can help to quickly respond to emergencies that affect food quality and safety. Emergency procedures for fires, accidents or leaks of hazardous substances are essential to protect both employees and food in crisis situations.
Reporting culture and open communication	Open and honest reporting of safety concerns by all employees is essential to understanding and managing potential causes of future accidents. This is particularly true for food safety and quality. Electronic and paper reporting systems enable employees to report unsafe situations quickly and effectively, contributing to better quality management. Equally important is reporting how an employee is being assessed and admitting when they make poor decisions. Open and honest communication should take place between all levels of the workplace. It is also important to remember that regular audits of both health and safety and hygiene on production lines can help identify weak points in the production process.
Work ergonomics	The risk of developing ailments and diseases of the musculoskeletal system and peripheral nervous system occurs not only when performing typical physical work (in production), but also in office work, which is generally considered to be very light. The occurrence of the above-mentioned ailments has a negative impact on the quality and efficiency of the tasks performed, as well as on the employee's safety. These ailments significantly reduce the quality of life, reducing employee well-being, which in turn leads to more frequent errors. Ensuring an ergonomically correct workstation and proper work organization is the employer's responsibility, but it is worth making employees aware of this area and encouraging them to self-control their working conditions (participatory ergonomics). Reducing the physical load on employees through ergonomic workstations reduces the number of errors resulting from fatigue, which can affect the quality of food.
Supervision of chemical agents	Health and safety rules for managing chemicals and other hazardous materials used in production processes are key to ensuring food safety. Proper storage and use of chemicals, including detergents and disinfectants, in accordance with health and safety regulations reduces the risk of food contamination. Implementing strict procedures for employees working with hazardous substances supports food safety by eliminating the risk of product contamination.

Source: Own research.

The surveyed company, wishing to strengthen its culture of food quality and safety, should try to notice areas of occupational health and safety that can contribute to its improvement. The areas discussed above should be given special attention, due to the fact that they can mutually reinforce each other, and the synergy effect achieved will have tangible benefits for the company. The surveyed company should pay special attention to the area related to the culture of reporting and open communication, build a system for informing employees about how they are assessed, especially since the area of "human resources management" was assessed the lowest by the management staff, which is why it is worth building a clear path of professional advancement and a system for rewarding the best employees. About 30% of employees in the surveyed company do not perceive the validity of the procedures and believe that it is acceptable to break them when the company is under time pressure. Therefore, by strengthening the message during training, employees can be made aware of the importance of procedures and the importance of following them, regardless of whether there is time pressure or not. The training itself can be enriched with visualized examples of breaking procedures. You can use videos/photos illustrating accidents and their consequences (affecting

the employee's health and the quality and safety of food). When creating such training materials, you can use data sources from your own resources (audits, accidents) and from other companies. However, what is most important is consistency in actions, i.e. constant supervision by management staff and unconditional response in the event of identifying a situation related to non-compliance with established procedures. Employees must know that non-compliance with procedures is associated with negative consequences for themselves, while proper conduct will be appreciated.

#### **4. Conclusions**

Quality culture, especially safety, is a key element in the functioning of an organization, influencing the quality of products and processes. The authors point to the need to develop this culture in the food industry, which has also been taken into account in EU legal regulations. The article emphasizes the importance of continuous improvement and mutual influence between the culture of occupational health and safety and the culture of food safety, which aims to minimize the risk associated with food production. Areas of occupational health and safety culture have been identified, which will also be important from the point of view of the culture of quality and food safety. In order to achieve synergy in the development of both cultures in the organization, it is necessary to focus on these areas and develop them methodically by creating appropriate working conditions. Employee training and a culture of reporting and open communication can significantly increase employee awareness of the need to comply with the established principles of good production and hygiene practices, which will probably translate into compliance with the principles related to hygiene, proper use of protective clothing, careful handling of chemicals, and finally the development of employees' skills in perceiving potential threats to the product and production process as well as to themselves.

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## ECODESIGN IN POLISH MANUFACTURING COMPANIES – GENERAL INSIGHTS

Katarzyna JOACHIMIAK-LECHMAN

Institute of Management, Poznan University of Economics and Business;  
katarzyna.joachimiak-lechman@ue.poznan.pl, ORCID: 0000-0003-2917-9131

**Purpose:** The article presents the results of research into eco-design conducted among selected companies. The aim of the study was to identify how ecodesign is defined, the rationale for ecodesign, the methods used, and the factors that support the development of a product in terms of environmental characteristics.

**Design/methodology/approach:** The study was carried out using the individual in-depth interview method with representatives of 24 companies. Manufacturers from industries representing product categories that fit into the EU's Sustainable Products Initiative were invited to participate in the study.

**Findings:** Not all companies participating in the study are aware of the idea of ecodesign. It was noted that some respondents found it difficult to clearly describe the assumptions of ecodesign. Many respondents seemed to be interested in selected elements of ecodesign. None of the surveyed entities uses a documented procedure to identify and assess the environmental aspects of designed/developed products. In most cases, the companies surveyed rely on the experience and intuition of their employees to develop the environmental features of the products they offer.

**Research limitations/implications:** Future research will continue to identify the drivers and barriers of ecodesign from an organisational perspective. The main limitation of the study is the varying level of verbal communication skills of the interviewees and dispersed knowledge in the companies.

**Practical implications:** Based on the study, it can be concluded that there is a need to support companies in ecodesign activities, for example, by organizing training and workshops to explain strategies and principles of ecodesign. For the vast majority of entities that declared the presence of an environmental mentor in the company, it is an important or very important factor supporting the design or development of products.

**Originality/value:** The paper is addressed to all interested in ecodesign. The study should be seen as a contribution to the discussion about the role of Product-Oriented Environmental Management Systems in sustainability reporting. What makes the research valuable is the attempt to present the issue of ecodesign on the example of companies from different industries.

**Keywords:** ecodesign, manufacturers, individual in-depth interview.

**Category of the paper:** Research paper.

## 1. Introduction

The application of sustainability principles in a business approach involves the comprehensive management of various aspects of an organisation's activities. Ecodesign represents a new management paradigm that demonstrates the ideas of sustainable production and consumption. According to Baumann, Boons and Bragd (2002), the idea of ecodesign emerged in the early 1970s and grew particularly in the 1990s. A report prepared by the European Network of Ecodesign Centres (ENEC) entitled *Envisioning Ecodesign: Definitions, Case Studies and Best Practices* collates numerous ecodesign definitions. Some of these are listed below (Table 1). Ecodesign is also described in the standard ISO 14006:2020, where ecodesign is defined as a “systematic approach that considers environmental aspects in design and development to reduce adverse environmental impacts throughout the life cycle of a product” (ISO 14006:2020, p. 3).

**Table 1.**  
*Selected definitions of ecodesign*

Definition	Author
Ecodesign and Design for Environment (DfE) are terms for strategies that aim to integrate environmental consideration into product design and development.	Dewulf, 2013
Ecodesign involves simultaneously taking into account the environmental impacts associated with the selection of materials, the manufacturing process, the storage and transportation phase, usage, and final disposal.	Plouffe et al., 2011
Ecodesign is a proactive approach of environmental management that aims to reduce the total environmental impact of products.	Pigosso et al., 2010
Ecodesign implies a new way of developing products where environmental aspects are given the same status as functionality, durability, cost, time-to-market, aesthetics, ergonomics, and quality. Ecodesign aims at improving the product's environmental performance and may be seen as a way of developing products in accordance with the sustainable development concept.	Guelere Filho et al., 2007
Ecodesign integrates environmental criteria in the design of products and services so as to get the reduction of environmental impacts they produce, taking into account all stages of their life cycle.	Alonso, 2006

Source: author's elaboration based on Prendeville et al., 2014.

Ecodesign is a complex process. It usually consists of the following activities (ISO 14006:2020):

- identification of requirements (from different interested parties) into a product specification,
- transformation of the specification into product function,
- combination of function into product concepts,
- evaluation, refinement, and selection of a final product concept,
- refinement of the selected concept into the final product.

Ecodesign uses a variety of methods and techniques, from semi-quantitative or qualitative approaches to advanced life cycle methods. The literature recommends the use of guides with generic ecodesign guidelines (golden rules) (Luttropp, Lagerstedt, 2006), or ecodesign

strategies based on the classification of products (Joachimiak-Lechman, Lewandowska, and Matuszak-Flejszman, 2019).

In the following years, a number of legal regulations, proposals, and action plans to spread eco-design were created. In the last few years alone, a number of EU regulations have been developed with regard to specific eco-design requirements for different groups of energy-using products (e.g. Commission Regulations 2019/2019 eco-design requirements for refrigerating appliances; Commission Regulations 2019/2020 eco-design requirements for light sources and separate control gears; Commission Regulations 2019/2021 eco-design requirements for electronic displays, Commission Regulations 2019/2022 eco-design requirements for household dishwashers, Commission Regulations 2019/2023 eco-design requirements for household washing machines and household washer-dryers). At European Union level, several other documents are also worth noting:

- A new Circular Economy Action Plan for a cleaner and more competitive Europe: The plan presents a set of initiatives to create a strong and coherent product policy framework that improves sustainable products, services, and business models (European Commission, 2020).
- Commission Recommendation on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations: As part of the undertaken initiatives, the Product Environmental Footprint (PEF) method has been developed to support the design of products minimising their environmental impact throughout their life cycle (Official Journal of the European Union, L 471/1 from 30.12.2021).
- Proposal for establishing a framework for setting eco-design requirements for sustainable products: The paper proposes to extend the scope of the eco-design framework, noting that the new rules should go beyond energy-powered products to include further requirements (European Commission, 2022).
- The Corporate Sustainability Reporting Directive (Directive (EU) 2022/2464): European Sustainability Reporting Standards (ESRS) refer to eco-design, for example by requiring the disclosure of circular design applications, leading to increased product durability and optimisation of use (Official Journal of the European Union, L 322/15 from 16.12.2022).
- Regulation (EU) of the European Parliament and of the Council establishing a framework for the setting of eco-design requirements for sustainable products (2024/1781): The document is the result of the long-announced extension of the scope of the Eco-design Directive (2009/125/EC), which introduces, among other things, regulations for a digital passport. The eco-design requirements in the delegated act shall be such as to improve the following product aspects: durability, reliability, reusability, upgradability, repairability, the possibility of maintenance and refurbishment, the presence of substances of concern, energy use and energy efficiency, water use and

water efficiency, resource use and resource efficiency, recycled content, the possibility of remanufacturing, recyclability, the possibility of the recovery of materials, and environmental impacts, including carbon footprint and environmental footprint (Official Journal of the European Union from 28.06.2024).

Taking into account the above regulations as well as other market factors, it can be expected that interest in ecodesign among entrepreneurs will increase. Therefore, it is worth to assess the activities undertaken by business practice in this area. In the second half of 2023, qualitative research was launched with the primary aim of analysing the issue of ecodesign on the example of manufacturers of selected industries. Manufacturers operating in industries that have been recognised in the Circular Economy Action Plan and subsequently in the Regulation (EU) of the European Parliament and of the Council (2024/1781) as relevant for building a market for sustainable products were invited to in-depth interviews.

The qualitative research took place in two stages. The aim of the first part of the study was to determine whether and to what extent the selected companies consider life cycle perspectives when designing and developing the products they offer. It has been shown that the companies surveyed are beginning to think in terms of life cycle, although not all of the actions taken are impressive (Joachimiak-Lechman, 2024). Presumably, many of the respondents did not identify their environmental activities with ecodesign. It is therefore worth analysing the surveyed companies' awareness of eco-design, including how they define the concept, what rationale they follow, what methods they use, and what factors, according to the surveyed companies, support activities leading to environmental product development. Determining the above issues was the aim of the second phase of research, the results of which are presented in this article.

The topic of ecodesign has been addressed in Polish (e.g. Annuszewska et al., 2011; Dostatni, Mikołajewski, and Rojek, 2023; Siwiec et al., 2024) and foreign literature (e.g. van Hemel, Cramer, 2002; Coté, Booth, 2006; Fernández-Viñé, Gómez-Navarro, Capuz-Rizo, 2010; Dekoninck et al., 2016; Triguero et al., 2023; Saari et al., 2024) for years. The studies show progress in terms of the application of ecodesign. In the paper of Saari et al. (2024), the CE maturity matrix was presented, which comprises five maturity levels mapped with seven linear manufacturing value chain phases. The matrix was piloted with manufacturing industry companies from Finland, Italy, Germany and Ireland. The results showed that in the area of product design, none of the interviewed manufacturing industry companies remained at the linearity level, where linearity means designing a product without taking into account durability, upgradeability, circularity or sustainability (Saari et al., 2024). A survey conducted by Triguero et al. (2023) among Spanish manufacturing companies proved that when designing products, the most common practice is to design for recycling, followed by design for reuse (DfR) and design for disassembly (DfD) (Triguero et al., 2023).

An analysis among Polish small and medium-sized enterprises (SMEs) carried out more than 10 years ago, i.e., prior to the intensification of the European Union's pro-environmental policy, showed little interest in ecodesign (Annuszewska et al., 2011). Recent studies show

a much higher level of engagement in companies in this area, especially among large companies, but the pro-environmental orientation of SMEs is also observed (Dostatni, Mikołajewski, Rojek, 2023). What makes the research presented in this article valuable is the attempt to show the issue of ecodesign on the example of companies from different industries in Poland. On the basis of the results obtained, attention was drawn to the necessity of reinforcing entrepreneurs in the field of ecodesign. Research conducted using interviews and company workshops with Finnish manufacturing companies showed that for supporting product design, there is a need for more comprehensive coverage of social, circularity and criticality aspects, and life cycle thinking in sustainability assessment (Hanski et al., 2024). Research on product sustainability has also been conducted in the Swedish fashion industry. A need of specific knowledge was underlined. Most of the interviewees emphasized the importance of knowing their whole supply and value chain for sustainable design, production and logistics, for reducing emissions, water use and chemicals, and for enabling transparency and recycling (Le Feber, Smit, 2023).

## 2. Methods

The study was carried out using the individual in-depth interview method with representatives of 24 companies, in close cooperation with the Warsaw Marketing Research Centre. As noted, manufacturers from industries representing product categories that fit into the EU's Sustainable Products Initiative were invited to participate in the study (PKD codes: 14.13, 31.09, 26.20, 27.40, 27.51, 23.32, 23.99, 20.30). The criterion used to select companies for the qualitative study was commitment to product-focused environmental activities. Recruitment was carried out by a trained person using an appropriate questionnaire. Data of companies were taken from the database Dan & Bradstreet and the Central Economic Information Service. During recruitment, an attempt was made to contact more than 600 companies. The list of entities for which contact details were available (as of 14.12.2022) is shown in Table 2.

The main causes of excluding a company from the study were ineffective contact or refusal for various reasons, usually due to lack of time (the study was intended for a manager with responsibility for product policy with an understanding of environmental issues) or lack of interest in pro-environmental activities. At last, 24 companies were chosen. A brief description of the companies interviewed is provided in Table 3. The study was conducted using a structured interview scenario. Each interview was recorded and transcribed. The interview transcriptions were analyzed through content analysis.

**Table 2.***Number of companies for which contact details were available*

Industry	Employment			
	Up 9	10-49	50-250	Over 250
Manufacture of other outerwear	951	344	98	9
Manufacture of other furniture	1478	338	188	96
Manufacture of computers and peripheral equipment	221	36	10	5
Manufacture of electric lighting equipment	177	57	50	13
Manufacture of household appliances	28	15	11	20
Manufacture of building ceramics	40	30	10	4
Production of insulating materials	70	50	23	4
Production of paints and varnishes	127	71	30	9

Source: author's elaboration.

**Table 3.***Characteristics of companies participating in the study*

Respondent code	Industry	Number of employees	Organizational and legal form
1	Manufacture of other outerwear	Up 9	Individual business activity
2	Manufacture of other outerwear	10-49	General Partnership
3	Manufacture of other outerwear	Over 250	Joint-stock company
4	Manufacture of other furniture	50-250	Individual business activity
5	Manufacture of other furniture	50-250	Limited liability company
6	Manufacture of other furniture	10-49	Individual business activity
7	Manufacture of computers and peripheral equipment	Up 9	Individual business activity
8	Manufacture of computers and peripheral equipment	10-49	Individual business activity
9	Manufacture of computers and peripheral equipment	10-49	Limited liability company
10	Manufacture of electric lighting equipment	10-49	General Partnership
11	Manufacture of electric lighting equipment	10-49	Limited liability company
12	Manufacture of electric lighting equipment	Over 250	Limited liability company
13	Manufacture of household appliances	Over 250	Joint-stock company
14	Manufacture of household appliances	Over 250	Limited liability company
15	Manufacture of household appliances	50-250	Joint-stock company
16	Manufacture of building ceramics	Up 10	Limited liability company
17	Manufacture of building ceramics	50-250	General Partnership
18	Manufacture of building ceramics	Over 250	Limited liability company
19	Production of insulating materials	10-49	Limited liability company
20	Production of insulating materials	Over 250	Limited liability company
21	Production of insulating materials	10-49	Limited liability company
22	Production of paints and varnishes	10-49	Limited liability company
23	Production of paints and varnishes	10-49	Individual business activity
24	Production of paints and varnishes	50-250	Limited liability company

Source: author's elaboration.

### 3. Results

As an introduction to the interview topic, the question was asked: *have you ever heard of ecodesign?* This question was answered in the affirmative by 14 respondents, with 8 of them giving a strongly positive answer. The others supplemented their statement with phrases such as "I've heard about it", "I've heard, but only in buzzwords", or "I've heard something there". Respondents who answered yes to the first question were then asked to describe the context in which they had heard the term ecodesign. The most frequent answers were "legal requirements" and "general market trends". In the third question, respondents were asked to define ecodesign. The statements were grouped into 3 main categories, which were assigned subcategories (Table 4).

**Table 4.**  
*Definition of ecodesign*

Superior category	Major category	Frequency of occurrence	Subcategory	Frequency of occurrence
Definition of ecodesign	Definitions including the general principles of eco-design	11	action related to ecology	5
			designing with the principle of environmental sustainability	1
			manufacturing the best products in terms of ecology at minimum cost	2
			manufacturing environmentally friendly products	3
	Definitions including the selected life cycle issues	16	manufacturing products with the least pressure on the environment	6
			manufacturing products that are easily degradable	4
			using eco-friendly materials	1
			implementing solutions allowing optimal energy consumption	1
			lowering the wastefulness of production	1
			creating durable products	1
	Definitions related to the life cycle	4	creating products from recyclates	2
Design taking into account the environmental performance of the product in the whole life cycle			2	
			Design taking into account all environmental aspects occurring in the life cycle of a product	2

Source: author's elaboration based on conducted research.

As a rule, respondents allowed themselves a broader and multi-faceted statement, starting with the general premise of ecodesign (e.g. an ecology-related activity), and then supplemented the argument by referring to selected product life cycle issues. The respondents often pointed to "manufacturing products with the least pressure on the environment" (6 statements). Reference to the term "product life cycle" in the definition of ecodesign appeared four times. Of the respondents giving this answer, two belonged to the energy-related products industry.

The next question was: *How do you identify and assess the environmental aspects of the products you design/develop?* None of the surveyed companies indicated a specific method used independently and systematically (e.g. MET matrix, ERPA /MECO matrix, ECM method, EQFD Ecodesign Pilot method, MIPS method, LCA method). One of the surveyed entities belonging to the energy-related products industry uses a calculator prepared for internal purposes, which contains basic parameters for calculating the carbon footprint. Significantly, none of the surveyed entities uses a documented procedure to identify and assess the environmental aspects of designed/developed products.

Subsequently, respondents were asked what rationale they follow when designing/developing products in terms of environmental features. The statements were grouped into 3 main categories and 6 sub-categories (Table 5). Most surveyed companies rely on the experience and intuition of employees and consider their product-oriented pro-environmental actions to be subconscious (9 statements). Few companies study the environmental preferences of their customers (5 statements). Most of these companies have their own design departments (4 entities), so internal expertise is an additional rationale for environmental product development. Externally sourced R&D services are used by 5 entities, of which 2 entities indicated the use of advanced analyses such as carbon footprint calculation (manufacturer of energy-related products) and LCA studies (manufacturer of insulating materials).

**Table 5.**  
*The rationale for ecodesign*

Superior category	Major category	Frequency of occurrence	Subcategory	Frequency of occurrence
The rationale for ecodesign	Signals from the market	10	Customer preferences (determined by consumer research)	5
			Competitors' activities	3
			Individual requirements of customers	2
	Signals from inside the organization	14	Experience and intuition of employees	9
			Expert knowledge from within	5
	Other	5	External R&D	5

Source: own elaboration based on conducted research.

Another issue raised in the interview was the competence of the surveyed companies in developing the products' environmental aspects. Representatives of the interviewed entities were asked to rate their competence on a scale from 1 to 5 (where 1 means no competence, 5 means very high competence). Most of the surveyed companies considered their competence to be very high (9 statements) or high (7 statements). Only 3 companies admitted they were not competent in this area, and 2 companies considered their competence to be low. The others had no opinion on the matter.

The next question of the interview focused on the environmental aspects that are most important to respondents during product design/development. Respondents were asked about direct environmental aspects (which are under their management control) and environmental



aspects occurring in a life cycle perspective (beyond management control, but which the manufacturer can influence). When asked about the direct environmental aspects considered during product design/development, most respondents stated the answer one without thinking long. "Consumption of production materials" was indicated most frequently (11 statements), followed by "energy consumption during operational processes" (6 statements). Respondents were also asked to identify the most critical environmental aspects from the product life cycle perspective. For the majority of respondents, "product durability/ reliability" was the most important one (11 statements).

Finally, respondents were asked to comment on what helps them plan and implement activities that serve to design and develop the products they offer with respect to environmental issues. In this regard, having an environmental management system, the presence of an environmental mentor, and working in an interdisciplinary team could be potentially important (Glenn, 2002; Gupta, Dangayach, Singh, 2015). The purpose was to determine whether a particular factor is present - if so, how important it is.

One tool that potentially supports pro-environmental activity is an environmental management system based on ISO 14001. Among the surveyed companies, only 3 have a certified system that meets the requirements of ISO 14001. Importantly, each of them considered this system a significant factor in developing the environmental aspects of the products. 6 companies rely on internal guidelines for environmental issues (calling them an "internal standard", "company standard", or "departmental book"). Half of them stated that internal guidelines are essential in developing the environmental aspects of the products, while the rest had no opinion in this regard.

Another issue raised was the question of defining environmental targets for specific product parameters. Only 1 company out of 3 with a certified EMS admitted that it formulates ecodesign goals. The other manufacturers define goals for the entire organization, e.g. in the area of material consumption. A representative of this company assessed that such action clearly helps them improve their products' features. Two companies without a formalized EMS declared that they define environmental goals for their products. One company assessed such a practice as very helpful.

A potentially important factor supporting companies in pro-environmental activities is the presence of an environmental mentor in the company. Among the surveyed companies, 9 entities admitted that such a person exists at their company. For the vast majority (7 statements), the presence of an environmental mentor is an important or critical factor in supporting the product design/development process. A company representative commented as follows: "The environmental mentor not only spreads good energy or encourages various activities but also keeps an eye on what we already have". A representative from another company pointed out that "while the environmental mentor oversees all pro-environmental activities, the most important role is played by product mentors, who are responsible for creating the product and implementing pro-environmental changes".

The next question addressed the issue of working in an interdisciplinary team. Among the surveyed entities, 16 companies confirmed that they establish interdisciplinary teams when designing or developing products, and for 12 of them, this is an important or very important factor supporting the development of the pro-environmental features of these products. Networking (the process of information exchange) was mentioned several times as an important factor in the above area. For example, one company described the practice of periodic meetings between salespeople or product managers and management, during which suggestions for product development are given to designers.

#### 4. Discussion

The qualitative study included companies that belong to selected industries and declared during recruitment that they take pro-environmental measures focused on products. Nevertheless, the question, *Have you ever heard of ecodesign?* not by all respondents was answered in the affirmative. Only one-third of the respondents answered this question with a definite affirmative. There was also some disappointment in the way ecodesign was defined. Many statements manifested pertinent insights, but only 4 respondents were able to define the concept of ecodesign comprehensively. Of the respondents giving this answer, two belonged to the energy-related products industry. Given that ecodesign requirements have long been developed for these sectors, one might have expected more manufacturers of energy-related products to give a comprehensive definition. However, the previous study proved that ecodesign requirements are unquestionable drivers for activities from a life cycle perspective. For example, all surveyed manufacturers of energy-powered products improve their products in terms of energy intensity (Joachimiak-Lechman, 2024). A study conducted over a decade ago by Akman, Pişkin, and Kremer (2011) showed that even then understanding of ecodesign is particularly pronounced among suppliers of electrical and electronic components (Akman, Pişkin, Kremer 2011).

Legal issues as well as pragmatic consideration drive ecodesign, as confirmed by other studies (Siwiec et al., 2023). When asked about the direct environmental aspects considered during product design/development, respondents most frequently indicated “consumption of production materials”. For many companies, this aspect was important mainly for economic reasons. A similar insight can be drawn for environmental aspects of the product life cycle. The majority of respondents assessed “product durability/reliability” as the most important one, highlighting the correlation of this aspect with customer satisfaction.

It is noteworthy that none of the companies surveyed disclosed the specific method they use independently and systematically to identify and assess the environmental aspects of the product life cycle. In most cases, these companies depend on the experience and intuition of

their employees. Quite surprising, then, are the statements made by the companies surveyed about the competence in developing the environmental aspects of the products they offer. Most of them were rated as very high or high. Despite the high level of self-assessment, based on the entirety of the respondents' statements, it can be concluded that there is a need to support companies in the area of ecodesign, for example, by organizing training and workshops to explain ideas, strategies, principles of ecodesign, etc.

## 5. Summary

It can be concluded that not all companies participating in the study are aware of the idea of ecodesign. It was noted that some respondents found it difficult to clearly describe the assumptions of ecodesign. Many respondents seemed to be interested in selected elements of ecodesign. None of the surveyed entities uses a documented procedure to identify and assess the environmental aspects of designed/developed products. However, they were able to select the most important direct and indirect aspects of the products they offer, which are taken into account in the design/development process. Additional conclusions are as follows:

- Companies with a certified environmental management system recognized that it is a crucial factor that helps to develop environmentally friendly products.
- For the vast majority of entities that declared the presence of an environmental mentor in the company, it is an important or very important factor supporting the ecodesign or environmental development of products.
- For most entities that confirmed that they set up interdisciplinary teams when designing or developing the products with respect to environmental issues, it is an important or very important factor supporting such activities.

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## COMMUNICATING QUALITY AND FOOD SAFETY: INSIGHTS FROM NON-FINANCIAL REPORTING IN POLISH FOOD SECTOR LISTED COMPANIES

Piotr KAFEL<sup>1\*</sup>, Paweł NOWICKI<sup>2</sup>

<sup>1</sup> Department of Quality Management, Krakow University of Economics; kafelp@uek.krakow.pl,  
ORCID: 0000-0002-4140-8366

<sup>2</sup> Department of Quality Management, Krakow University of Economics; nowickip@uek.krakow.pl,  
ORCID: 0000-0002-7496-0157

\* Correspondence author

**Purpose:** The main goal of the conducted research was to acquire knowledge and analyze the official information on fulfilment of food safety and quality culture, as well as management systems aspects reported by food organizations listed on the Polish Stock Exchange.

**Design/methodology/approach:** In order to address the research questions, the research team conducted a content analysis of management board reports on the activities of food organizations. The sample of 18 organizations with statements from 2021 and 20 organizations with 2024 statements was used.

**Findings:** With regard to quality and safety culture, as well as top management's involvement in its continuous improvement, only indirect elements are communicated through official statement reports and channels. Supplier standards such as BRC and IFS are referenced more frequently by organizations than quality and food safety management systems based on ISO standards. Comparing the samples from 2021 and 2024 a noticeable decline is observed in the prevalence of the communicational content related to quality and safety issues.

**Originality/value:** The importance of food safety and quality culture in the communication with organizational owners and investors was analyzed offering a new perspective considering both the source of information as well as the recipients of communication.

**Keywords:** Polish Stock Exchange, certification, food safety, management commitment, quality culture.

**Category of the paper:** Research paper.

### 1. Introduction

In the food sector the safety of products is a prerequisite for achieving long-term success. Communication plays an important role in building trust and confidence. The perception of the quality of food products both by consumers and often supported by the organization's external

communications. Traditional communication channels, such as advertising, can be supplemented by using communication channels required by law as part of reporting. In the case of listed on stock exchange companies, there are well developed and describe investor relations activities which include methodical efforts and communication activities aimed at their transparency, compliance with regulations, reliability, credibility, timeliness and efficiency in following market signals, interactivity, as well as agility in informing, educating, cooperating with stakeholders in real time and improving the forms and methods of communication, which enables dialogue, creates value for all involved entities and helps to strengthen relationships (Tarczydło, 2021). One of the mandatory documents reporting the organization's activities is the financial report, the main recipients of which are stock market investors. Such reports provide an opportunity for organizations to emphasize the importance of food quality culture and accurate communication of food safety activities. Therefore, the primary objective of this research, and of this paper, is to gather and analyze official information on food safety and quality culture, as well as management systems, from the annual non-financial reports of Polish food organizations listed on the Polish Stock Exchange. Consequently, this will allow to assess the significance of quality and food safety communication within food sector organizations listed on Polish Stock Exchange.

## **2. Literature review**

The importance of public communication is well established within literature. Grunig and Hund (1984) emphasize the importance of external communication in building long-term relationships with the environment. The content of communication is influenced by the growing impact of civil rights, environmental, and consumer movements that emerged from the late 1950s and 1960s (Grunig and Hund, 1984). Nowadays, we are in the era of digital communication, with the importance not only of the content of communication but also the trust of the sources (Huda, 2024).

The ISO 9000 series of standards define quality as the degree to which a set of inherent characteristics of an object fulfils requirements (ISO, 2015). In the case of food and beverages products, that kind of requirements, among others, are related with food safety issues. Food safety is a necessary condition for the functioning of an organization in the food industry. It is not only a legal requirement but also one of the basic principles that allow sustainable growth. The basic principles for food safety are included in the requirements of good hygiene practices and the HACCP system. The much more advance voluntary systems such as quality management system according to the ISO 9001 standard or supplier standards such as BRCSG Food/IFS Food are implemented by the more aware are of the potential opportunities and risks associated with the quality of food products organizations. According to BRCSG Food



9 standard, the fulfilment of the certification criteria relies on clear commitment from the site management to adopt the best-practice principles outlined within the Standard and to the development of a food safety culture within the business. The main elements of food safety and quality culture should include clear and open communication on product safety, training, feedback from employees, the behaviors required to maintain and improve product safety processes, performance measurement of activities related to the safety, authenticity, legality and quality of products (BRCGS, 2022).

Considering the consumer perception of food products, there are a growing number of credence attributes related with purchasing decisions that cannot be directly inferred through search or experience, such as safety, nutrition, environmental protection (Thøgersen et al., 2019; Maehle et al., 2015). According to Wu et al. (2021) that issues are traditionally covered by branding, marketing and advertising. Those traditional sources can be supplemented with a reliable source of information provided directly by the organization as part of financial reporting. In accordance with the requirements of Directive 2014/95/EU of the European Parliament and of the Council of October 22, 2014 amending Directive 2013/34/EU with regard to disclosure of non-financial and diversity information by certain large entities and groups, introduced in national law by provisions contained in the Polish Accounting Act, in Article 49, para. 3, the report on the company's activities should include at least (EU, 2013; Ustawa o rachunkowości, 1994; Kafel, Nowicki, 2021):

- 1) key financial performance indicators related to the activities of the entity,
- 2) key non-financial performance indicators related to the entity's operations and information on employee issues and the natural environment.

Within the nonfinancial statements, there should be such information as (Ustawa o rachunkowości, 1994):

- a brief description of the entity's business model,
- key non-financial performance indicators related to the business units,
- a description of the policies applied by an individual in relation to social and labor issues, the natural environment, respect for human rights and counteracting corruption, as well as a description of the results of applying these policies,
- a description of due diligence procedures - if the entity applies them as part of the policies listed above,
- description of significant risks related to the activities of the entity that may have an adverse effect on the issues referred to above.

Non-financial statement data is widely used as a source of information in scientific research (Węgrzyńska, 2021; Martyniuk, Gostkowska, 2022). The role of non-financial information in the communication between an organization and its external environment is growing (Skoczylas-Tworek, 2020; Słoniec et al., 2017, Bek-Gaik, Krasodomska, 2018).

As indicates Błażyńska (2018) non-financial information not only supports the interpretation of financial information, but also often constitutes an independent source of information about entities. Non-financial information has become a regular part of corporate reporting. However, its recognition and presentation are not based on generally accepted principles of information presentation, but are largely discretionary (Błażyńska, 2018).

In practice, such statements in the food sector typically highlight the implementation of food safety and quality management systems, along with other activities related to quality and safety concerns. Considering the method of publication and verification of the reports subject to the research, it can be considered as one of the reliable sources of information provided directly by the organization with low risk related to the trust of the communication sources.

### 3. Methodology

The main goal of the conducted research is to get knowledge and analyze the official information on fulfilment of food safety and quality culture, as well as management systems aspects provided by the food organizations listed on the Polish Stock Exchange. As in the follow-up study initially conducted in 2021, the objective of this study was also to identify the main differences over time. The results of the first study was published in Kafel and Nowicki research (2021). This study followed an explorative approach. In order to answer the research questions, the research team performed a content analysis of reports of the management board on the company's activities issued by food organizations coming from Poland. Only food industry organizations were selected for the purpose of this study. The total number of analyzed companies was 20, of which 14 are from the main market and 6 coming from the *New Connect* market. Due to small population of food companies listed on the Polish Stock Exchange, the whole sample was analyzed. From the study, there were excluded organizations from Polish Stock Market, that are registered abroad or do not provide the required statements. Due to that, there is no requirement to publish official standards in Poland or in the Polish language. Eight organizations were excluded from the analysis. Data from the remaining 20 organizations was obtained from the official Polish website dedicated to publishing such information (<https://ekrs.ms.gov.pl/>), which is managed by the Polish Ministry of Justice. Consequently, there were no restrictions in sample selection taking into consideration such items as its size, type of activity or others. For the purposes of this study, the latest available official reports on the activities of companies published in 2023 were analyzed. In Table 1. there is a description of organization's that nonfinancial statements were analyzed. Six of the studied organizations operate on the primary market as well as in food processing activities. The main activities of the remaining 14 organizations are focused solely on food processing.

**Table 1.***Description of studied organization's main activity*

No	Main type of activity	No	Main type of activity
1	Production of agricultural crops, with particular emphasis on wheat and sunflower	11	Fish processing products, mainly pickled and salted
2	Production and distribution of wines	12	Production, processing and sale of meat and meat products
3	Production and processing of nuts and dried fruit as used in cooking	13	Production of confectionery such as chocolates, sweets, bars
4	Trade and distribution of meat and meat products, slaughter and cutting of red meat, livestock and plant crops production	14	Producer of food products mainly sweets, breakfast and cereal
5	Production and processing of nuts and dried fruit as used in cooking	15	Production of dietary supplements
6	A producer of energy drinks, classified as foods for nutritional uses and carbonated drinks.	16	Manufacturing products from fresh fruit and vegetables and their freezing
7	Production and sale of pasta as well as ready to eat food	17	Production of biscuits and corn chips
8	Production and distribution of alcoholic beverages	18	Production of dietary supplements
9	Producer of meat and vegetable dishes	19	Trade and production of honey and bee products
10	Potato processing, production of starch and starch products, processing and preservation of vegetables and fruits	20	Production of gelatin and vegan jellies

Source: own study.

Comparing the studied sample form 2021 and 2024, there were 75 % of the same organizations. The other 25 % of organizations have occurred in only one study. The biggest changes in companies on the stock market concerned the *New Connect* one.

Most often studied in 2024 organizations were multi-plant structures in the form of holding companies. The number of employees in these organizations ranges from 1 to 1360, with an average of 430 employees. As a result, most of these organizations are large. Detailed employment data is presented in Table 2.

**Table 2.***Number of employees in the studied organizations*

Number of employees	Number of organizations 2021 study	Number of organizations 2024 study
Less than 50	1	5
From 51 to 250	6	4
From 251 to 500	2	5
From 501 to 1000	6	4
More than 1000	3	2

Source: own study.

The average number of pages of the analyzed report was 45 (compared to 57 in 2021). The extracted data were charted using Microsoft Excel forms. Next quantitative and qualitative content analysis was used to examine the data. Specifically, the quantitative content analysis was conducted as originally intended: to systematically identify, categorize, and count the objective elements of the examined issue (Rourke, Anderson, 2004). Distinguished categories enabled the research team to describe food safety management systems activities in the selected

sample as well as the food safety quality culture. The results of the study are presented in the next section in accordance with the adopted theoretical framework.

#### 4. Results and discussion

The food safety and quality culture were directly communicated only by 2 organizations in the statements from 2024 year. Both organizations have BRC and IFS standards implemented. In one case only the quality culture was mentioned. In the other one there was information that:

*Ensuring the appropriate standard of goods is achieved, among others, by spreading the Culture of Quality and Product Safety among employees at all levels in the organization. The developed program aims to maintain a high level of awareness and engage all employees in activities that affect the development of the entire organization.*

Despite its great importance for the proper functioning of the organization, official statements are not used by companies to raise its level and authenticate the involvement of top management. However, it is not as bad as it might seem. Culture of Quality and Product Safety is built on the basis of clear and open communication on product safety, training, feedback from employees, the behaviors required to maintain and improve product safety processes, performance measurement of activities related to the safety, authenticity, legality and quality of products (BRCGS, 2022). These processes are implemented by the use of quality and food safety management systems, which are communicated by the studied organizations. According to Spagnoli et al. (2023), food safety culture distinguishes the food safety management system activities and two other areas important for its implementation, which are: the human-individual and the human-organizational involvement.

Among the studied organizations, information about the most widely recognized quality and food safety systems was typically present. Only in the case of 6 (5 in 2021) organizations there were no statements concerning quality or food safety management systems. For the other 14 (13 in 2021) organizations, more or less extensive references to the implemented quality or food safety management systems as well as product quality have been found. The most popular systems that were communicated to the readers of published statements were suppliers' requirements certified according to BRCSG (Brand Reputation through Compliance Global Standard) and IFS (International Food Standard) requirements in both studies. In 2 (4 in 2021) organizations there were mentioned food safety management system complied with ISO 22000 standard requirements. It is not surprising that the quality management system certified according to ISO 9001 was the least frequently indicated management system. Only 3 (3 in 2021) organizations boasted with that particular management system. In table 3 there are presented data concerning the management system implementation within studied organizations that are related to the quality or food safety.

**Table 3.***Examples of management systems reported in nonfinancial statements*

Standard	Number of organizations 2021 study	Number of organizations 2024 study
▪ BRC	▪ 9	▪ 7
▪ IFS	▪ 7	▪ 7
▪ ISO 22000 and FSSC 22000	▪ 4 and 2	▪ 2 and 2
▪ ISO 9001	▪ 3	▪ 3
▪ GMP	▪ 2	▪ 2

Source: own study.

It is worth emphasizing that supplier standards certification is often addressed in the statements that standards published by ISO. In 2 cases not only the information concerning the BRCSG Food certification was mentioned, but also the final grade (AA+ or AA) was provided, which is the highest possible that can be obtained within that certification scheme.

In both samples from 2021 and 2024 there were some companies that has the management system certified but did not include that information in the annual statement. It is possible that quality management system certificate is not any longer an information worth underlining and present as an advantage. Also, the number of declarations of management and safety systems may confirm this trend. In 2024 sample there were there were fewer references to certified systems than in the previous study. It is important to highlight that the published statements are addressed to the stock market investors. That conclusion is in line with other studies that indicate the decrease in the marketing benefits of ISO 9001 certification (Ferreira, Cândido, 2021). It is possible that the certification withdrawal process also may affect the companies from the Polish Stock Exchange. According to the study Delfino et al., (2024) the interplay of external motivations, the lack of internalization and continuous improvement, and the nature of benefits gained by these entities ultimately leads to certification withdrawal.

The number of different management systems that can be implemented and certified is quite big, and that could be the reason why organization prefer to only inform about the integrated management system. That was a case of 3 statements from 2024 and 4 from 2021. The sample references to Integrated Management Systems are:

*...The company has implemented an Integrated Quality Management System, as well as quality certificates (IFS Food Standard and BRC Food Standard), which guarantee production at the highest level...*

*...Thanks to the integrated management system implemented and certified since 2007, high quality and full health safety of manufactured products are ensured...*

The number and types of systems implemented can vary depending on the organization. The organizations studied are typically large, multi-plant holding companies, where different plants or even product lines may be certified under different standards. In such cases, it is often simpler to provide an overview of the integrated management system rather than detailed specifics. References only to the environmental management systems without quality or food safety systems is part of the growing trend related to sustainability or organizations. The green

economy, circular economy, and sustainability are now important factors in gaining a competitive advantage for food sector companies (Sharma et al., 2021). There is still room for improvement in that sector. Studies of Castillo-Díaz et al. (2023), unveiled a moderate level of sustainability in the food production and processing in the European Union.

In 2021 study there were 3 organizations, that informed about the lean management practices. Lean management is more general management concept than well specify standards such as e.g. ISO 22000 or BRC. That can be compared to the well-known TQM philosophy that was popular in the past. In the up-to-date sample, there were no such mentions concerning lean management. It can be assumed that the fashion for this type of solution is passing. This phenomenon is even more visible in the case of the TQM philosophy. The TQM mentions were not found within studied documents at all in 2021 and 2024 samples. The TQM is not any more a concept worth advertising by companies even if there are similarities and common ideas between TQM and currently popular systems such as lean management or some common management practices describe in BRC/IFS food standards. On the other hand, based on bibliometric analysis Ali (2024) studies claim that TQM still remains a current and relevant research topic at this moment, mostly in the manufacturing industry in developed economies. As Polish organizations should be rather situated in well developed countries, the decreasing popularity of TQM is explainable.

Quality and food safety of products can be confirmed not only by food and quality management systems but also product and process certification. The organizations indicated the most popular management standards such as environmental management systems in compliance with ISO 14001, ISO 50001 and the occupational health system in compliance with ISO 45001. As for other certification schemas that were in studied data, there were identified such product certification schemes as: “Jakość-Tradycja” mark that is polish high quality food program, organic food certification, vegan, V-Label, Gluten Free, GMP and MSC. There were mentions related to certificates related to the requirements of religious groups. Certificates such as Kosher and Halal were mentioned respectively by organizations in both 2021 and 2024 samples.

### **Quality – is it a risk or chance?**

In one of the statements, the authors claimed (Kafel, Nowicki, 2021):

*Food safety issues have been classified as the main source of reputational risk for our business. Quality problems can potentially lead to product recalls and penalties that can materially affect the Company's operations. We have implemented a rigorous quality control plan to mitigate food safety risks. We also have a food hygiene training and audit program to ensure that our high-quality standards are met.*

That kind of statement emphasizes the potential risk of low-quality food products. According to the minimal requirements of annual nonfinancial statements, there should be indication of significant risks related to the activities of the organization. Some typical risks, that were usually identified by organizations both in 2021 and 2024 studies, were: currency risk, risk of bad weather conditions, risk of changes in legal regulations or the risk associated with a covid-19 pandemic. New risk that was indicated by the vast majority of companies in 2024 statements, was the war situation beyond the eastern border of Poland. As the main activity of the organization was food processing, the intriguing question is, if studied companies consider quality or food safety issues as a significant risk factor that can affect the financial performance of a holding. Climate change is an increasingly significant risk that organizations should take into account. The formal analysis of such risks has gained particular importance following the changes introduced in the ISO 9001 standard in 2024, specifically in Chapter 4 (Munro, 2024; ISO, 2024). Therefore, it can be expected that in future reports, organizations will more frequently communicate these requirements.

Risks related to quality or food safety were declared by 2 companies (6 in previous studies), the other ones did not indicate them directly. An example of provisions directly related to quality and safety are described in table 4.

**Table 4.**

*Risks related directly with quality or food safety matters in 2024 statements*

<b>Risk</b>	<b>Statement citation</b>
▪ Risk of complaints (2021 year)	<i>...The quality of raw materials is closely related to the stages of growth, transport and storage. During these stages, the contamination of the raw materials can occur... The company maintains the ISO 9001:2015 quality management system certification, which aims to meet customer requirements and constantly improve the quality of manufactured products and services.</i>
▪ Risk to the health and life of the consumer (2021 year)	<i>In the event of a sale of a product creating a threat to health or life, there would be ... the obligation to pay compensation for customers and consumers, and costs incurred in connection with the recall of the product and its disposal. The risk is low due to the implemented Quality and Food Safety Management System.</i>
▪ Risks related to the production process (2024 year)	<i>...Food production is associated with a number of specific requirements and regulations regarding hygiene in production processes and the labeling of food products. The company meets all requirements in this area, as evidenced by the certificates it holds...</i>
▪ Risks related to the internal control system HACCP and raw materials quality (2024 year)	<i>The application of the HACCP system is verified by control bodies. Refusal to extend certification may lead to the impossibility of conducting business... The use of inappropriate quality raw materials in the production process may lead to a deterioration of relations with the most demanding customers, possibly complaints and a drop in demand...</i>

Source: own study and (Kafel, Nowicki, 2021).

In some cases, the organization indicated other risk factors, at the same time referring to, e.g. poor product quality or loss of brand credibility related to product recalls. For example: *...the manufacturing process is multi-stage and complex, and almost every stage requires different types of devices. Operating these devices is subject to risks related to disruptions in the production process or its faulty course...* In table 5 there are examples or topics related to the risks where quality or food safety are mentioned.

**Table 5.**  
*Examples of risks where quality or food safety matters*

Risk	Statement citation
<ul style="list-style-type: none"> <li>▪ Competition risk</li> </ul>	<p>(2021) <i>In order to eliminate this risk, the Company conducts activities aimed at strengthening its strong market position by providing high-quality products and building brand awareness...</i></p> <p>(2024) <i>There is a risk of aggressive competition on the markets from other entities that are able to compete with the Company through the quality, price of products, and the technological solutions used. Competitors may in the future force the Company to reduce the margins achieved and increase expenses on improving the quality of the products offered.</i></p>
<ul style="list-style-type: none"> <li>▪ Risk related to commercial contracts with customers</li> </ul>	<p>(2021) <i>... in the event of failure to comply with the terms of the contract (e.g. in terms of timeliness, quantity or quality of deliveries) ...</i></p> <p>(2024) <i>...Due to the established business model, the Issuer sells its products to the largest retail chains in the country and abroad. In the event of termination of the contract with a large retail chain, there is a risk that the Issuer will not be able to compensate for the loss of orders from lost clients in a short time with new projects, which may translate into reduced revenues for the Company...</i></p>
<ul style="list-style-type: none"> <li>▪ Risk of legal changes</li> </ul>	<p>(2021) <i>Quality teams follow all legal regulations regarding products and packaging on an ongoing basis, and changes required by law are implemented without undue delay...</i></p> <p>(2024) <i>The Issuer is exposed to imprecise provisions in legal and tax regulations, which may lead to interpretation discrepancies, in particular with respect to operations related to income tax, civil law transaction tax and VAT as part of the Company's business activity.</i></p>

Source: own study and (Kafel, Nowicki, 2021).

Considering the above-mentioned risks with relation to the quality or safety of products, it can be concluded, that generally food sector organizations that are listed on the Polish stock market are aware of those risks. When the risk is given then usually the quality management and food safety standards are indicated as a way to minimize the risk. That is in line with the goals of the standards as well as results of other studies e.g. Spadoni et al. (2014) or Smith (2019).

## 5. Conclusions

The main goal of the conducted research was to acquire knowledge and analyze the official information on fulfilment of food safety and quality culture, as well as management systems aspects provided by the food organizations listed on the Polish Stock Exchange. In conclusion, supplier standards such as BRC and IFS are referenced more frequently by organizations than quality and food safety management systems based on ISO standards. Comparing the samples from 2021 and 2024, a visible decline in the emphasis on the examined issues in company reports can be observed. This trend becomes even more pronounced when the Total Quality Management (TQM) philosophy is analyzed. The observed reduction in communication regarding quality and safety may result from economic, organizational, regulatory, and technological factors. Each of these reasons requires an individual analysis in the context



of the specific industry and the particular organization. Considering the research findings from other areas (Tyle, 2021), the most likely reasons include additional administrative burdens and a lack of interest from shareholders and investors. Another possible explanation for the decrease in communication intensity in the area of management systems could be the high level of organizational maturity in the examined companies. According to the Hines model (1996), quality standards are utilized in the early stages of relationships, but in later phases, they are replaced by other tools and methods of creation. This could be one of the avenues for further research in this area. Despite the risks associated with product quality and safety, it can be concluded that food sector organizations listed on the Polish stock market are generally aware of these risks and typically address them, either directly or indirectly, in their non-financial statements. With regard to quality and safety culture, as well as top management's involvement in its continuous improvement, only indirect elements are communicated through official statement reports and channels.

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## THE CHALLENGE OF EMPLOYEE MOTIVATION IN BUSINESS MANAGEMENT

Anna KASPERCZUK<sup>1\*</sup>, Michał ĆWIAKAŁA<sup>2</sup>, Ernest GÓRKA<sup>3</sup>, Dariusz BARAN<sup>4</sup>,  
Piotr RĘCZAJSKI<sup>5</sup>, Piotr MRZYGLÓD<sup>6</sup>, Maciej FRASUNKIEWICZ<sup>7</sup>,  
Agnieszka DARDZIŃSKA-GŁĘBOCKA<sup>8</sup>, Jan PIWNIK<sup>9</sup>

<sup>1</sup> Białystok University of Technology, Faculty of Mechanical Engineering; a.kasperczuk@pb.edu.pl,  
ORCID: 0000-0002-5919-5346

<sup>2</sup> IM Brand Institute sp. z o.o.; m.cwiakala@imbrandinstitute.pl, ORCID: 0000-0001-9706-864X

<sup>3</sup> WSB - National-Louis University, College of Social and Computer Sciences; ewgorka@wsb-nlu.edu.pl,  
ORCID: 0009-0006-3293-5670

<sup>4</sup> WSB - National-Louis University, College of Social and Computer Sciences; dkbaran@wsb-nlu.edu.pl,  
ORCID: 0009-0006-8697-5459

<sup>5</sup> MAMASTUDIO Pawlik, Ręczajski, spółka jawna; piotr@mamastudio.pl, ORCID: 0009-0000-4745-5940

<sup>6</sup> Piotr Mrzygłód Sprzedaż-Marketing-Consulting; piotr@marketing-sprzedaz.pl, ORCID: 0009-0006-5269-0359

<sup>7</sup> F3-TFS sp. z o.o.; m.frasunkiewicz@imbrandinstitute.pl, ORCID: 0009-0006-6079-4924

<sup>8</sup> Białystok University of Technology, Faculty of Mechanical Engineering; a.dardzinska@pb.edu.pl,  
ORCID: 0000-0002-2811-0274

<sup>9</sup> WSB Merito University in Gdańsk, Faculty of Computer Science and New Technologies; jpiwnik@wsb.gda.pl,  
ORCID: 0000-0001-9436-7142

\* Correspondence author

**Purpose:** This paper examines the role of employee motivation in effective business management. It also explores the impact of financial and non-financial motivators on employee engagement.

**Design/methodology/approach:** The research used a quantitative methodology and an online survey of 102 individuals. Statistical analyses, including variance analysis and correlation analysis, were conducted to identify significant patterns and differences in motivation levels.

**Findings:** Financial motivators, particularly bonuses for achieving targets, were identified as the most effective. Non-financial motivators, such as flexible work schedules and additional days off, also showed high effectiveness in enhancing motivation. Significant differences in motivation levels were observed by gender, age, and length of service.

**Research limitations/implications:** The study is limited to a specific demographic and geographic scope. Future research could explore diverse cultural and occupational contexts.

**Practical implications:** Combining financial and non-financial motivators can effectively increase employee satisfaction and engagement.

**Social implications:** Fostering effective motivation practices contributes to stronger family-company relationships. Companies adopting such strategies set benchmarks for the best workplace.

**Originality/value:** This study provides insights into the balance of financial and non-financial motivators in shaping employee motivation. It offers actionable recommendations for HR managers and organisational leaders.

**Keywords:** business management, financial motivators, non-financial motivators.

**Category of paper:** research paper.

## 1. Introduction

Employee motivation is an integral part of successful business management. In a dynamic business environment where competition is increasingly fierce, keeping employees engaged and highly motivated becomes a key challenge for managers and organisational leaders. A properly motivated staff not only contributes to better performance, but also influences the atmosphere in the workplace, which has a significant impact on organisational culture and company image (Karas, 2004).

In today's professional environment, both financial and intangible aspects play an important role in motivating employees, aiming to increase their commitment and efficiency. The development of the work-life balance concept is becoming increasingly important for employee well-being. The impact of motivators on this balance is extremely important, as it has a direct impact on the quality of employees' professional and personal lives (Lesniewski, Berny, 2011; Kozminski, Piotrkowski, 2007).

Today, both financial and non-financial motivators are an integral part of human resource management strategies. When looking for new jobs, employees not only pay attention to salary, but also to a comprehensive benefits package, which may include flexible working hours, a remote working option, support with health issues and development programmes (Lesniewski, Berny, 2011).

Labour market research shows that organisations that effectively combine a variety of motivators in their offerings enjoy higher employee engagement and loyalty. In this perspective, the concept of work-life balance is becoming increasingly valued. For many employees, it is crucial for maintaining mental and physical health, building family relationships and pursuing passions and interests outside the workplace. Organisations that understand the importance of work-life balance not only promote a healthier and more productive work environment, but also build a positive image as an employer that cares about the well-being of its employees (Paszkievicz, Wasiluk, 2022; Wiradendi et al., 2021).

Motivators, both financial and non-financial, have a direct impact on achieving and maintaining a work-life balance. By offering employees the opportunity to tailor their work schedules to their individual needs and by making available support programmes or other life-enhancing initiatives, organisations create an environment conducive to harmoniously combining work and private responsibilities. Financial incentives, such as raises or bonuses, can stimulate employees' motivation to perform better. However, when they become the sole or main motivating factor, they can lead to work overload and an imbalance between work and

personal life. Employees may be inclined to devote more time and energy to work at the expense of their personal lives, which in the long term may result in job burnout and health problems (Paszkiwicz, Wasiluk, 2022; Kocot, Kwasek, 2023).

On the other hand, non-financial motivators, such as flexible working hours or the possibility to work remotely, can be beneficial in achieving a better work-life balance. They allow employees to adapt their work schedule to their individual needs and life priorities, enabling them to manage their time effectively, engage in non-work activities and take care of their health and well-being. It is important to strike a balance between financial and non-financial motivators in the context of work-life balance. Organisations should strive to create a conducive working environment that takes into account both these spheres of motivation, supporting employees to achieve professional success without negatively impacting on their personal lives. After all, the long-term success of an organisation depends on the health, satisfaction and commitment of its employees, and properly aligned motivators play a key role in this (Tomaszewska-Lipiec, 2014).

## **2. Research material and method**

The aim of this study was to analyse the role of employee motivation in effective business management and to identify the main challenges in providing it. It assessed how employees evaluate the various motivational factors and what strategies managers can use to effectively manage the organisation.

A survey method was used in the study. The research tool used was a questionnaire. A proprietary questionnaire consisting of two sections was developed to implement the survey. The first section included socio-demographic data such as age, gender, place of residence and length of service. The second section of the questionnaire concerned the evaluation of the motivation system and the motivators used.

The study assessed the following research problems:

1. How do employees assess their own work motivation?
2. Which motivation instruments do employees most prefer?

The survey was conducted between May and July 2023, using the Internet as the main data collection tool. The survey questionnaire was prepared using the Google Forms platform, and a link to it was made available on various thematic forums and other online platforms. Respondents were assured of the anonymity of their answers and the purpose of the survey. In addition, participants were given the option to stop completing the questionnaire at any time.

The collected results were statistically analysed and presented in the form of tables and graphs. The method of frequency analysis and basic descriptive statistics for quantitative data, such as mean, median and standard deviation, were used to analyse the self-reported data.

An analysis of variance (ANOVA) with repeated measures was performed to compare motivator ratings. Comparisons between two independent samples were made using the Student's t-test or the Mann-Whitney test when assumptions about the normality of the data distribution were not met. On the other hand, for comparison of values between more than two independent groups, analysis of variance (ANOVA) or the Kruskal-Wallis test was used. When significant differences were detected, POST-HOC tests were used for more detailed analysis. The normality of the data distribution was checked using the Shapiro-Wilk test. Analysis of the relationship between quantitative variables was performed using Pearson's or Spearman's correlation analysis. The significance level was taken as  $\alpha = 0.05$ . All analyses were performed using Statistica 13.3 software from StatSoft.

There were 102 participants in the self-survey, of whom 61.76% were female and 38.24% were male. The age range of 18 to 25 years was 9.80% of respondents, 26 to 35 years was 48.04% and 36 to 45 years was 29.41%. The remaining 12.75% were employees aged 46 and over. Within the surveyed group, the largest age group were respondents with a length of service of 11 to 15 years and 16 to 20 years. Seniority of more than 20 years was indicated less frequently. On the other hand, seniority of 6 to 10 years was declared by 9.80% of the respondents and less than 5 years by 5.88%.

### 3. Research results and discussion

The participants were subjected to a self-assessment of their level of motivation, which showed that half of them assessed their level of motivation as medium (50.00%). In the study group, 39.22% of the subjects described their motivation as high or very high, while the remaining subjects indicated a low (7.84%) or very low level of self-motivation. Statistically significant differences in the level of work motivation were observed between women and men ( $p = 0.005$ ). Work motivation was found to be significantly higher among men ( $M = 3.82$ ;  $SD = 0.91$ ) compared to women ( $M = 3.16$ ;  $SD = 0.88$ ). Detailed results are shown in table 1.

**Table 1.**

*Self-assessment of level of motivation by gender (N = 102)*

Gender	Woman (n = 63)			Man (n = 39)			Significance
	M	Me	SD	M	Me	SD	
Self-assessment of level of motivation	3,16	3,00	0,88	3,82	3,00	0,91	0,005*

\*  $p < 0,01$ ; M – Mean; Me – Median; SD – Standard Deviation; p – Probability Level.

Source: Own elaboration based on conducted research.

Statistically significant differences were also shown between age groups in terms of the level of motivation to work ( $p = 0.016$ ). The highest level of motivation was observed among the oldest people ( $M = 3.85$ ;  $SD = 1.68$ ), while the lowest level of motivation was shown in the group of people aged 26-35 ( $M = 3.20$ ;  $SD = 0.84$ ) (Table 2).



**Table 2.***Self-assessment of level of motivation by age (N = 102)*

Self-assessment of level of motivation	<i>M</i>	<i>Me</i>	<i>SD</i>	<i>p</i>
18-25 years (n = 10)	3,70	4,00	0,48	0,016**
26-35 years (n = 49)	3,20	3,00	0,84	
36-45 years (n = 30)	3,47	3,00	0,73	
46 years and more (n = 13)	3,85	5,00	1,68	

\*\* p &lt; 0,05; M - mean; Me - median; SD - standard deviation; p - probability level

Source: Own elaboration based on conducted research

The analysis also showed statistically significant differences in the level of motivation according to length of service ( $p < 0.001$ ). The highest level of motivation was found among employees with more than 20 years of work experience ( $M = 4.12$ ;  $SD = 1.54$ ), while the lowest level of motivation was found among those working for less than 5 years ( $M = 3.00$ ;  $SD = 0.01$ ) (Table 3).

**Table 3.***Self-assessment of level of motivation by seniority (N = 102)*

Self-assessment of level of motivation	<i>M</i>	<i>Me</i>	<i>SD</i>	<i>p</i>
Below 5 years (n = 6)	3,00	3,00	0,01	<0,001***
6-10 years (n = 10)	3,70	4,00	0,48	
11-15 years (n = 37)	3,41	3,00	0,83	
16-20 years (n = 32)	3,09	3,00	0,59	
Above 20 years (n = 17)	4,12	5,00	1,54	

\*\*\* p &lt; 0,001; M - mean; Me - median; SD - standard deviation; p - probability level.

Source: Own elaboration based on conducted research.

The majority of respondents (82.35% in total) declared that they had received (30.39%) or rather received (51.96%) this information regarding the workplace motivation system. In contrast, a smaller group of respondents (17.65% in total) stated that they rather did not have such knowledge (6.86%) and definitely did not know the motivation system used at the workplace (10.78%).

The respondents rated the importance of financial motivators on a scale of 1 to 5, where 1 meant low importance and 5 meant very high importance. The results obtained are presented in Table 4. The analysis showed statistically significant differences in the rating of individual motivators ( $p = 0.013$ ). Financial motivators were ranked from lowest to highest rated. The highest rated financial motivator was the awarding of bonuses for achieving goals ( $M = 4.60$ ;  $SD = 0.69$ ), while the lowest rated was receiving rewards for achieving goals ( $M = 4.19$ ;  $SD = 1.21$ ).

**Table 4.***Evaluation of the effectiveness of financial motivators (N = 102)*

Financial motivator	M	Me	Min	Max	SD	F	p
Rewards for achieving targets <sup>a</sup>	4,19	5,00	1,00	5,00	1,21	3,91	0,013 **
Percentage of sales <sup>ab</sup>	4,23	5,00	1,00	5,00	1,19		
Salary <sup>ab</sup>	4,41	5,00	2,00	5,00	0,73		
Bonus for meeting targets <sup>b</sup>	4,60	5,00	3,00	5,00	0,69		

<sup>abc</sup> successive letters stand for homogeneous groups; \*\* p < 0,05; M – mean; Me – median; SD – standard deviation; Min – minimum value; Max – maximum value; F – test statistic; p – probability level.

Source: Own elaboration based on conducted research.

Respondents were asked to rate the effectiveness of non-financial motivators on a scale of 1 to 5, where 1 meant low effectiveness and 5 meant very high effectiveness. The results obtained are presented in Table 5. The analysis showed statistically significant differences in the rating of individual motivators (p < 0.001). It was found that stocks and bonds were considered the least effective (M = 2.02; SD = 1.39). In contrast, extra days off (M = 4.10; SD = 1.27), subsidised holidays (M = 4.10; SD = 1.32) and the possibility to use a company car, fuel or reimbursement of commuting costs (M = 4.18; SD = 0.99) were considered to be the most effective.

In addition, statistically significant differences were found in the evaluation of individual intangible motivators (p < 0.001). Public praise was rated lowest (M = 2.98; SD = 1.36). In contrast, flexible work schedules (M = 4.29; SD = 0.85), opportunities for career development and advancement (M = 4.37; SD = 0.86) and work atmosphere and comfort (M = 4.46; SD = 0.78) were rated highest.

**Table 5.***Evaluation of the effectiveness of non-financial motivators (N = 102)*

Non-financial motivator	M	Me	Min	Max	SD	F	p
Shares, bonds <sup>a</sup>	2,02	1,00	1,00	5,00	1,39	9,23	0,001***
Company housing <sup>ab</sup>	2,46	2,00	1,00	5,00	1,65		
Staff loans <sup>abc</sup>	2,68	2,00	1,00	5,00	1,57		
Special events <sup>abc</sup>	2,78	3,00	1,00	5,00	1,38		
Gym passes, theatres, cinemas, swimming pools <sup>abcd</sup>	3,07	3,00	1,00	5,00	1,48		
Reimbursement for studies, courses <sup>bcd</sup>	3,09	3,00	1,00	5,00	1,62		
Company computer, telephone <sup>bcd</sup>	3,23	3,50	1,00	5,00	1,55		
Lunches, buffet, catering <sup>bcd</sup>	3,29	4,00	1,00	5,00	1,59		
Supplementary insurance (group, life) <sup>bcd</sup>	3,42	3,00	1,00	5,00	1,15		
Medical care <sup>cde</sup>	3,86	4,00	1,00	5,00	1,02		
Christmas parcels or vouchers <sup>de</sup>	3,90	4,00	1,00	5,00	1,26		
Additional days off <sup>e</sup>	4,10	5,00	1,00	5,00	1,27		
Holiday allowance <sup>e</sup>	4,10	5,00	1,00	5,00	1,32		
Company car, fuel or reimbursement of commuting expenses <sup>e</sup>	4,18	4,00	1,00	5,00	0,99		

<sup>abc</sup> successive letters stand for homogeneous groups; \*\*\* p < 0,001; M – mean; Me – median; SD – standard deviation; Min – minimum value; Max – maximum value; F – test statistic; p – probability level.

Source: Own elaboration based on conducted research.

**Table 6.***Evaluation of the effectiveness of intangible motivators (N = 102)*

Intangible motivator	<i>M</i>	<i>Me</i>	<i>Min</i>	<i>Max</i>	<i>SD</i>	<i>F</i>	<i>p</i>
Public praise <sup>ab</sup>	2,98	3,00	1,00	5,00	1,36	15,22	<0,001***
Training and coaching <sup>bc</sup>	3,67	4,00	1,00	5,00	1,32		
Work-life balance <sup>cd</sup>	4,15	5,00	1,00	5,00	1,16		
Professional development <sup>cd</sup>	4,24	5,00	2,00	5,00	0,96		
Flexible schedule <sup>d</sup>	4,29	5,00	3,00	5,00	0,85		
Opportunities for development and promotion <sup>d</sup>	4,37	5,00	2,00	5,00	0,86		
Atmosphere and comfort at work <sup>d</sup>	4,46	5,00	3,00	5,00	0,78		

<sup>abc</sup> successive letters stand for homogeneous groups; \*\*\*  $p < 0,001$ ; *M* – mean; *Me* – median; *SD* – standard deviation; *Min* – minimum value; *Max* – maximum value; *F* – test statistic; *p* – probability level.

Source: Own elaboration based on conducted research.

#### 4. Summary

In today's dynamic labour market, which is saturated with competition, there is the challenge of maintaining a work-life balance. Organisations that are aware of these challenges and take initiatives to promote this balance can reap numerous benefits, including increased employee motivation. Promoting work-life balance signals an organisation's concern for the wellbeing of its employees, which builds trust and loyalty among staff. As a result, these employees are often more committed to their responsibilities, loyal to the company and willing to engage in additional activities that contribute to the success of the organisation (Knap-Stefaniuk, 2018; Mroczkowska, Kubacka, 2020).

The results of the present study indicate a diversity of motivation levels among employees, which is an important aspect in the context of human resource management and the development of effective motivational strategies. A surprisingly high proportion of employees (50%) assess their motivation as average. The results obtained in this study confirm that there is great potential to improve motivation in many organisations.

The study showed differences in motivation by gender, age and length of service. Men often show higher levels of motivation than women, which may be due to differences in career expectations or availability of resources. Older people tend to have higher levels of motivation, which may be related to work experience and a sense of professional fulfilment. In contrast, younger employees may experience lower levels of motivation due to lack of development prospects or work-life conflict (Paszkievicz, Wasiluk, 2022).

The final aspect of seniority also highlights the relevance of work experience in terms of motivation. Those working for more than 20 years can derive satisfaction from long-term commitment and visible contribution to the organisation. In contrast, younger employees, working less than five years, may experience initial adaptation difficulties or a lack of understanding of their needs and expectations.

Financial factors, such as remuneration and financial rewards, are considered the most important factors in motivating employees. Non-financial factors, in particular job security, also play an important role in motivating employees. The analysis of variance suggests that a combination of financial and non-financial motivators is necessary to achieve the desired effects in employee motivation, which is also supported by academic research (Rakić et al., 2022).

The results of the survey clearly indicate the dominant role of the target achievement bonus as the main financial motivator among respondents. Modern organisations are increasingly using a variety of incentive systems to increase employee engagement and productivity, with financial motivators playing an important role in this context. A high rating of bonuses for the achievement of specific goals may be indicative of several key aspects. Firstly, it may suggest that employees are aware of the demands of the organisation and value clearly defined standards and expectations. Bonuses, as a form of direct reward for performance, may be perceived by employees as fair and appropriate to the effort put in. In addition, effective bonus systems can stimulate competitiveness in the workplace and encourage employees to strive for continuous development and improvement of their skills. However, despite the dominance of financial motivators, it is also important to consider other motivational aspects, such as professional development, job satisfaction or a positive team atmosphere, which can have an equally significant impact on employee engagement and satisfaction (Rakić et al., 2022).

The results of the presented study clearly show that non-financial motivators are an important element in shaping employee satisfaction and commitment. The conclusion from our research is the low effectiveness of shares and bonds as motivational tools. Traditionally, it was thought that participation in company profits or the opportunity to invest in the company should be an attractive motivator. However, the current results suggest that, in light of alternative forms of compensation, this approach may no longer be so encouraging for employees. It may also indicate employees' concerns about the stability and future of the company. On the other hand, the high effectiveness of additional days off, holiday subsidies or the possibility to use a company car and reimburse commuting expenses highlights the importance of work-life balance. The contemporary labour market increasingly emphasises flexibility and customisation for employees, which is supported by our results showing the high price of such benefits (Wiradendi et al., 2021).

Our study on the evaluation of intangible motivators revealed several important findings regarding the value employees place on different aspects of their work. Surprisingly, public praise, which is often considered a simple and inexpensive way to increase employee motivation, was rated as the least effective. Such a result may indicate that in today's work environment, employees value individual recognition and feedback more, which is not presented publicly. Public forms of praise may be perceived as less authentic or even stressful for some employees, which affects their perception of work quality. In addition, high ratings for flexible schedules, opportunities for development and promotion, and work atmosphere and

comfort emphasise the importance of work-life balance and long-term professional development. Today's employees are increasingly looking for workplaces that offer them not only tangible financial benefits, but also opportunities for development, flexibility in working hours and a friendly, supportive atmosphere (Menderak, 2019).

In conclusion, in order to effectively motivate employees, organisations should consider both financial and non-financial factors and tailor motivational strategies to individual staff needs and expectations.

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## DETERMINANTS OF CONSUMER DECISIONS IN THE SHORT-TERM RENTAL SERVICES MARKET (AIRBNB) IN THE ASPECT OF THE SHARING ECONOMY

Julia KAŻMIERCZAK<sup>1</sup>, Magdalena ANKIEL<sup>2\*</sup>, Michał KUCIA<sup>3</sup>

<sup>1</sup> Uniwersytet Ekonomiczny w Poznaniu; 73828@student.ue.poznan.pl

<sup>2</sup> Uniwersytet Ekonomiczny w Poznaniu, Instytut Marketingu, Katedra Marketingu Produktu;  
magdalena.ankiel@ue.poznan.pl, ORCID: 0000-0003-2594-1600

<sup>3</sup> Uniwersytet Ekonomiczny w Katowicach, Wydział Zarządzania, Katedra Zarządzania Międzynarodowego;  
mkucia@ue.katowice.pl; ORCID 0000-0001-9112-7805

\* Correspondence author

**Purpose:** The main objective of the manuscript is to identify the determinants influencing the purchasing decisions of consumers using short-term rental services as an aspect of the sharing economy.

**Design/methodology/approach:** The study was conducted using an online survey method, and the research tool was a Google Forms. The subject scope of the study was consumers – members of Facebook groups dedicated to tourism, who had experience using Airbnb platform services.

**Findings:** The results of the study allow for the identification of consumer attitudes towards Airbnb services, the identification of key determinants of the use of Airbnb services and the identification of unique experiences that consumers using Airbnb services expect.

**Research limitations/implications:** Research limitations concern the size of the research sample. In addition, the article presents a statistical analysis of data conducted on the basis of structure indicators and correlation analysis.

**Practical implications:** The results and conclusions from the study regarding consumer preferences in using Airbnb services, the main determinants of choosing Airbnb services and the unique experiences that consumers expect constitute an important guide for entities on the Airbnb services market in terms of shaping their product offering.

**Originality/value:** The originality of the article lies in the comprehensive identification of key determinants of the use of Airbnb services by consumers and the identification of unique experiences that consumers using Airbnb services expect.

**Keywords:** sharing economy, short-term rentals, Airbnb, travel services.

**Category of the paper:** research paper.

## 1. Introduction

The sharing economy is an important manifestation of technological progress and a response to the dynamic social and economic challenges of the modern world. It is developing based on new socio-economic models that use initiatives undertaken by individuals. Sharing economy is often defined as a disinterested exchange of resources and mutual provision of services. Sharing economy is an organizational models (Dreyer et al., 2017; Guyader, Piscicelli, 2019; Habibi et al., 2017) that include sharing, renting, borrowing, lending, bartering, swapping, trading, exchanging, gifting, buying second-hand, and even buying new goods. The sharing economy has many positive aspects. At one end of the spectrum community gardens, car-sharing programs, food co-ops and other small, not-for-profit entities are growing, pooling and sharing resources for the benefit of their members (Chang, Foley, 2018). The recent global economic recession helped catalyze the sharing economy, but it is also rooted in values related to sustainable consumption and community connectedness (Botsman, Rogers, 2010; Chase, 2015). It is assumed that the central feature of the sharing economy is P2P, i.e. relationships between individuals conducted via technological platforms (Leoni, 2020). The sharing economy reflects changes in the lifestyle and work organization of these generations. The main reason is an attractive alternative to the market offer due to lower prices - participants can use various products and services at a more affordable price, which contributes to increased accessibility for a wider group of people and promotes a more economical use of resources (Kwok, Xie, 2018). The rapid digitalization and penetration of smart phones, sharing economy platforms have been transforming production and consumption systems in cities around the world (Mont et al., 2017; McLaren, Agyeman, 2015; Zvolska et al., 2018). The sharing economy plays a key role in shaping contemporary consumer trends. It influences the way products and services are consumed, mainly due to leaders setting new directions of development not only for the sharing economy industry (Kim, 2019).

Of the home sharing companies operating today, the most well-known is Airbnb, an online peer-to-peer (P2P) platform that facilitates marketing exchanges between hosts and guests, whereby the host is a non-commercial provider (i.e., not a registered business) who has and is willing to offer a space suitable for overnight stays (e.g., entire place, private room, shared room) to the guest, who is an end user seeking paid accommodation in private vicinities (Lim et al., 2021). A peer-to-peer sharing approach for the accommodation sector such as Airbnb has been suggested as a more environmentally sustainable alternative to conventional forms of accommodation services (Cheng et al., 2020).

Airbnb and the sharing and platform economies have had as major an effect on tourism and hospitality research as they have on destination economies, the experience of place by resident and guest, and on the markets they serve (Hall et al., 2022). Within a few years, Airbnb had become one of the most successful sharing economy platforms (Roelofsen, Minca, 2018).



Airbnb offers many benefits to its stakeholders. For customers, Airbnb accommodation is typically cheaper than traditional accommodation like a hotel (Guttentag, 2015; Lin et al., 2019; Varma et al., 2016). In addition, Airbnb offers local authenticity (Bucher et al., 2018; Amaro, 2019), giving customers the opportunity to live like locals in a listed apartment, house, or private room (Hamari et al., 2019; Gurrán, Phibbs, 2017; Lin et al., 2019; Paulauskaite et al., 2017; Chang, 2020). The Airbnb website ([www.airbnb.com](http://www.airbnb.com)) is quite straightforward: a prospective guest searches based on destination, travel dates, and party size; the website returns a list of available spaces that can be refined by attributes like price, neighborhood, and amenities; and then individual listings can be selected for greater detail, including a description, photographs, and reviews from previous guests (Guttentag et al., 2016). The analysis of the literature indicates that the main reasons for using short-term rental services are: savings, trust, community affiliation, usefulness and satisfaction (Tussyadiah, 2016). This brings many benefits, but also raises concerns for sharing market participants. These are presented in Table 1.

**Table 1.**  
*Airbnb Benefits and Risks*

Aspect	Benefits for Hosts	Threats for hosts	Benefits for renters	Risks for renters
Income	Additional revenue stream	Unprofitable rental	Lower price than market price	Poor quality, no way to cancel a reservation
Resource utilization	Monetize unused space	Damage to property	Access to various locations and an alternative to hotels	Lack of safety standards
Relationships	Interact with guests	Conflicts with the tenant or neighbors	Possibility of interaction with the host	Lack of support from the host
Reviews	Build a reputation through positive guest reviews	Deterioration of reputation due to negative guest reviews	Verification of the quality of the stay, better choice of place	Inaccurate or false reviews that are misleading
Loyalty	A steady stream of income from trusted customers	Dependence on regular customers	Preferential prices,	Limited choice, no flexibility in schedule

Source: (Hamari et al., 2016; Guttentag et al., 2016; Amaro et al., 2019; Tripp et al., 2023).

However, the benefits outweigh the threats due to the availability of publicly available information, the development of the Internet and the growing popularity of the sharing economy on a global scale. Consumers value non-standard experiences and the uniqueness of offers made available by hosts and local communities. Considering the development of the sharing economy, it is worth looking at the impact not only on its participants, but also on their surroundings. The social and economic attractiveness of peer-to-peer accommodation significantly affects the expansion of the choice of destination, increasing the frequency of travel, the length of stay and the range of activities in visited tourist destinations (Tussyadiah, Pesonen, 2016). The growing interest that travelers seem to express toward the possibility to replace standardized tourist experiences with experiences that allow them to be in touch with

the local community, the local identity and authenticity, makes it urgent to consider these renewed tourists' habits or tastes in Airbnb sector (Decrop et al., 2018).

## 2. Methodology

The main objective of the study was to identify and analyze the key determinants of the choice of Airbnb services by consumers in Poland. Additionally, the specific objectives were:

- to identify consumer habits and customs in terms of traveling and choosing a place to stay and accommodation,
- to identify consumer preferences in terms of choosing short-term rental services.

The study was conducted using an online survey method, and the research tool was a Google Forms form. The survey questionnaire consisted of 21 questions divided into five sections. The individual parts of the form included:

1. General travel habits - frequency, company during travel and method of planning trips.
2. Determinants of using Airbnb services - factors influencing consumers' decisions in terms of using short-term rental services.
3. Consumer preferences - type of rented facilities, negative experiences with Airbnb; preferences regarding the form of accommodation depending on location, length of stay and company during travel.

In addition, the interview questionnaire included questions allowing for the identification of the respondents in terms of demographic, economic, and social characteristics such as: sex, age, place of residence, material status, education. The interview questionnaire used scales adequate to measure attitudes, namely, the nominal scale and the ordinal scale. The basic criterion for selecting scales in the study was the type of allowed data transformations, without affecting the amount of information. The research sample consisted of 300 people – the selection of the sample was purposeful, and the scope of the study was consumers – members of Facebook groups dedicated to tourism, who had experience in using Airbnb platform services. The spatial scope of the study was Poland, and the time scope was August 2024.

## 3. Results and discussion

The basic information obtained during the study was the frequency of travel by the surveyed consumers, company during the trip and the way of organizing tourist trips. A significant group of respondents (regardless of age) indicated that they travel more often than once a year.

This answer was given by 83% of people. 12% go on vacation once a year, and only 5% of the respondents travel less often than once a year. This result may indicate a strong interest in traveling in the surveyed group. The largest group of respondents (45%) most often travels with a partner. A large percentage (28%) choose to travel with friends, while 20% of respondents prefer to travel with their family. Only 7% of respondents usually travel alone. These results indicate that the majority of respondents prefer to travel in the company of close people, which influences the choice of accommodation. The answers to the question about the way of planning trips indicate a clear dominance of independent preparations. As many as 93% of respondents organize their trips using the Internet and other available sources, which emphasizes the significant role of technology in this sector of the economy. The reasons for self-organization include convenience of access to information, the ability to personalize the trip, cost savings, and independence in decision-making. Barriers include information overload, lack of planning experience, time-consuming processes, and technical issues for less tech-savvy users. Only 6% of respondents admit to using trips organized by family members or friends. In turn, only 1% of respondents use the services of travel agencies, which indicates a clear decline in the popularity of this form of travel organization in the era of the development of online booking platforms.

During the survey, respondents were asked about the frequency of using Airbnb services compared to traditional hotels. The results are presented in Table 2.

**Table 2.**  
*Airbnb's Frequency of Use Compared to Hotels*

Variables	Percentage
more often	20.00%
equally often	45.00%
less often	36.00%

Source: own research.

The survey results indicate that 20% of respondents choose Airbnb more often than other accommodations such as hotels, hostels or campgrounds. 36% of respondents declared that they use Airbnb and other forms of accommodation equally often, while 45% of respondents indicated that they choose Airbnb less often compared to other accommodations. As a result, despite the growing popularity of the platform, some users prefer traditional accommodations due to greater certainty regarding the standard of service and the convenience they provide.

The study also identified respondents' preferences in the context of travelling alone or with a group (Table 3) and depending on the specific location (Table 4).

**Table 3.**  
*Preferences of consumers travelling alone and in groups*

Variables	Hotel	Airbnb	No matter
alone	55.00%	14.00%	31.00%
with a partner	22.00%	35.00%	43.00%
with family	22.00%	43.00%	35.00%
with friends	5.00%	58.00%	37.00%
with a pet	6.00%	33.00%	61.00%

Source: own research.

When travelling alone, 55% of respondents prefer a hotel, while 14% choose an Airbnb property. When travelling with a partner, the most common (43%) choice was no preference for accommodation, although a larger number of people (35%) choose to stay in Airbnb properties. When travelling with a family, 22% of participants choose a hotel, while as many as 43% prefer to rent a property from Airbnb. When travelling with friends, only 5% choose a hotel, while 58% indicate Airbnb as their preferred form of accommodation. When travelling with a pet, 61% of respondents do not consider accommodation to be of major importance, but only 6% choose a hotel as their preferred option. For around one third of respondents, the form of accommodation is irrelevant, both in the context of individual (31%) and family (35%) travel.

**Table 4.**  
*Consumer preferences by location*

Variables	Hotel	Airbnb	No matter
big city	19.00%	39.00%	32.00%
small town	25.00%	42.00%	33.00%
seaside town	19.00%	41.00%	40.00%
village	13.00%	50.00%	37.00%
mountains	13.00%	49.00%	38.00%
near a lake	10.00%	45.00%	45.00%
exotic place (e.g. tropics)	51.00%	23.00%	26.00%
ski resort	29.00%	25.00%	46.00%
near an airport	44.00%	15.00%	41.00%

Source: own research.

The analysis of accommodation preferences in different locations indicates that the highest interest in hotels (51%) occurs in the case of travel to exotic destinations and places near airports (44%). The fewest people decide to choose a hotel near a lake, in the countryside and in the mountains. In turn, these locations are more likely to be chosen in the case of accommodation in a place from Airbnb, obtaining the results: near a lake (45%), in the countryside (50%), in the mountains (49%). The trends in a large and small town are similar - Airbnb is chosen by about 40% of people, a hotel by about 22% of respondents, and for one third it is not important. In the case of seaside towns, Airbnb is very popular (41%), but as many as 40% of respondents indicate that the form of accommodation in this location is not important to them, while 19% choose a hotel. The most concentrated results are in the case of a ski resort, where 29% of people choose a hotel, 25% Airbnb, and for 46% of respondents it is not important. In many cases, a significant proportion of respondents declared no clear preferences regarding the form

of accommodation. On average, respondents indicated this option at the level of 38%.

The main objective of the study was to identify the determinants influencing the choice of Airbnb accommodation by individual consumers. Respondents rated individual factors on a scale from 1 to 5 (where 1 – low importance; 5 – the greatest importance). The results of the study are presented in Table 5.

**Table 5.**  
*Determinants of choosing an Airbnb rental property*

Variables	Women ( $\bar{x}$ )	Men ( $\bar{x}$ )
reviews from other users	4,41	4,51
price	4,40	4,62
location	4,40	4,24
privacy of the place	4,35	4,10
flexibility of check-in and check-out	4,25	4,00
comfort and facilities of the property	4,14	3,66
description of the offer	4,09	4,00
home amenities	4,01	3,79
host profile	3,50	3,31
authenticity and unique experiences	3,04	2,93
direct contact with the host	2,99	2,75
additional amenities	2,90	2,44
activities provided by the host	2,01	1,76

Source: own research.

The results indicate that the factors presented were assessed by respondents at a similar level regardless of gender. Slightly more important factors for men were financial savings and the experience of other users, while for women the location and privacy of the place were more important. The results suggest the following motivations for travelers to book on the Airbnb platform:

- opinions of other users; tourists choose properties based on positive reviews and reject offers that are not verified or have negative comments, focusing on their sense of comfort and safety,
- price; respondents are looking for savings and choose places with a lower rental cost, choosing offers with a good quality to price ratio,
- location is important for the overall comfort of the stay due to the time saved in traveling to tourist attractions and other important travel destinations,
- privacy of the place is important for people looking for freedom and comfort.

The people taking part in the survey also indicate that aspects such as:

- flexibility of check-in and check-out – due to the possibility of making changes due to external factors (such as delays in transport) and internal factors (e.g. preferred check-in in the early morning hours),
- home amenities: motivated by the need to function in conditions similar to home, especially in the case of longer trips; the possibility of cooking independently, allowing for financial savings.

The least rated factors determining the choice of a property on Airbnb were activities provided by the host. The analysis shows that travelers value independence and autonomy. This means that they prefer to travel at their own pace without having to participate in organized activities. Organizing a trip independently is often associated with planned attractions, so guests may not be interested in additional offers from hosts. People who use this option are open to new acquaintances and are more willing to get to know the local culture than others. A barrier to using such services may be the lack of information about the proposed activities or an undetailed description of the offer. In addition, the offers may not suit travelers' tastes due to the nature of the activity, and additionally limit their privacy due to the need to interact with other people. Direct contact with the host was rated by respondents as less than neutral as a factor determining the choice of a place on Airbnb. This determinant is important for people looking for security through the possibility of asking local hosts questions, thanks to which they gain additional information about the place and the chosen destination. This also allows for a more personalized user experience, as hosts can tailor services to the individual needs of travelers. However, the analysis shows that this is not a significant factor for travelers. Most respondents rely on the information available on the platform. A barrier that guests may encounter is the lack of immediate response from hosts, especially in emergency situations. This can lead to frustration and limitations related to the lack of necessary information. Misunderstandings due to language differences can also be a threat, but Airbnb's platform offers automatic translation of conversations between hosts and travelers, which minimizes this problem.

During the study, respondents were asked to share negative experiences related to renting properties via the Airbnb platform. The results indicate that as many as 41% of surveyed consumers had to deal with unpleasant situations while using this form of accommodation. The aforementioned experiences largely concerned the cleanliness of the property (55%) and differences in the actual appearance of the premises and the one presented in the offer (50%). There were also responses related to poor contact with the host (32%), low sense of security (21%), problems with check-in (11%) and hidden rental costs (9%). The respondents had the opportunity to indicate their own answer. 6% indicated a situation with a cancellation of the reservation just before the start of the stay.

In order to compare the benefits of staying in a private place and in a hotel, respondents were asked what additional services in properties offered on the Airbnb platform would be useful for them. The most responses were received by factors such as the option of airport transfer (40%) and food provided at the property (34%). Respondents were also eager to indicate answers such as: cleaning services during the stay (18%), travel and stay insurance (18%), rental of recreational equipment (11%), services of local guides (10%). For 28% of respondents, none of the given answers would be an additional value in the context of renting on Airbnb.

#### 4. Conclusions and limitations

For consumers using short-term rentals on the Airbnb platform, price and location are key factors in their choice. Both of these factors received high average scores of 4.47 and 4.36 on a scale of 1 to 5, respectively. The results show that rental costs and the convenient location of the property are priorities for people choosing this form of accommodation. The indication of price as the most important selection criterion is reflected in the growing sharing economy, which is based on the use of available resources and cost savings. New solutions in the tourism industry attract travelers who want to maximize benefits while minimizing expenses. It can therefore be said that travelers using Airbnb are highly price-sensitive.

Although cheaper offers are preferred, respondents do not give up comfort. This is confirmed by the results of the Pearson correlation analysis. It showed the existence of a weak negative correlation at the level of -0.01 between the importance of price and the standard of equipment of the facility. A result very close to zero means there is no relationship between these two variables. These factors of choosing an accommodation facility seem to be independent of each other for respondents. This means that tourists choosing lower prices are not necessarily willing to accept low comfort during their trip, nor are they always able to pay more for a higher standard of rental accommodation. The lack of a significant correlation suggests that travelers are guided by other factors when choosing short-term rental facilities.

The second important factor when choosing an Airbnb listing is location, which often determines the comfort and functionality of the stay. A convenient location saves time and additional costs related to transport. The choice of accommodation often depends on the distance to tourist attractions, transport hubs and city centers. In the questionnaire, respondents indicated their preferences for choosing a place to stay between short-term rentals and hotels based on the nature of the destination. The results indicate that Airbnb rentals are preferred in more secluded locations, such as villages, mountains and places near lakes. This suggests that travelers in such locations are looking for a more intimate and individual experience that short-term rentals offer. Most respondents also indicated a preference for Airbnb over hotels in large and small cities. Travelers probably value the flexibility and variety of offers available on Airbnb, which can better suit their individual needs and budget. In large cities, Airbnb often offers locations in more diverse districts, as well as access to more spacious accommodations compared to standard hotels. In the case of exotic destinations, respondents tend to prefer hotels. The answers indicate that travelers choosing more distant and exotic locations can expect a higher standard of service and greater safety. Additional hotel amenities, such as organized tours, 24-hour service, or security, may be particularly important in these locations. The results may also indicate a desire to take advantage of luxury and comprehensive offers, which are more common in this market segment. Also in the case of locations near airports, respondents are more likely to choose hotels. Such facilities guarantee ease of organization thanks to

additional amenities such as airport transfers, 24-hour reception, or an on-site restaurant. In turn, for locations such as ski resorts or seaside towns, the choice between a hotel and an Airbnb place is not very important for most respondents. This may mean that other factors play a greater role when choosing accommodation in these locations. Tourist attractions, accessibility, or the general atmosphere of the place may be more important, with the type of accommodation being secondary.

For respondents, the opinions of other users (4.45) and the privacy of the place (4.29) were equally important when choosing accommodation on Airbnb. This shows that users make decisions about choosing accommodation based on guest ratings posted on the online platform. In this case, platform users create a community around which trust in the validity of the content published on the website is built. The opinions of other travelers and their recommendations are an important element influencing the choice of the facility. In turn, owning a place is appreciated by travelers due to greater comfort, a sense of security and intimacy. Additionally, travelers have control over the conditions of their stay, which significantly improves the quality of their experience. Travelers using Airbnb are aware of the standard of accommodation and do not expect non-standard amenities that can be experienced more often in hotel facilities. A greater advantage for them is the comfort of living provided by private premises, which are gaining popularity thanks to the growing awareness of consumers about the sharing economy.

The least important factors when choosing a property for short-term rental are: direct contact with the host and additional activities provided by them. Interest in additional activities organized by Airbnb hosts is very low. As many as 97% of respondents declared no participation in such initiatives. This suggests that for the vast majority of Airbnb users, additional attractions offered by hosts are not an important element of their stay. It can be concluded that travelers using Airbnb are not looking for deep immersion in the local culture or an offer related to active participation in experiences organized by hosts. The literature review suggested that an important factor in choosing Airbnb by travelers is the possibility of renting an unusual, distinctive property, offering a different experience than traditional forms of accommodation. However, the results of the study indicate that this aspect is not important for respondents. Moreover, a contradiction also appears in the context of the idea of belonging to a community and establishing contacts with other travelers or hosts. Theorists assumed that Airbnb users would prefer social interaction and connecting with others as part of their trip. However, the study found that such aspects are not a key consideration for most users. The results suggest that the real motivations of travelers using Airbnb are related to functional aspects such as price and location, rather than seeking unique experiences or social interactions. While Airbnb theoretically offers a choice of unique, local places, travelers are guided by more pragmatic factors when choosing a place to stay.

The study was conducted on a group of 300 respondents using Airbnb services, which may significantly affect the representativeness of the obtained results. Such a research sample limits the possibility of generalizing conclusions to a wider population of users of this platform.



Therefore, the results may not reflect the full range of preferences and behaviors of travelers. In order to obtain more reliable data, it is recommended to repeat the study on a larger and more diverse sample. Additionally, to obtain more precise conclusions, it is suggested to focus on more detailed aspects related to the use of Airbnb. Examples include studies focused exclusively on group travel or on the analysis of unique experiences of tourists. Such detailed questions would allow for a deeper understanding of travelers' motivations and expectations, which in turn would allow for a better definition of the factors that determine the choice of a specific offer on the short-term rental market. Conducting the study on a wider scale and taking into account more detailed aspects could also contribute to the identification of new trends and preferences among Airbnb users, such as the role of home amenities, access to local attractions or the need for personalized experiences. This, in turn, could help hosts and intermediary platforms better adapt their offers to the dynamically changing expectations of consumers.

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## PREVENTION OF TERRORIST ATTACKS ON CRITICAL INFRASTRUCTURE ON THE EXAMPLE OF AN AIRPORT

Maciej KAŻMIERCZAK

War Studies University, Warsaw; m.kazmierczak@akademia.mil.pl, ORCID: 0000-0001-6985-3157

**Purpose:** The purpose of this article is to evaluate the state's critical infrastructure protection system using an airport as an example. Identifying potential weaknesses and suggesting improvements is a key part of this assessment. Selected research is presented to highlight the need to protect airports from terrorist threats and to illustrate the importance of inter-agency cooperation, resource allocation and advanced security measures in enhancing national security.

**Design/methodology/approach:** The research combines theoretical analysis and empirical investigation. Theoretical methods include a review of the literature and legal frameworks concerning critical infrastructure protection. Empirical research involves a diagnostic survey conducted through structured interviews with experts in national security and airport operations and survey technique using survey questionnaire tool. The data collected were analyzed qualitatively to synthesize key findings and recommendations.

**Findings:** The study reveals that while significant efforts have been made in securing airports, vulnerabilities remain due to accessibility and operational complexity. The findings highlight critical issues such as insufficient inter-agency coordination, inadequate allocation of resources, and the need for better threat anticipation capabilities. Recommendations are provided to address these gaps and improve the overall resilience of airports against terrorist attacks.

**Research limitations/implications:** The primary limitation of the research is the focus on airports as a specific type of critical infrastructure, which may limit the applicability of findings to other sectors. Additionally, reliance on expert opinions may introduce subjective bias. Future research could expand the scope to include other critical infrastructure types and incorporate quantitative data for broader validation.

**Practical implications:** The research offers practical guidelines for policymakers and airport operators to enhance the security of critical infrastructure. By implementing the proposed measures, such as advanced surveillance technologies and improved inter-agency coordination, airports can reduce their vulnerability to terrorist attacks. The paper also has implications for the development of standardized protocols in critical infrastructure protection.

**Social implications:** The findings have significant social implications by contributing to public safety and national security. Improved airport security can increase public confidence in the safety of transportation infrastructure, reduce the societal impact of potential terrorist attacks, and foster trust in government measures aimed at protecting citizens.

**Originality/value:** The originality of the paper lies in its comprehensive approach to evaluating airport security as part of critical infrastructure protection. By combining theoretical insights with empirical data from expert interviews, the paper provides a valuable resource for

academics, policymakers, and security professionals interested in enhancing national security frameworks.

**Keywords:** state security, critical infrastructure, airports, threats, protection.

**Category of the paper:** Research paper.

## 1. Introduction

Civilization or technological progress, in addition to its positive aspects, also has a negative character. The increased standard of living due to the development of electricity or ICT is associated with the dependence of the functioning of societies on their abilities. The electricity subsystem, which is a key component of any economy, can be disrupted, for example, by a terrorist act. Any disruption of the electricity supply can disrupt all areas of socio-economic life and create a local, regional and national emergency. The facilities of this subsystem include nodal transformer stations or power substations, the supervisory system of main transmission lines, power plants and thousands of kilometres of transmission lines. Another example is the ICT network, which is also very important for the smooth functioning of the state, its administration and business entities. Unfortunately, it is very susceptible to paralysis through, among other things, cyber-terrorist attacks (for example, on air traffic control towers at airports). Unfortunately, it is highly susceptible to paralysis through, among other things, cyber-terrorist attacks.

The subject of research presented in the article are the processes taking place in the national security environment, determining the need to strengthen defense capabilities in terms of protecting critical infrastructure facilities of the state. The cognitive purpose of the study is to check, verify and evaluate the functioning of the critical infrastructure protection system of the state and to demonstrate the need to protect facilities in the light of possible threats. The utilitarian goal was to specify conclusions and indicate recommendations aimed at improving the functioning of the critical infrastructure protection system for state security.

From the opinions of experts in the field of national security, a research hypothesis emerges, which shows that despite taking multi-directional actions in the field of crisis management, public administration operating at many organizational levels is not able to foresee all the threats that threaten the facilities and critical infrastructure.

The general research problem of the article boils down to an attempt to find an answers to the questions: What is the impact of threats to critical infrastructure facilities on the forms of their protection (on the example of an airport), and thus on the security of the state and its citizens? and how to prevent terrorist attacks on critical infrastructure?

The conducted research (Jakubczak, 2006) shows that the problem in providing adequate protection to critical infrastructure facilities and equipment whether point (such as airports) or linear may be the fact that they are relatively accessible and easy targets for attacks by terrorists, diversionary and special groups, as well as madmen or hackers.

In order to ensure the effective protection of critical infrastructure facilities and systems, steps must be taken to identify, that is, to determine on the basis of clear criteria, which facilities and systems constitute critical infrastructure of national, regional and local importance. The protection of critical infrastructure facilities and systems is a major challenge for governing entities in view of ensuring the security of the state as well as society as a whole. Therefore, the need to analyse this problem with detailed consideration of threats to critical infrastructure to organise means and ways that will be used to protect critical infrastructure systems and facilities using the airport as an example.

## **2. Critical infrastructure - literature review**

Prior to the introduction of the term critical infrastructure into the national terminology related to crisis management (Lidwa, Krzeszowski, Więcek, Kamiński, 2012), there were such formulations as: facilities of particular importance for the security and defense of the state, areas, facilities, equipment, and transports subject to mandatory protection (Presch-Cronin, Marion, 2016).

However, regardless of the terminology, the protection of the state's critical infrastructure systems is increasingly based not only on the solutions operating in a given country, but primarily on international security standards, designed to ensure the continuity of their operation in the conditions of interconnected global undertakings, minimizing threats to these systems, and above all through mutual information and warning (Moteff, 2012).

In the area of critical infrastructure threats, terminological ambiguity does not prevail, so the consequence is that there is a situation in which a specific object belongs simultaneously to critical infrastructure and is particularly important for the security and defence of the state and is therefore subject to mandatory protection. Thus, there are suggestions that the concept of critical infrastructure should distinguish defence infrastructure (Lidwa et al., 2012), which would define facilities that are particularly important for state security and defence.

Defining facilities and installations critical for the functioning of the state is of fundamental importance in shaping the appropriate level of security for citizens. The rules for determining the systems and objects belonging to the critical infrastructure, which are real and cybernetic systems necessary for the minimum functioning of the economy and the state, are contained in a classified annex to the National Program for Critical Infrastructure Protection and only selected persons have the opportunity to check which of the objects belongs to critical

infrastructure (NPFCCIP, 2013). The emergency response system, based on the practical aspect that allows systems to be classified into groups to facilitate identification, is divided into system infrastructure elements, which include (Lidwa et al., 2012):

- normative-legal infrastructure,
- social infrastructure,
- IT infrastructure (infosphere),
- technical infrastructure (technosphere).

The above elements of the system infrastructure also include critical infrastructure systems defined by law. When talking about critical infrastructure systems, it should be remembered that these are objects, devices and installations constituting a given system, which are interrelated and dependent (Tyburska, 2010). Critical infrastructure systems are undoubtedly key facilities and systems from the point of view of the functioning of the state, on the efficiency of which the continuity of operation of specific public utility institutions depends), including power structures. These facilities and systems can be classified into 4 areas (Lidwa et al., 2012):

1. State defence.
2. Protection of the state's economic interest - such as airports.
3. Public.
4. Protection of other important interests of the state.

Pursuant to the Crisis Management Act (Act of 26 April, 2007), critical infrastructure includes systems and their functionally related facilities, including buildings, devices, installations, services crucial for the security of the state and its citizens and serving to ensure the efficient functioning of public administration bodies, as well as institutions and entrepreneurs.

The fundamental problem highlighted by the Crisis Management Law is ensuring that critical infrastructure is adequately protected from potential attacks, failures or other events such as assaults, unpredictable acts of nature or disasters that may disrupt the proper functioning of that infrastructure.

An important aspect, which is related to the protection of the most useful infrastructure, is also the minimization and neutralization of the potential consequences of the destruction and failure of the elements that make up a specific critical system, as well as its prompt restoration so that the situation does not adversely affect the state of security of citizens (Tyburska, 2010). Critical infrastructure protection is a significant problem due to its complexity, which results from multivariate threats, i.e.: failures, terrorist attacks, disasters, acts of nature or other unforeseen events.

Based on the provisions of the National Critical Infrastructure Protection Program, critical infrastructure protection is the process of ensuring its security including the pursuit of the expected outcome and continuous improvement. This process encompasses a significant number of task areas and competencies, involves multiple parties, and includes many activities aimed at ensuring functionality, following up on actions taken, and ensuring the integrity of



critical infrastructure (NPFICIP, 2013). However, according to the Law on Crisis Management (Act of 26 April, 2007), critical infrastructure protection includes all activities aimed at ensuring the functionality, continuity of operations and integrity of critical infrastructure in order to prevent threats, risks or vulnerabilities, and to reduce and neutralize their effects, as well as to quickly restore this infrastructure in the event of failures, attacks and other events that disrupt its proper functioning. By critical infrastructure protection (Piątek, Truchan, 2013) they mean the part of protection and national defence that includes all kinds of projects of a preventive, preparedness and response nature, aimed at increasing the resilience of critical infrastructure to all kinds of disruptions limiting its proper functioning, as well as directed at the rapid restoration of the functions carried out in the event of destruction, damage or failure.

Critical infrastructure protection tasks include (Tyburska, 2010): issues of collecting and processing information that relates to critical infrastructure threats; aspects of developing and implementing procedures in the event of critical infrastructure threats; restoration of critical infrastructure; and the possibility of cooperation between the public administration and owners and owners-in-ownership or subsidiaries of critical infrastructure facilities, installations or equipment in the area of critical infrastructure protection.

Preparing effective protection of critical infrastructure requires a comprehensive approach that takes into account the following areas in the organization of protection (Tyburska, 2010): physical protection; technical protection; personal protection; information and communication technology protection; legal protection; and assistance from the government party in the reconstruction of the damaged or destroyed element. Each of the aforementioned areas constitutes a complex system of activities requiring general and specialized knowledge, a wealth of experience including the use of so-called “good practices”, the ability to analyze, as well as forecast threats.

The methods and measures used in critical infrastructure protection (Tyburska, 2010) are aimed at preventing or mitigating the effects of attacks carried out against a specific piece of critical infrastructure. These attacks can be caused by people (terrorists, criminals, hackers) or can be the result of natural disasters and technical failures (accidents involving hazardous materials like nuclear, radioactive, biological or chemical substances). According to the Critical Infrastructure Protection Program (NPFICIP, 2013), the protection system should be applied to all types of identified threats, whether natural, technical or intentional. The protection system should also be prepared to restore all functions performed by a particular piece of critical infrastructure in the shortest possible time.

In summary, critical infrastructure protection aims to safeguard those resources and assets of a key state that are indispensable to society and contribute to social well-being. Therefore, it focuses on protecting the key nodes and systems of any infrastructure that provides services to its communities - such as airports.

### 3. Terrorism vs. aviation terrorism

The phenomenon of terrorism still figures among the many problems that the international community has to solve today. For terrorists, it is a type of conducting asymmetric warfare, in which groups that are small in number, using sometimes unsophisticated means and simple methods, are able to shake the authorities and societies that have the most powerful armed forces and the highest level of civilizational development. It should be clearly emphasized here that all actions carried out by terrorists are criminal activities in the eyes of the law, as well as by socio-moral norms. By definition, terrorists take as victims innocent people, often of the same nationality as the terrorists, and the greater the enormity of the crime, the greater the social, political, sometimes economic, and certainly psychological and media effect of the terrorists' actions.

Definitions of terrorism, including terrorism in civil aviation, are nowadays presented in large numbers by various authors or state institutions around the world. Therefore, for the purposes of this work, a few of their examples have been selected, which, in the author's opinion, most closely reflect the essence of terrorism, including terrorism in aviation.

It is worth starting by presenting E. Zablocki's definition. According to his views, modern international terrorism, along with military and non-military (economic, social, environmental) threats, causes the greatest security threat in the world. He proposes to depict terrorism as a method of action involving the use of violence to obtain certain political, social or material benefits (Zablocki, 2009).

The approach to the terminology of terrorism according to American views is presented, among others, by B. Hoffman in the publication *Faces of Terrorism*. According to this author, the essence of terrorism boils down to terrorists creating fear among societies in a conscious manner, maintaining the constant threat of a bloody attack in order to achieve the goals set by the terrorists. Hoffman also emphasizes the far-reaching psychological impact not only on the direct victims of attacks and their loved ones, but on the people and societies that learn about and experience it through the media, sometimes tens of thousands of kilometers away from the scene of the attack. It is in the sowing of fear, in the constant intimidation and creation of an atmosphere of psychosis among people attacked at random, completely unrelated to the cause for which the terrorists are fighting, innocent of the fact that they happened to be in that place, that Hoffman sees the essence of terrorism. On top of all this, he emphasizes the extremely important issue of media publicity, which is supposed to lead to terrorists achieving (Hoffman, 2001). It should be noted that similar interpretations of terrorism are presented by two important US state institutions: the State Department and the Department of Defense.

Nowadays in the literature one can find various types of terrorism, the classification of which is based on criteria including: ideological motivation, the acting entity, the tactics and purpose of the attack or the operating environment (Zabłocki, 2009).

Acts of air terrorism involve both attacks on aircraft and on aviation infrastructure (Liedel, 2013). It should be noted that in the available literature, aviation terrorism is often equated with air terrorism. It is therefore worth clarifying this issue as well. For example, according to P. Krawczyk, air terrorism is a narrower concept, as it indicates the airspace as the area where terrorist acts take place. Accordingly, air terrorism is a broader concept because it includes both airspace and the activities that secure it (Zabłocki, 2009).

The detailed classification of aviation terrorism threats includes attacks on air aviation (so-called air terrorism) and ground aviation (so-called air ground terrorism). In addition, it indicates how these attacks are carried out. For example, there are attacks aboard an aircraft, an attack by an aircraft on a ground (surface) object, an attack on an aircraft carried out from the air (occurs less frequently), an attack on an aircraft from the ground, and an attack on aviation infrastructure, usually at an airport, but also outside it.

Definitions of aviation terrorism presented by various authors or state institutions around the world are now numerous, and most often they differ only in minor details. However, the lack of an official definition in this area makes it difficult for individual states, as well as organizations, to prosecute and punish the perpetrators of terrorist attacks or aviation incidents. A way out of this situation is the recognition of the term “act of unlawful interference” in civil aviation.

Today, thanks to its qualities and structure, civil aviation is and will continue to be one of the most attractive targets for terrorists. Attacks targeting aircraft and the entire aviation infrastructure and the effects they have on society cause terrorists to achieve their goals while gaining worldwide publicity.

#### **4. Legal conditions for civil aviation security (including airports)**

The most important pieces of legislation in the area of countering terrorist attacks targeting civil aviation (including airports) are:

- Aviation Law of July 3, 2002 (Journal of Laws of 2002, No. 130 item 1112, as amended).
- Regulation of the Minister of Infrastructure on the National Civil Aviation Security Program of December 2, 2020 (Journal of Laws of 2021 item 17, as amended).
- Law on anti-terrorist activities dated June 10, 2016 (Journal of Laws of 2016 item 904, as amended).
- Law on the National Cyber Security System of July 5, 2018 (Journal of Laws of 2018 item 1560, as amended).
- Law on State Border Protection of October 12, 1990 (Journal of Laws of 2005, No. 226, item 1944, as amended).

- Decree of the Council of Ministers on the determination of the air defense command authority and the procedure for the application of air defense measures in relation to foreign aircraft disobeying the calls of the state air traffic management authority dated November 2, 2011 (Journal of Laws of 2011, No. 254 item 1522, as amended).

In the Aviation Law, the issue of terrorism and protection against it is contained primarily in Article 2, Section 20, and in Division IX “Civil Aviation Security” (Articles 186 to 189a), where requirements have been set out for, among other things, such important matters related to countering aviation terrorism as:

- operation of security guards and the Border Guard activities at airports,
- security control of passengers and freight,
- security requirements for agents and suppliers of supplies,
- the airport manager's security responsibilities, including considerations of the activities of the airport security service subordinate to him and the separation of protected areas at the airport,
- the drafting, implementation and control of the National Civil Aviation Security Program (NAPOLC).

The Border Guard activities carried out at airports include: the way security checkpoints operate, checking of airport security personnel (the way they act during inspections, their psychophysical state or possession of relevant certificates) and responding to incidents of public order disturbance at security checkpoints. In order to carry out its tasks, the Border Guard may use image recording systems located at the airport.

Tasks related to passenger and freight screening are performed under the supervision of the President of the Civil Aviation Authority in cooperation with the Border Guard, and carried out by: airport manager (this includes: passengers, cabin and checked baggage, non-passengers of the aircraft and their baggage, as well as mail, cargo and other materials transported by air); registered agent (for cargo and mail); and registered supplier of in-flight supplies (for in-flight supplies). The airport manager's tasks are carried out by the Airport Security Service (ASS).

The designation of a registered agent and a registered supplier of in-flight supplies is implemented by an administrative decision of the President of the Civil Aviation Authority after verification of civil aviation security requirements. In each case, the decision is supported by the opinion of the Commander of the relevant branch of the Border Guard. The prerequisites for obtaining the status of a security control operator are: positive completion of training, absence of negative prerequisites (positive opinion of the relevant Border Guard Commander) and obtaining a security control operator certificate.

The airport manager is responsible for designating operational and restricted areas and restricted areas of the airport and ensuring their proper security in order to prevent unauthorized access to them. Said zones should have designated passageways, which the airport manager agrees with, among others: Police, Border Guard, Customs and Fiscal Service and the President

of the Civil Aviation Authority. Tasks in the area of airport security are carried out in cooperation with security services and concern, among others, the identification system (persons, vehicles) and security control related to access to restricted areas of the airport - concerns, among others, the detection of weapons, explosives and explosive (dangerous) devices. If there is a need to perform tasks that are beyond the competence of SOL, the airport manager is obliged to notify the Police and Border Guard. The list of zones and passages is specified in the airport security program.

An important piece of legislation describing general issues related to counterterrorism (including in civil aviation) is the Anti-Terrorist Activities Act, which has been in force in Poland since 2016. This law defines, among other things, what anti-terrorist and counter-terrorist activities are, as well as the manner of cooperation between the authorities responsible for carrying out these activities. These authorities are: Minister of the Coordinator of Special Services, Head of the Internal Security Agency, Commander-in-Chief of the Police, Commander-in-Chief of the Border Guard and Commander-in-Chief of the Military Police.

Another important document is the Law on the National Cyber Security System, which is a response to new terrorist threats. It identifies in Article 4 key service operators and the Polish Air Navigation Services Agency (PANSAs) as participants in the system. Annex 1 of the law details which air transport entities are key service operators, which include an air carrier (an air transport company with a valid operating license), an airport operator (a management entity entered in the register of civil airports) and an entrepreneur who performs services for air carriers regarding, among other things, the handling of passengers, baggage, cargo, goods or mail, as well as the airport apron and aircraft, and security control tasks. Tasks for these entities to function in the national cyber-security system are specified in Chapter 3 (Articles 8 through 16). They concern, among other things, the need for key service operators to implement a security management system in the information system to ensure, among other things, the collection of information on cyber security threats (estimating the risk of an incident) and its impact on the provision of a key service. All these measures are aimed at avoiding terrorist attacks in cyberspace.

To sum up the consideration of Polish law in the field of civil aviation security, it should be emphasized that an important role is played here by the law regulating aviation activities Aviation Law (along with implementing acts), and the issues contained therein are in line with the with European Union legislation. On the other hand, detailed provisions on civil aviation security are contained in the National Civil Aviation Security Program, which is set forth in the appendix to the Decree of the Minister of Infrastructure dated December 2, 2020. Nevertheless, in the author's opinion, some provisions of the cited legal acts need to be amended and clarified (this applies especially to the discussed issues of actions against aviation terrorism). However, it should be borne in mind that the mere formulation of regulations is not enough and it is necessary to comply with them.

## **5. Organizational and technical methods of countering terrorist attacks at the airport**

Counter-terrorism in civil aviation aims to ensure the safety of passengers, flight personnel and all other persons who are at risk. This is made possible by the introduction of effective security systems and the operation of relevant services at the airport and on board the aircraft.

### **5.1. Airport security services**

One of the most important elements of the security system against terrorism are the relevant services at the airport and the aircraft crews, sometimes reinforced by security guards. Among the services that provide security against terrorist attacks and leveling their potential effects at the airport include: Airport Security Service; Border Guard; Police; Airport Fire and Rescue Service and additional services from outside the airport (such as the Office of Anti-Terrorist Operations of the Police Headquarters or mine patrols).

The main service responsible for airport security is the Airport Security Service, which protects the area of the entire airport. It performs its tasks in the form of direct personal protection carried out by officers of this formation, as well as through other activities. These include the constant supervision of signals transmitted and collected in electronic devices and alarm systems located at the airport. The basic activities that are carried out by the Airport Security Service primarily include:

- security control of passengers, crews and baggage,
- protection of restricted areas of the airport,
- checking passes (authorizations) of persons at checkpoints between individual airport zones,
- inspection of the technical condition of the airport fence.

Currently, to detect airport security threats, the Airport Security Service uses specialized, state-of-the-art equipment including, among others: stationary and hand-held metal detectors, X-ray equipment for cargo and baggage screening, explosives identification equipment, and uses trained service dogs to detect weapons and ammunition. The principles of some of the equipment designed for airport security screening are described in the next section of the article.

The second important service performing airport security tasks is the Border Guard. In addition to its basic tasks related to the protection of the state border at an international airport, this formation carries out activities with regard to countering terrorist attacks in accordance with the provisions contained in the Act of July 3, 2002. Aviation Law (as amended) and the Border Guard Act of October 12, 1990 (as amended).

The Border Guards at the airport focus their activities on a number of important activities related to preventing terrorist attacks. One of them is to prevent the smuggling of explosives and hazardous substances across the border. This is carried out, among other things, through

effective control of passengers, baggage, shipments and goods. Pyrotechnic reconnaissance is also of great importance in this regard and the proper securing of aircraft prior to takeoff, which is particularly important to ensure the safety of passengers during flight. Added to this is the prevention of illegal border crossings. No less important is also ensuring public order at the airport and recognizing and, if necessary, neutralizing terrorist threats. In order to be able to effectively carry out the above tasks at the airport, Border Guard officers have appropriate powers over passengers and freight control. These boil down to, among other things, the ability to conduct personal inspections, inspect luggage and check cargo at airports. Also important is the observation of arriving and departing passengers who may pose a terrorist threat to the airport. Border guards at the airport work closely with other services to counter terrorist threats.

Another service responsible for security at airports is the Police Department. The police station at the airport mainly carries out tasks related to common crimes, but in a crisis situation, officers of this station can be engaged to counter terrorist activities, among others. However, the Police as a whole formation is extremely important in the fight against terrorism due to the availability of specialized anti-terrorist and counter-terrorist services (<https://www.ulc.gov.pl>). A very important role is played by the Police during the occurrence of the aforementioned crisis situation that a terrorist attack at the airport can be. Then, thanks to police negotiators, negotiations are conducted with the terrorists, and when they do not bring the expected results, police counter-terrorists come into action. The main anti-terrorist unit is the Central Counter-Terrorist Subdivision of the Police Anti-Terrorist Operations Bureau and the Independent Counter-Terrorist Subdivisions of the Police operating in all provinces. These sub-divisions are responsible for conducting counter-terrorist operations under conditions of special threat, when there is a need to use specially trained officers and specialized weapons and equipment, as well as appropriate tactics adapted to the object where the terrorist attack takes place (including at airports). One of the police's most important partners in these operations is the Border Guard, as it has sizable forces and resources and is familiar with the vital infrastructure elements that serve port security.

The last of the services discussed, but very important from the point of view of the safety of airport operations, is the Airport Rescue and Firefighting Service. The scope of this service is regulated by a decree of the minister responsible for transport. This is an important airport security body is primarily tasked with securing all aircraft operations related to takeoffs and landings taking place at an airport. Thus, the Airport Rescue and Firefighting Service undertakes actions necessary to eliminate threats to human health and life and infrastructure at the airport. Specific tasks carried out by the Airport Rescue and Firefighting Service may include: securing fire-hazardous operations on the tarmac (e.g., refueling aircraft with passengers); or securing an emergency landing of a damaged aircraft. The task of conducting rescue and firefighting operations at the airport and the adjacent operational area is important.

The primary body responsible for planning and organizing airport security is the Airport Security Team. This team is appointed by the airport manager on the basis of the obligation under the Law of July 3, 2002. Aviation Law and the Decree of the Minister of Infrastructure of December 2, 2020 on the National Civil Aviation Security Program.

The main purpose of this team is the joint action of all entities operating at the airport to prevent the preparation of and occurrence of acts of unlawful interference, including terrorist attacks. The Airport Security Team meets periodically, at least once a quarter, and the content of its work during such meetings is mainly to agree on specific actions proposed by the entities responsible for security at the airport within the scope of their competence. On the other hand, in the event of a crisis situation at the airport, and such a situation may be a terrorist attack, a crisis staff prepared in advance (also by the airport manager) comes into action. This staff, once activated in an emergency mode, directs all entities involved in resolving the crisis situation. The chairman of the crisis staff is usually the airport manager, and sometimes the director of security. The operation of the crisis staff is based on the same legal basis as the operation of the Airport Security Team.

## **5.2. Technical anti-terrorism security systems at the airport**

A very important element related to airport security is technical systems, whose task is primarily to support all activities carried out by airport services to counter terrorist attacks at airports. Among the security control systems we can include: systems for the control of personnel, crews, passengers and baggage; access to specific regions (areas) and facilities of the airport; courier shipments, cargo (goods) and mail, or people employed at the airport. At the same time, it should be borne in mind that the aforementioned systems should provide an effective, unified and integrated airport security management system while remaining immune to any attacks by terrorists (Dilling, 2005).

The technical means used to control people are usually stationary metal detectors, as well as trace analysis equipment. Nowadays, the use of gates with explosives trace analyzers is also a good option. They are usually located in front of the entrance to the operational area of the airport behind the security checkpoints. The most common devices of this type on the market are Sentinel II and Entry Scan.

An important element of security screening at airports is the metal detection gate, the principle of operation of which is related to the impact on the person located in the gate an alternating low-frequency electromagnetic field. Detection of dangerous objects (metals) is the result of interference generated by the magnetic field coil. The quality and sensitivity of these devices makes it possible to precisely and accurately determine what type of metal is to be detected and what is to be ignored (e.g., allows detection of small blades that can be a danger to the crew and passengers of an aircraft).



Another important part of the security procedure is the screening of each passenger's carry-on baggage, which is done with a scanner that uses X-rays. This allows the operator of the machine to see exactly what has been packed in the hand luggage. Since each item has a different density, the operator can clearly distinguish between soft and hard items (e.g. glass bottles, metal or explosives). Nowadays, modern devices of this type can identify potentially dangerous items themselves.

Extremely important from the point of view of protection against terrorism is the ability of the services to detect non-metallic objects that can be a tool in the hands of terrorists. Most often, terrorists may place such items in carry-on luggage, and it cannot be ruled out that terrorists carry them in person by stealth. Hence the great interest of the services in having devices for detecting such items. Manufacturers, meeting such demand, offer devices for sub-millimeter waves with an operating frequency of about 600 GHz. Another type of such devices are those operating on the principle of low-energy X-ray backscattering. All this makes the level of security even higher.

Security control systems related to airport security also consist of technical devices whose task is to detect intruders (dangerous situations) and immediately alert airport security services of the events. Among the most common we can include: motion detectors, buried sensor cable and overhead, radars and microwave barriers.

The operation of the buried sensor cable is based on the principle of interference with the detection field caused by an unwanted person. The interference depends on the mass and speed of movement of the individual in question. This eliminates false alarms caused, for example, by small animals.

Sensory cable infiltration is designed to prevent unwanted people from trying to get over the top of the fence. At the same time, interference caused by, among other things, ground vibrations caused by passing cars or adverse weather conditions (precipitation, wind) is excluded (<https://ale-wiedza.pl>).

The radars used for protection allow precise determination of the direction, distance and size of the detected object. Radars can monitor a fairly large area, so their operating range can be from a few hundred meters to 10 km.

The principle of the microwave barrier is that an invisible beam of energy in the microwave frequency range travels between the transmitter and the receiver. Any change in signal amplitude between these devices is immediately read and analyzed for the physical characteristics of the object that caused the interference. As a result, the system can detect an individual running, walking or crawling, and objects that do not pose a threat are considered a false alarm (<https://atline.pl/kategorie-oferta/bariery-mikrofalowe/>).

The above systems largely minimize the risk of unwanted people entering the airport area. However, it should be remembered that they are not perfect and there is always a risk of unlawful intrusion into the protected area or the occurrence of a false alarm.

### 5.3. Innovative technology as part of counter-terrorism at the airport

Ensuring a high level of security is paramount for any aviation organization. At airports, in order to improve security levels, electronic systems are increasingly being used to support security and service operations. It should be borne in mind that innovative technical systems for airport security play a key role in the process of detecting manifestations of acts of unlawful interference and enable effective counteraction.

An innovative latest-generation access control system for use at airports is AC2000 Airport (Figure 1). It provides integration of other security systems from various manufacturers, including surveillance systems (including video), intrusion or assault signaling and fire alarms. These systems are managed centrally and function as a single multifunctional security system. The solution's capabilities, integration and multifunctionality make the AC2000 Airport system widely applicable in airport security.

This system makes it possible to direct the movement of passengers to the various check-in counters located in the airport, as well as to control the movement of luggage. This is possible with the use of special identification cards. In addition, the AC2000 Airport system makes it possible to control and track the work of airport security services, improve the service of airport service cells, and facilitate the enforcement of order regulations with respect to passengers. According to experts, the AC2000 Airport system is currently the best tool that enables safe and efficient management of the airport both operationally and economically, as it provides a high level of security for the entire facility thanks to innovative software applications.



**Figure 1.** AC2000 Airport system components.

Source: <https://lanster.com/systemy-zabezpieczajace-z-rozproszona-inteligencja-cem-systems/>.

Next-generation CEM equipment is a smart and innovative technology, as its readers create the possibility of multi-level security management throughout the airport. This allows for efficient and effective control of, among other things, the boundaries between spaces (land and air), passageways (gates) for personnel, the operation of the air traffic control tower or other infrastructure functionally related to the airport. The possession of internal databases by the CEM readers makes it possible to continuously (24/7) verify the validity of ID cards off-line,

and thus it is possible to control access to sensitive areas of the airport without any downtime. Equipped with touchscreens, CEM's emerald multifunction terminals enable the latest intelligent features of the AC2000 Airport system to be implemented at any point in the airport where they are deployed. This makes the emerald terminals both integrated readers, controllers and VoIP intercoms, which enable, using the appropriate applications (software), directly from the controlled passageways, the secure use of key AC2000 Airport system functions.

Access to protected areas of the airport using additional security such as a PIN code is enabled by modern and intelligent S610 readers, which, synchronized with an LCD display, inform security of the prohibition of access to certain areas of the airport, e.g. by the expiration of a card or the barrack of the appropriate authorization to a particular airport area. Another solution is the S610f biometric reader, which provides protection by verifying the validity of the identification card with confirmation of the PIN and the match of the fingerprint of the cardholder in question. Depending on the required level of security, one can choose the appropriate combination of these authorization criteria - from confirmation of the relevant PIN code alone, or additionally with simultaneous verification of the card bearers' fingerprint matches (<https://lanster.com>).

A new solution to improve airport security is an innovative magnetic sensor technology that aims to provide better and reliable ways to observe vehicle traffic. The use of this technology is expected to help airports eliminate runway incursion incidents. ISAMEL has developed a system to enhance protection and security in the harshest weather conditions and in places where traditional monitoring systems cannot truly assess the situation. ISAMEL's sensors are created to work as part of so-called advanced ground traffic management and control systems Advanced Surface Movement Guidance and Control Systems – ASMGCS ([www.trimis.ec.europa.eu](http://www.trimis.ec.europa.eu)).

## **6. Analysis of on research results – assessment of critical infrastructure systems and facilities**

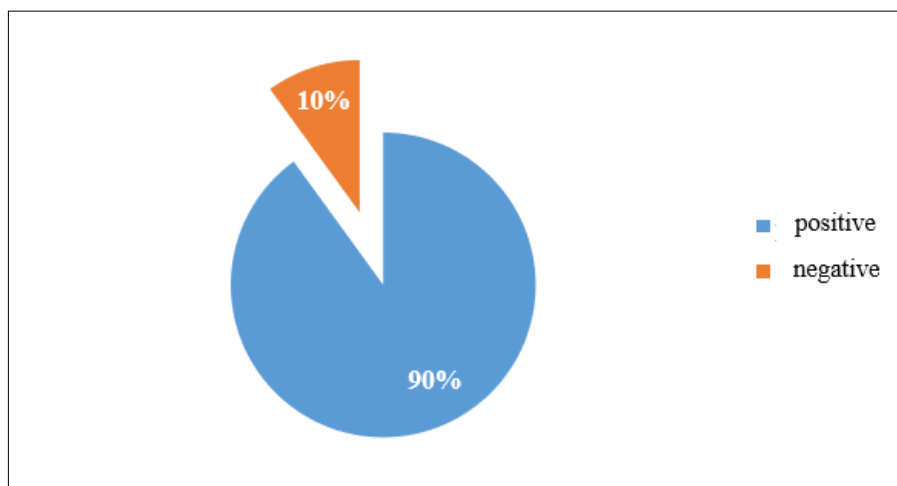
The conducted research shows that the economic and social role of critical infrastructure requires a systemic approach to its protection, while ensuring its normal functioning. This is related to organizing such solutions that are adequate to the needs posed by the population. Broad expectations of the reliability of critical infrastructure make it necessary to involve various entities in its protection, which should have sufficient competence, knowledge and tools to counter threats by reducing the possibility of their occurrence and to remove their consequences, including restoring the functionality of this infrastructure.

The extent of preparation of entities protecting critical infrastructure is extremely important. These activities must be subject to control, which can be implemented by preparing, conducting and analyzing Multimedia Decision Training. However, due to the declarative and unsanctioned nature of the participation of critical infrastructure protection entities in the infrastructure protection program, its organization may be the subject of exercises, such as in the form of decision-making games, recommended by the Government Security Center (GSC).

In order to be able to assess the security and security methods of critical infrastructure systems and facilities (such as the airport), 60 respondents were asked to express their opinion on this aspect. The metric shows the characteristics of the survey group in terms of gender, age, education, place of residence and affiliation with uniformed formations. The study included 18 women, accounting for 30% of the respondents, and 42 men, accounting for 70%. The respondents participating in the study formed a very diverse group in terms of age. There were no individuals under the age of 20. The largest group, nearly half of all respondents, were middle-aged 31-40 year olds – 49%. Slightly smaller was the percentage of those aged 21-30 – 21% and 41-50 – 23%. The smallest group was made up of people over 50 years old – 7%.

Taking into account the education of the respondents, the largest group, 65%, were those with higher education. One in five respondents – 20% have so far obtained a secondary education, and only 4% a vocational education. The largest group of those taking part in the survey were those living in the countryside – 30%, 32% live in a city of up to 20,000 residents. One in five respondents lives in a city with a population of 20,000 to 50,000. The remaining 18% of respondents live in a city with a population of 50,000 to 100,000. Most of the survey participants serve in the Polish Army – 54%, 25% in the Police, 14% in the Border Guard, and only 7% in Airport Security Service.

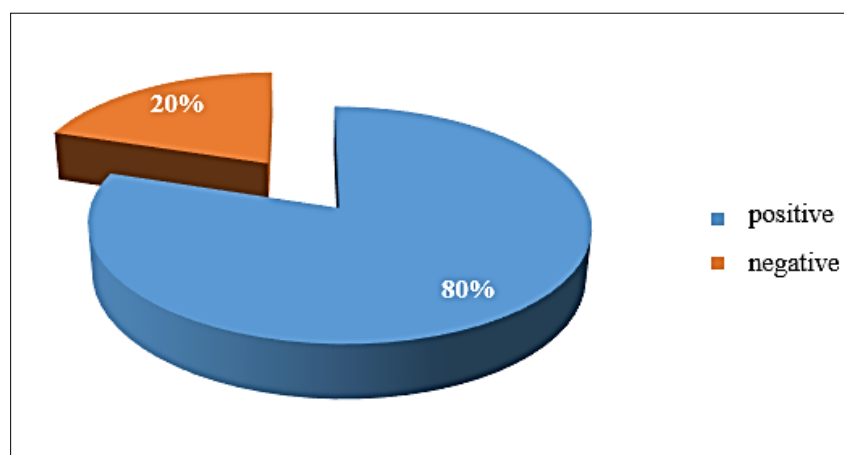
The results of the respondents' opinions on the protection of critical infrastructure presents figure 2.



**Figure 2.** Survey group opinion on the protection of critical infrastructure in Poland.

Source: own study.

Substance-related questions focused on survey participants' opinions on: critical infrastructure protection (including facilities and systems), potential threats to Poland's critical infrastructure, and the hierarchy on the issue of threats related to the protection of critical infrastructure facilities and systems. As many as 90% of respondents believe that the protection of critical infrastructure in Poland is adequate, only 10% believe that it is inadequate, and in justifying their choice, this group recognizes that some elements of this infrastructure are not protected at all, or that protection is reduced to technical or mechanical security only. One person indicates that there are too few IT specialists – programmers who can design security systems, and that it is too expensive to operate security and protection systems. Figure 3 presents the results of respondents' opinions on the protection of critical infrastructure facilities and systems.



**Figure 3.** The opinion of the survey group on the protection of objects and systems of critical infrastructure in Poland.

Source: own study.

In the case of protection of objects and systems of critical infrastructure in Poland, as many as 80% of respondents said that it is sufficient. Unfortunately, one in five respondents felt that this protection was not adequate. Among the reasons cited here was the weakness of safeguards regarding infrastructure related to the provision of water to residents, including insufficient protection of deep wells, transportation systems. Respondents also made comments as to poor security regarding internet access. Table 1 shows potential threats to Poland's critical infrastructure as perceived by respondents.

**Table 1.**

*Potential threats to Polish critical infrastructure in the opinion of respondents*

Type of threat	n	%
Natural hazards	42	70
Accidental threats	8	17
Informed threats	10	13
Total	60	100

Source: own study.

The largest group of people said that Poland's critical infrastructure is most threatened by disasters and natural hazards. This is the opinion of 70% of respondents. 17% of respondents indicated accidental threats, and 13% indicated deliberate (intentional) threats.

The next question asked which system respondents believe is most at risk? Among the most threatened systems, respondents cited the energy, energy resources and fuel supply system at 42%, the financial system at 26%, the water supply system at 12%, the transportation system at 9% and the food supply system. 3% of respondents each cited the communications system, the health care system, the emergency system, the system that ensures the operation of public administration, and the system for the production, storage, storage and use of chemical and radioactive substances as the most endangered system.

Another question asked about the most important issues in critical infrastructure protection. The most important issues in critical infrastructure protection were considered by respondents to be cooperation between the public administration and owners and owners and owners-in-ownership or subsidiaries of critical infrastructure facilities, installations or equipment in terms of their protection – 33%, restoration of critical infrastructure – 25%. A slightly smaller percentage considers the collection and processing of information on threats to critical infrastructure to be the most important aspect – 22%, and the development and implementation of procedures in case of threats to this infrastructure – 20%. Analyzing the degree of importance of forms of protection in the event of an emergency, the largest number of people considered technical protection – 32%, physical protection – 24%, ICT protection – 22% and personal protection – 12%. The least important, in the opinion of respondents, is legal protection – 2% of respondents believe so, as well as assistance from the government side in the reconstruction of the damaged or destroyed element - as indicated by 6% of respondents.

Considering 10 aspects, such as analyzing the degree of threat to the facility, assessing the current state of security, ensuring the safety of the occupants, controlling the movement of people, controlling the movement of materials, controlling the technical security of the facility, complying with regulations and procedures, ensuring the reliable operation of the facility or system, protecting against theft, damage, vandalism and maintaining official secrecy, respondents were asked to prioritize them. Table 2 shows this hierarchy for facilities, and Table 3 for critical infrastructure protection systems.

**Table 2.**  
*Importance of each aspect in protecting facilities*

Aspect	Importance of aspect				
	1	2	3	4	5
Analysis of the degree of threat to the facility	74%	18%	5%	3%	0%
Assessment of the current state of protection	64%	14%	15%	4%	3%
Ensuring the safety of the occupants of the facility	0%	0%	0%	18%	82%
Control of personnel movement	24%	19%	40%	10%	7%
Control of material movement	6%	14%	62%	10%	8%
Control of technical security of the facility	41%	31%	13%	8%	7%
Compliance with regulations and procedures	66%	19%	15%	0%	0%
Ensuring reliable operation of the facility	11%	16%	51%	20%	2%
Protection against theft, destruction, vandalism	8%	20%	39%	19%	14%
Maintaining service secrets	2%	3%	14%	21%	60%

Source: own study.

**Table 3.**  
*Importance of individual aspects in system protection*

Aspect	Importance of aspect				
	1	2	3	4	5
Analysis of the degree of threat to the system	18%	66%	6%	3%	7%
Assessment of the current state of protection	8%	10%	74%	5%	3%
Ensuring the security of the system	2%	18%	58%	19%	3%
Systematic control of the system	2%	3%	19%	10%	66%
Control of system repairs	18%	20%	42%	16%	4%
Control of authorizations of people working in the system	0%	29%	44%	24%	3%
Control of technical security of the system	1%	0%	0%	26%	73%
Compliance with regulations and procedures	5%	20%	52%	20%	3%
Ensuring reliable operation of the system	0%	21%	27%	39%	13%
Protection against theft, destruction, vandalism	0%	3%	17%	26%	54%
Maintaining service secrets	8%	11%	21%	39%	21%

Source: own study.

The most important in the protection of the system according to the opinion of the respondents is the control of technical security of the system, its regularity and protection against theft, destruction, vandalism. A point less important is maintaining official secrecy and ensuring reliable operation of the system. Of medium importance to respondents is the evaluation of the current state of security, ensuring the security of the system, compliance with regulations and procedures, control of the authority of people working in the system, and control of system repairs. Respondents considered the analysis of the degree of threat to the system to be the least important aspect.

## 7. Conclusions

The growing importance of critical infrastructure facilities and systems to state security derives from their strategic importance in sustaining the uninterrupted functioning of the state under modern threats. The threat of a terrorist attack, regional instability near national borders,

the use of weapons of mass destruction or the potential possibility of a crisis situation requires increased efforts to prevent, limit or minimize the loss and destruction they will bring with them. Critical infrastructure systems and facilities are particularly important for the proper functioning of state security. Their destruction can negatively affect the sense of security in citizens and contribute to the weakening of our country. Particularly dangerous are natural, civilization and terrorist threats hence the need to develop specific systems for the protection of critical infrastructure objects and systems. Their security is provided by physical, technical, ICT and legal protection. To make this protection as effective as possible, the constantly updated and responsive Act on crisis management obliged the Government Security Center to create a National Program for the Protection of Critical Infrastructure.

This article was an attempt to examine the need to protect critical infrastructure systems and facilities – such as airports resulting from their strategic importance and their security in light of possible threats.

The objective presented in the paper, the main research problem and the considerations undertaken in the article allowed the author to formulate the following general conclusions:

1. Threats to critical infrastructure systems and objects have a significant impact on the forms of their protection (depending on the projected threat to the object, appropriate measures are applied).
2. Of vital importance in ensuring security at airports and the entire aviation infrastructure are technical security systems. Airports use various types of X-ray equipment, stationary metal detectors, gates with explosives trace analyzers and, increasingly, biometric passport readers to screen passengers and luggage. However, it should be remembered that even 100 percent efficient systems and technical devices that use the latest technology cannot replace the operator, who makes the most important decisions.
3. A very important role in ensuring airport security, are the security services, which are responsible for specific tasks related to ensuring the safety of passengers. These include, among others, the Police, Border Guard, Airport Security Service.
4. Taking into account various factors and aspects and possibilities of terrorist activities, it can be assumed that the degree of terrorist threat in aviation will continue at least at the current level. However, it should be borne in mind that in the future the challenge for aviation will be not only legal-competitive disputes over the assessment of specific examples of air terrorism, but primarily security, i.e. security in airports, terminals, airports and their surroundings.
5. Security of critical infrastructure systems and facilities will be provided by physical, technical, personal, ICT and legal protection. At the same time, respondents considered the most important aspect in protecting facilities to be ensuring the safety of people on the premises and maintaining official secrecy. In turn, the most important aspect of system protection is the control of technical system security, its regularity and protection against theft, destruction, vandalism. Slightly less important is the maintenance of official secrecy and ensuring the reliable operation of the system.



In summary, the multifaceted nature and voluminousness of the presented content contributed to limiting the work to only the most relevant elements and narrowing the analysis by selected issues. In the author's opinion, the presented study can become an inspiration to explore the subject matter and serve for further scientific research.

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## EFFECTS OF THE IMPLEMENTATION OF SELECTED HOUSING POLICY INSTRUMENTS IN POLAND IN 2008-2023

Maciej KOSZEL<sup>1\*</sup>, Anna MAZURCZAK<sup>2</sup>, Łukasz STRĄCZKOWSKI<sup>3</sup>

<sup>1</sup> Poznan University of Economics and Business, Institute of Management, Department of Investment and Real Estate; maciej.koszel@ue.poznan.pl, ORCID: 0000-0003-1613-2334

<sup>2</sup> Poznan University of Economics and Business, Institute of Management, Department of Investment and Real Estate; anna.mazurczak@ue.poznan.pl, ORCID: 0000-0003-0311-1884

<sup>3</sup> Poznan University of Economics and Business, Institute of Management, Department of Investment and Real Estate; lukasz.straczkowski@ue.poznan.pl, ORCID: 0000-0002-5555-5324

\* Correspondence author

**Purpose:** The article addresses the functioning of the housing market with particular attention to the effects of government housing programs supporting the demand side. Dynamic increases in housing prices, reduced credit availability as a result of high central bank interest rates, increasing pressure from the institutional sector and, finally, the increasingly popular recognition of housing as an investment asset negatively affect the situation in the housing market and the affordability of housing.

**Design/methodology/approach:** For the purpose of the article, a review of literature related to the topic of the housing market and housing policy was conducted. A diagnosis of the housing situation was carried out based on current statistical data covering the effects of housing construction, demand for mortgages and housing, or housing price dynamics. A review of housing policy programs and instruments made it possible to identify present directions for supporting the population in meeting housing needs. The analytical part also included the calculation of indicators of housing affordability, thus showing the ambiguous effects of housing policy.

**Findings:** Evaluation of government policies to support the population in meeting housing needs is ambiguous. On the one hand, the demand policy instruments used make it possible to purchase housing for households that do not have this ability. On the other hand, the increase in the amount of demand for housing results, in the long term, in an increase in the price of this good, which is confirmed by market data. However, the attempt to isolate the impact of specific factors is severely hampered by their multiplicity and often difficult-to-measure nature.

**Research limitations/implications:** Assessing the impact of a specific factor on the real estate market situation, on the residential segment, is difficult due to the complex nature of this market and the multiplicity of players, connections and high dynamics of change in this area. An additional difficulty is the methodological diversity used by various authors and entities engaged in the analysis of this market. The possibilities of diagnosing the housing situation are also limited by the available data.

**Practical implications:** The study presented in the article can be used both at the government level in terms of shaping housing policy, as well as commercial players in the area of matching supply to needs and preferences in the housing market.

**Social implications:** Improving the housing situation of the population and the affordability of housing are currently some of the main social challenges. Attempting to solve this problem using instruments developed ad hoc often ends up generating negative side effects, in the form of price increases. That is why a well-thought-out approach to supporting the population in the field of housing is so important.

**Originality/value:** The survey is part of a discussion on the implementation of housing policy instruments in the real estate market. The survey is aimed primarily at public authorities active in the residential rental market, policy makers and developers.

**Keywords:** housing market, housing policy, demand-side housing policies

**Category of the paper:** research paper

## 1. Introduction

The housing market, which is an important and specific segment of the real estate market, is an extremely complex system, closely linked to the economy and subject to the impact of several economic, social, demographic, technological, legal, or resulting from the requirements of sustainable development. For this reason, assessing the phenomena occurring in this market is extremely difficult. The housing market is also one of the most capital-intensive markets in the economy, so knowledge of the factors that significantly affect its development is crucial to understanding the mechanisms of operation.

Housing policy plays a key role in shaping the housing market, having a direct impact on the availability, quality and price of housing. The various instruments used by the state, such as regulations, subsidies, tax breaks or social housing support programs, can, on the one hand, stimulate the development of the housing market, and, on the other hand, influence the reduction of barriers to access to housing for various social groups. In an era of rising real estate prices and increasing demand for affordable housing, appropriate housing policies are becoming a key tool for influencing market stability and quality of life.

This article aims to present the essence of both pro-population and pro-supply housing policy instruments used in Poland in 2006-2023, and to answer the question of whether and how these tools have affected the housing market. The article includes an analysis of the situation in the primary and secondary housing market in terms of price levels, housing supply and affordability of the selected household. In addition, to determine the role of the discussed instruments in meeting housing needs, the loan agreements concluded during the period under study and the transactions concluded in the housing market were analyzed. It is worth noting that the collection of data encountered objective obstacles in the form of different time ranges. The data collected in the Local Data Bank of the Central Statistical Office differs regarding the sections given. As a result, some of the data are available for earlier years, some only for later years, and some still must wait due to the late time of their publication.

## 2. The housing market and the determinants of its development

The market is one of the fundamental categories in economic theory, encompassing the totality of purchase and sale transactions between economic agents. Despite the various definitions, the market should not be equated only with the physical space of transactions. The contemporary view of the market goes beyond a simple model of the interaction of supply and demand, considering also the institutional framework that regulates its functioning. These institutions, as a set of rules and norms, significantly influence the course of market processes. Changes to this regulatory framework can modify the mechanisms of market functioning. Enforcement of the applicable rules is handled by state authorities and specialized institutions responsible for supervising their observance (Gołabeska, 2024).

The concept of the real estate market, according to Kucharska-Stasiak (2005), refers to the activities and interactions undertaken and occurring between actors involved in the buying, selling, exchanging, using, developing and transforming of real estate. The housing market, on the other hand, can be defined as the place where housing demand meets housing supply, shaping the price and enabling transactions (Łaszek, 2006). As emphasized in the literature, the mechanism of the housing market is conditioned by the same factors that constrain the functioning of the broader market, as well as by characteristics specific to real estate (Bryx, 2006).

The high specificity of the housing market is evidenced by its features such as, first, high heterogeneity, limited access to information, local character, relatively small number of transactions or links with other markets. One of the most important features of the real estate market is the high level of public interventionism realized through public sector activities, i.e. spatial planning, protection of historical monuments, protection of agricultural and forestry land, influence on rent policy. State action takes a direct form, aiming to increase supply or transform needs into demand. In addition, financial involvement in the implementation of investments is noticeable (Bryx, 2006).

Determinants of housing market development, affecting both the demand and supply side, can be classified into four groups of factors: political, legal/organizational, social and economic (Foryś, 2011). Among the political factors influencing demand, preferential housing purchase scheme, long-term housing policy and increased trust in state institutions were mentioned. Favorable tax legislation was included in this category on both the demand and supply side. Legal and organizational factors shaping demand included protection of tenants' rights, diverse methods of financing the market and a functioning judicial system. Social demand factors included the high level of unmet housing needs, dynamic demographic changes and the multifunctionality of housing spaces. Economic demand factors include the economic situation and creditworthiness of households, the socially acceptable cost of housing and the inflow of foreign investment into the housing market (Wilczek, 2013).

Another classification of factors shaping demand in the housing market includes: income (own, transfers, loans), prices (rents, housing prices, interest rates), preferences (consumption pattern, level of need satisfaction, demographic factors) (Łaszek, 2006). In turn, supply is determined by: zoning plans (taking into account building sites), the timing of building permits, the level of economic activity, consumer spending (Borowski, 2015).

The real estate market is significantly influenced by legal regulations, including legislation on meeting housing needs and changes resulting from state housing policy. Also of key importance is the set of laws and regulations governing investment processes in the housing sector - from the design stage, through construction, to tax policy issues, including tax breaks for the sector (Gołabeska, 2024).

The role of housing in shaping material and social living conditions is extremely important, and the need for state intervention in the housing market stems from existing structural problems that make the housing market unable to effectively meet housing needs. Without state support, ensuring access to housing for all citizens is not possible (Suszyńska, 2017).

State intervention in housing should result in optimization in terms of housing availability, household housing costs and the efficient deployment of financial resources. To improve access to housing, governments typically take measures to stimulate the construction of new units. Through various housing policy tools, such as government mortgage interest subsidies, the overall cost of construction can be reduced, thus encouraging increased housing production. Tax concessions, exemptions, as well as subsidies and grants influence the structure of the production of new units, thus shaping the rental housing market. Rental regulations, such as rent freezes or limits on rent increases, are also an important factor influencing the development of this market, which can lead to a reduction in investor activity in the rental market (Suszyńska, 2017).

### **3. The essence and role of housing policy**

Considering, firstly, the importance of housing as a good satisfying key human needs and, secondly, the essence of the housing problem, it is necessary to reflect on the further implications of these, as reflected in the deliberate policies pursued by the state and local government units at municipal level. The aim of housing policy is to create conditions for meeting housing needs in accordance with the preferences, aspirations and economic possibilities of the population (Strączkowski, Koszel, 2021, p. 149). The objective of housing policy can also be expressed in terms of housing availability. Thus, for the purposes of this study, it is assumed that the objective of housing policy is to improve housing accessibility, which is reflected in the assumptions of housing policy programmes and instruments implemented in Poland over the last three decades.

Due to the significant dynamics of the socio-economic situation in 2020-2023, the last of the indicated criteria - the economic capacity of the population - can be objectively considered the most significant determinant of housing availability. In accordance with the content of Article 75 of the 1997 Constitution of the Republic of Poland (Journal of Laws No. 78, item 483, as amended), the role of the state is to support citizens in meeting their housing needs. In recent years, a comprehensive support programme has been, among others, the National Housing Programme (NPM) adopted on 27 September 2016 by Resolution No. 115/2016 of the Council of Ministers (gov.pl). The NPM has three main objectives:

1. To increase access to housing for people with incomes that do not allow them to purchase or rent housing on a commercial basis.
2. To increase the possibility of satisfying the basic housing needs of persons at risk of social exclusion due to low income or a particularly difficult life situation.
3. To improve the housing conditions of the population, the technical condition of the housing stock and to increase energy efficiency.

It was to be possible to achieve the adopted objectives through the implementation of nine measures, which were to favour the development of the offer of flats for rent and increase the quality of living (including the following programmes: Apartment+, Apartment for Senior). The National Housing Programme, as well as its individual measures, were evaluated for their effects and effectiveness (Sobczak, 2021; NIK, 2022b, Szelałowska, 2023). This evaluation is inconclusive, pointing to measures which, despite their positive effects, failed to meet the initial assumptions due to their potential scale and numerous negative side effects in the form of dynamic increases in the level of prices on the housing market (Szelałowska, 2023). According to the contents of the Act on Municipal Self-Government (Journal of Laws 1990 No. 16, item 95): ‘Satisfying the collective needs of the community is one of the municipality's own tasks. Its own tasks include matters of: (...) municipal housing construction’. The provisions of the Act on Municipal Self-Government are further specified by the provisions of the Act on the Protection of Tenants’ Rights, the Commune's Housing Stock and Amendments to the Civil Code (Journal of Laws 2001, No. 71, item 733), which regulate in particular the principles and forms of protection of tenants’ rights and the principles of management of the commune's housing stock. Considering the above, it is reasonable to discuss the possibilities in terms of the implementation of the housing policy.

Agata Twardoch (2015) points to three levels of housing policy-making - central, regional and local. Given the impact of these policies on the housing situation and the real sphere more broadly, it is reasonable to present the main assumptions of central and local (municipal or city) housing policies. In doing so, it is pointed out that the importance of these regional policies is marginal. It is worth tracing the assumptions and instruments of housing policy historically - Tables 1 and 2.

**Table 1.***Assumptions of housing policy implemented in Poland in the period 1990-2023*

<b>Diagnosis of the housing situation based on key strategy and programme documents (for the periods indicated)</b>	<b>Housing policy objectives</b>
Resolution of the Sejm of the Republic of Poland of 6 July 1995 on the state housing policy (1990-1999) <ul style="list-style-type: none"> <li>– low quality of the stock,</li> <li>– housing deficit</li> </ul>	<ol style="list-style-type: none"> <li>1. improving housing conditions for families.</li> <li>2. eliminating the housing deficit.</li> <li>3. State assistance in obtaining a first home.</li> <li>4. Support for the provision of resources for the middle-income group in rental housing.</li> <li>5. support of social housing for people with permanently low incomes.</li> <li>6. Popularization of long-term savings instruments.</li> </ol>
Assumptions of the state housing policy for the years 1999-2003 <ul style="list-style-type: none"> <li>– low supply of housing,</li> <li>– high implementation costs and prices of flats,</li> <li>– formal problems of functioning of housing communities,</li> <li>– lack of modern rental policy and management of public resources,</li> <li>– poor technical condition of the housing stock</li> </ul>	<ol style="list-style-type: none"> <li>1. Eliminating the housing deficit.</li> <li>2. Reducing development costs and housing prices.</li> <li>3. Improving the technical condition of the housing stock.</li> <li>4. Improving the management of the public stock and adjusting the rent policy.</li> </ol>
National Development Programme 2004-2006 <ul style="list-style-type: none"> <li>– housing deficit,</li> <li>– low quality of stock,</li> <li>– no direct reference to housing issues</li> </ul>	<ol style="list-style-type: none"> <li>1. Eliminating the housing deficit.</li> <li>2. Improving the quality of housing.</li> </ol>
National Development Plan 2007-2013 <ul style="list-style-type: none"> <li>– the need to support the private and non-profit rental housing sector,</li> <li>– low occupational mobility of Poles</li> </ul>	<ol style="list-style-type: none"> <li>1. To promote institutional and legal rental housing.</li> <li>2. Development of the rental housing sector carried out by the private sector and non-profit institutions.</li> <li>3. Support of the private sector with public funds.</li> <li>4. Development of rental housing in the commercial sector.</li> </ol>
Main issues, objectives and directions of the housing support programme up to 2020. (2010-2016) <ul style="list-style-type: none"> <li>– support for people with low incomes,</li> <li>– supporting the supply of affordable housing</li> </ul>	<ol style="list-style-type: none"> <li>1. To meet the housing needs of those at risk of social exclusion.</li> <li>2. To promote access to housing for those unable to purchase or rent market housing.</li> <li>3. To stimulate the supply of affordable housing.</li> <li>4. To improve the technical condition of the housing stock, including energy efficiency.</li> </ol>
National Housing Programme (2017-2023) <ul style="list-style-type: none"> <li>– support for people on low incomes,</li> <li>– support for people at risk of social exclusion</li> </ul>	<ol style="list-style-type: none"> <li>1. To increase access to housing for people with incomes that prevent them from buying or renting housing on the commercial market.</li> <li>2. To increase the possibility of satisfying the basic housing needs of persons at risk of social exclusion due to low income or special life situation.</li> <li>3. To improve the housing conditions of the population, the technical condition of the housing stock and to increase energy efficiency.</li> </ol>

Source: (NIK, 2022, pp. 78-79).

The development of housing policy, which is the subject of long-standing state development strategies, is made up of specific housing policy instruments which have a real impact on the housing situation of those supported. Specific housing programmes and their effects, have been the subject of much analysis and research (Groeger, 2016; Szelągowska, 2021; NIK, 2022;



Bochenek et al., 2023). Two main types of housing policy instruments are identified - pro-demand and pro-supply (Marona, Tomasik, 2023, pp. 40-41). One of the most important findings of research conducted to date is the relationship between the general economic situation and the situation on the housing market - in the case of the latter, primarily in the context of supply and price levels (Bochenek et al., 2023). The main conclusion of the research to date is that the housing boom has a positive impact, but that potential negative side effects must also be taken into account. Pro-housing instruments such as housing allowances, mortgage subsidies (programmes: Family on its own, Apartment for the young, Apartment without own contribution) also contribute to a general increase in the level of housing prices, which is a natural consequence of the market game stimulated by an increase in demand for a given good. Supply-side instruments should, in principle, work in the opposite direction, but in reality this is not the case at all, to which the peculiar paradox resulting from the role of housing - on the one hand as a good for satisfying living needs (semi-public good), on the other hand as an investment good (commodity) - contributes. The described paradox can also be understood as a side effect of the conflict of interests between those in need of housing and investors.

Table 2 presents selected instruments (programmes) of housing policy implemented in Poland from the mid-1990s to the present. It should be noted here that the government's role was mostly to initiate changes of a formal and legal nature, including the drafting of legislative acts which subsequently enabled municipalities to undertake activities and implement their own housing-related tasks.

**Table 1.**

*Selected housing policy instruments in force in Poland in the period 1995-2023*

<b>Years of application</b>	<b>Instrument</b>	<b>Supported side of the market</b>
1992 – 2001	Large construction relief (Duża ulga budowlana)	Pro-Supply
1995 – now	Social housing associations and social housing initiatives (Towarzystwa Budownictwa Społecznego, Społeczne Inicjatywy Mieszkaniowe)	Pro-Supply
2001 – now	Housing allowances	Pro-Demand
2002 – now	Reduced VAT for housing investments	Pro-Supply
2002 – 2006	Interest relief	Pro-Demand
2006 – now	Scheme for non-refundable subsidisation of part of housing costs	Pro-Supply
2009 – now	Renovation premium	Pro-Supply
2007 – 2013	Family on its own (Rodzina na swoim)	Pro-Demand
2014 – 2018	Apartment for the young (Mieszkanie dla młodych)	Pro-Demand
2019 – 2028	Apartment for a start (Mieszkanie na start)	Pro-Demand
2016 – 2023	Apartment plus (Mieszkanie plus)	Pro-Supply
2020 – now	Apartment for land (Lokal za grunt)	Pro-Supply
2022 – now	Apartment without own contribution	Pro-Demand
2023	Safe credit 2%	Pro-Demand

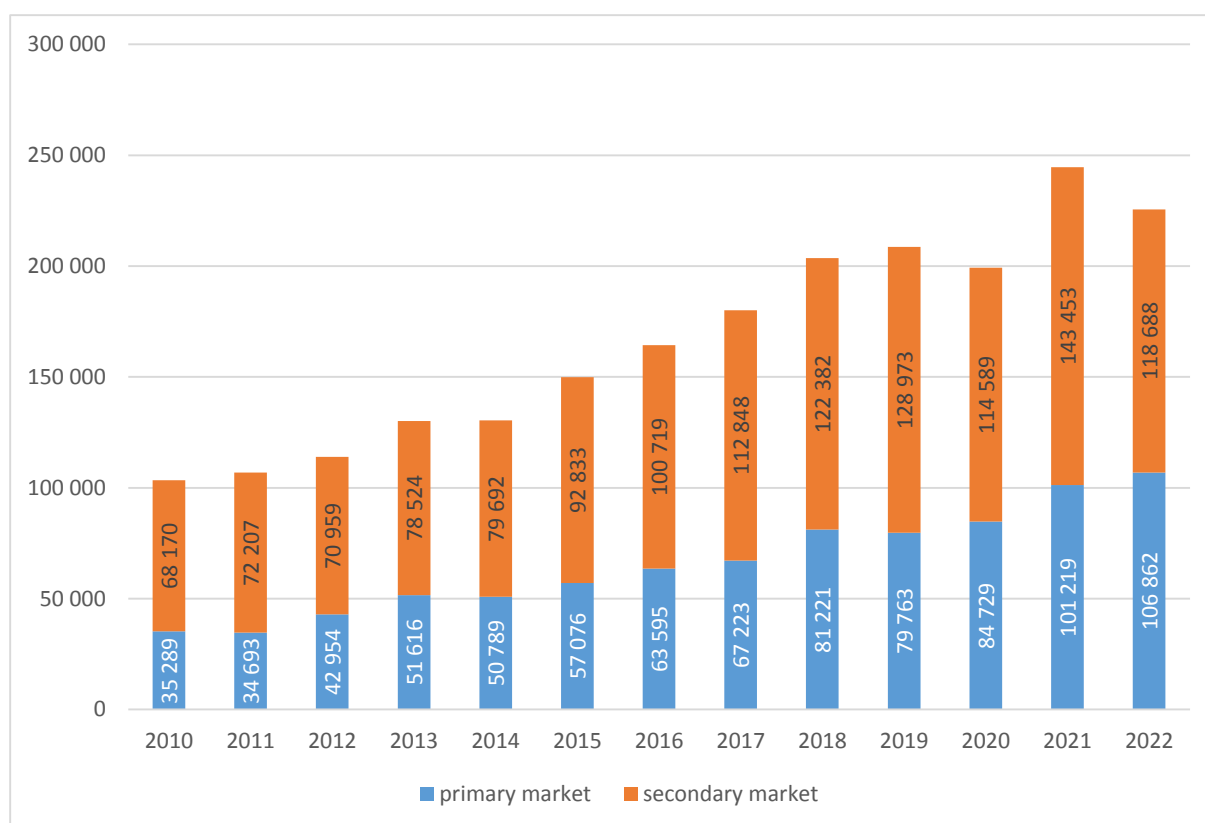
Source: (NIK, 2022; Marona, Tomasik, 2023; Szelągowska, 2023).

The effects of the implemented housing policy instruments, as pointed out earlier, are ambiguous. Instruments of a pro-demand nature, dominant in recent years, did indeed contribute to an increase in housing availability, but only for persons meeting eligibility criteria, but at the same time resulted in an increase in the level of housing prices. The result, in turn, has been a polarization of the overall availability of housing - from the perspective of households unable to use it for formal reasons. A potentially considered effect is even a situation in which households, accumulating funds for the own contribution required when financing the purchase of a flat with a mortgage on general terms, fell into the rent gap, thus losing their creditworthiness. Given the dynamics of price changes on the secondary market in selected cities in Poland (based on Otodom Analytics data), the scenario seems likely. Taking into account the rigid housing supply and the general turbulence in the construction sector, which resulted in a temporary decrease in the number of building permits issued and construction commenced, we should expect a further deepening of the unfavorable situation, which may also be influenced by the implementation of the new housing loan bill #naStart, which is still (as of Q2 2024) at the consultation and opinion stage, replacing the earlier Safe Credit 2%, which was analyzed in more detail by Szelałowska, among others (2023, pp. 55-84).

#### **4. Housing market and selected housing policy instruments in Poland 2007-2023**

Programs introduced between 2007 and 2023 to support the purchase of housing, such as Family on its own, Apartment for the young and Safe Credit 2%, have undoubtedly translated into a significant increase in demand for residential real estate. The number of transactions in the housing market is shown in Figure 1.

Unfortunately, objective obstacles were encountered in the collection of data in the form of different time ranges. The data collected in the Local Data Bank of the Central Statistical Office differ with regard to the sections given. As a result, some data are available for earlier years, some only for later years, and some still must wait due to the late time of publication. Hence, transaction data only cover the period 2010-2022.

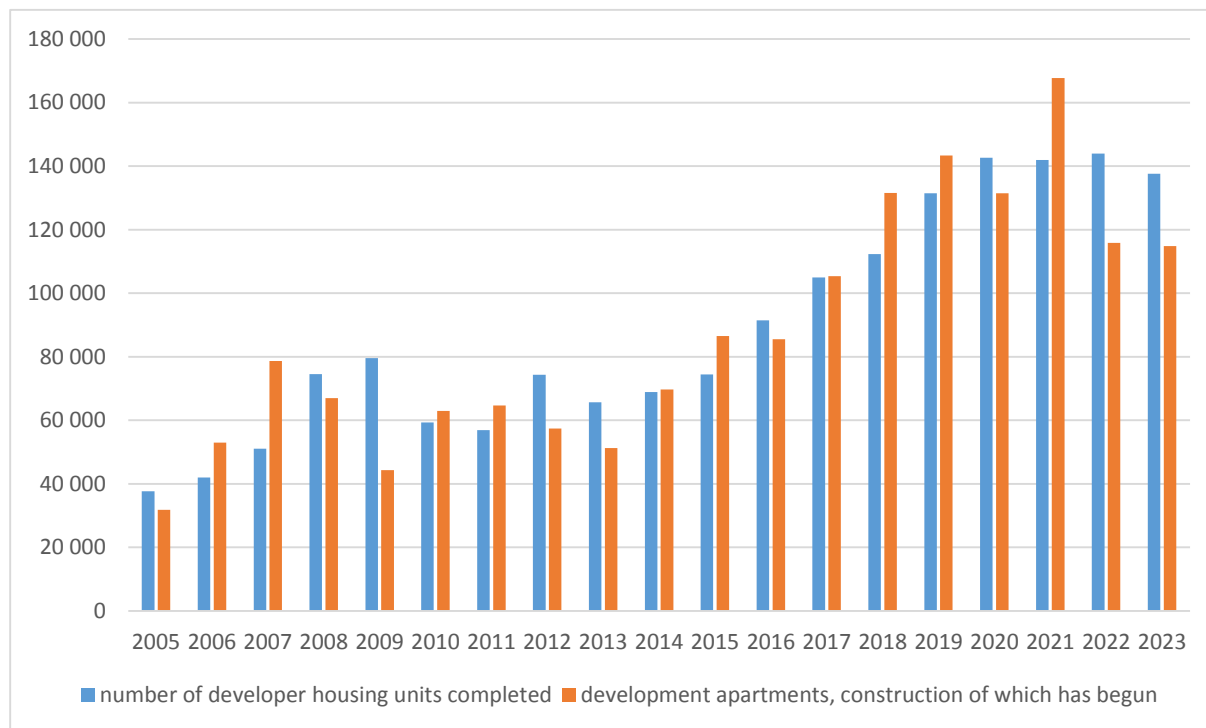


**Figure 1.** Number of housing market transactions between 2010 and 2022.

Source: own elaboration based on the Local Data Bank of the Central Statistical Office.

The number of housing market transactions in Poland in 2010-2022 fluctuated under the influence of various factors, such as the economic situation, changes in interest rates, banks' lending policies, and consumer sentiment. It should be noted that because of the global financial crisis in 2008-2009, the real estate market recorded a marked decline in the number of transactions. The credit crunch and limited availability of mortgages resulted in lower demand for flats than in previous years. After 2010, the number of transactions started to gradually increase, although it was still lower compared to the pre-crisis period. It was not until 2013 and 2014 that there was greater credit availability, moderate prices and a higher number of transactions. The dynamic increase in demand due to low interest rates, ease of financing, facilities in the form of the Apartment for the young programme brought record numbers of transactions in the housing market between 2015 and 2019, especially in large cities. In 2020, due to the COVID-19 pandemic, the number of transactions initially fell, especially in the second quarter of the year. However, by the second half of 2020, the housing market had already started to recover and demand for properties returned to pre-pandemic levels. The increase in interest in buying homes was partly driven by low interest rates and fears of inflation. In 2021, the number of transactions in the residential market reached record levels, particularly due to the high activity of investors seeking, in the face of high levels of inflation, alternative forms of capital investment. This growth continued into 2022, although the second half of the year began to see some signs of a slowdown, linked to interest rate rises.

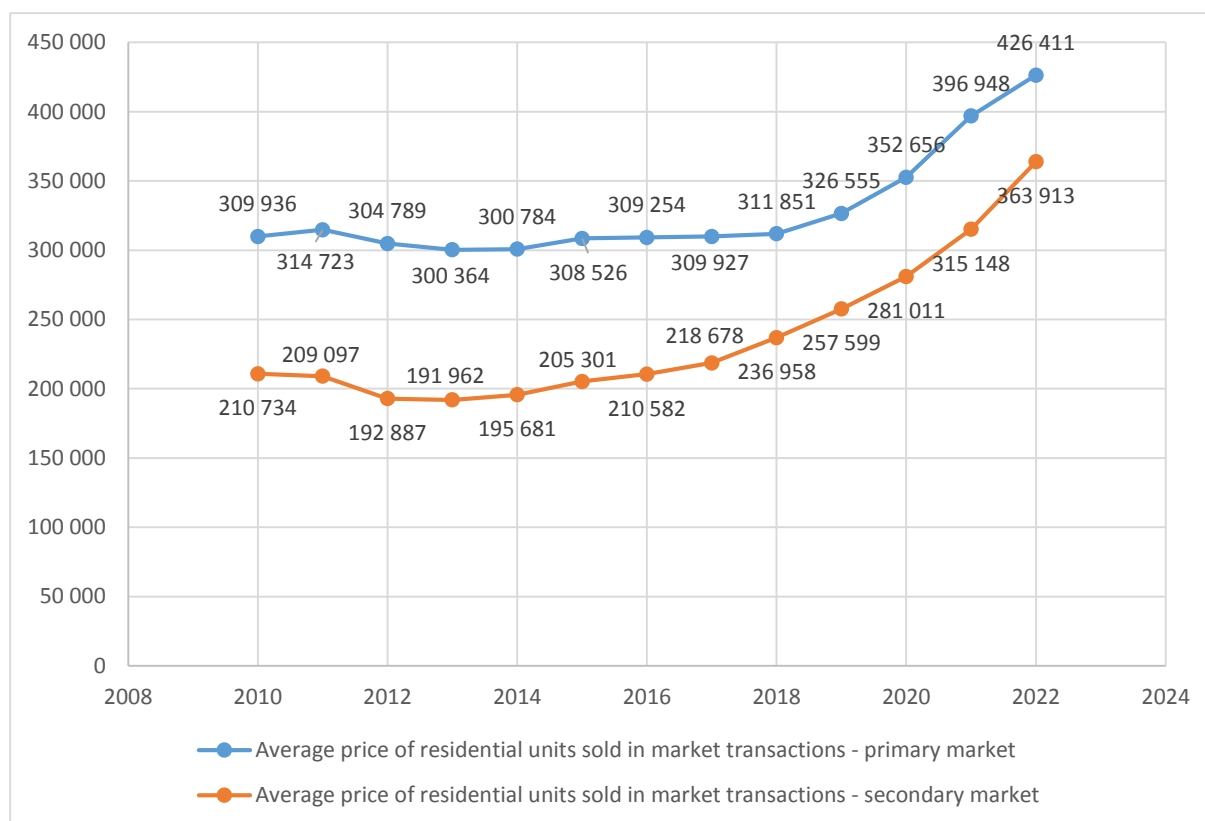
The changes in the housing market are also reflected in the activity of developers in this sector of the property market (Figure 2).



**Figure 2.** Developers activity in the housing market from 2005 to 2023.

Source: own elaboration based on the Local Data Bank of the Central Statistical Office.

The activity of developers in the housing market in Poland in 2005-2023 was dynamic and strongly dependent on macroeconomic conditions, credit policy, land availability and legal regulations. During the period under review, large fluctuations can be observed, from a housing boom (2005-2008, 2014-2019) to periods of major slowdown and investment caution (2008-2013, 2022-2023). The main factors affecting the market are the availability of mortgages, changing government policies, including programs to support demand, such as “Housing for the Young”, which stimulated the purchase of housing by young people, which increased activity in the market. The COVID-19 pandemic, contrary to expectations, did not decelerate the market, and its consequences in the form of problems with the availability of construction materials, and the consequent increase in the cost of investment, were the drivers of price growth. In turn, 2022 brought the onset of high interest rates and inflation, which clearly reduced the availability of credit and ultimately the decline in demand. Only the 2% Safe Credit program, introduced in mid-2023, led to an increase in buyer activity and, with a low supply of housing, a dynamic increase in prices (Figure 3).



**Figure 3.** Average housing prices from 2008 to 2023.

Source: National Bank of Poland.

The indirect effects of the introduction of the various pro-demand instruments in the form of programs that help finance the purchase of one's own home (Family on its own, Apartment for the young and the safe credit 2%) can be seen in the estimated indicators of housing income availability (Table 3 and Table 4). To construct the accessibility index, the following were used:

- A. for the total market - the average price of housing units sold in total market transactions and the average gross monthly salary.
- B. for the primary market - the average price of housing units sold under market transactions in the primary market and the average gross monthly salary.
- C. for the secondary market - the average price of residential units sold as part of market transactions in the secondary market and the average gross monthly salary.

The following assumptions were made:

- A. the composite housing affordability index recommended by the World Bank was used for the calculation. The method of its calculation is described in: (Strączkowski, 2021, p. 21; Strączkowski, Mazurczak, 2015, p. 18; Trojanek, 2014, p. 6). For clarity - the value of the index up to 3 points - indicates housing affordability, from 3 to 4 points - moderate affordability, from 4 to 5 - unaffordability, and above 5 points - high housing affordability;

- B. gross wages were converted to net wages. The reason for such a procedure is that apartment buyers, disregarding their motives, when deciding to purchase units are guided by the size of their budget (funds in the bank account) and creditworthiness, calculated on the basis of real incomes in the account;
- C. calculations were made on the assumption that two adults have equal income throughout the year;
- D. calculations were made for the total market (primary and secondary markets combined), and then for the two segments separately, in order to illustrate price differences in the purchase of housing within one or the other market.

**Table 3.***Affordability index of apartments for sale in Poland in 2010-2023*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>total</b>	4,12	3,89	3,63	3,51	3,42	3,41	3,36	3,23	3,19	3,17	3,26	3,37	3,40
<b>primary market</b>	5,22	5,02	4,71	4,48	4,35	4,30	4,17	3,96	3,73	3,65	3,69	3,83	3,68
<b>secondary market</b>	3,55	3,34	2,98	2,87	2,83	2,86	2,84	2,79	2,84	2,88	2,94	3,04	3,14

Source: own elaboration based on the Local Data Bank of the Central Statistical Office

As can be seen from the table above, the primary market is characterized by greater unavailability of housing than the secondary market. Throughout the analyzed period, apartments in the primary market were characterized by unavailability or moderate unaffordability. The situation was different in the secondary market, where apartments were affordable between 2012 and 2020.

It is also worth tracing the development of the housing affordability index in Poland's largest cities. In line with the assumptions made for the NBP's quarterly information on housing prices and the situation in the residential and commercial real estate market in Poland, it was decided to analyze the situation in Warsaw and the other five largest cities in Poland, viz: Gdansk, Krakow, Lodz, Poznan and Wroclaw.

In order to calculate the housing affordability index, data on average transaction prices per square meter from two information resources were used: 1) for the years 2010-2022, annual data from the CSO's Bank of Local Data were used, 2) while for the period covering the period from the first quarter of 2023 to the second quarter of 2024, AMRON-SARFIN data published in quarterly reports were used. AMRON-SARFIN data were averaged for 2023 and the first half of 2024. Data on average gross wages and salaries in the business sector were taken from the GUS Local Data Bank (2010-2023) and from current CSO publications for the period covering the months of January to June 2024 - these data were also averaged for the purpose of calculating the final values of the accessibility index. To make the figures more realistic, the amount of average net wages was calculated by subtracting the amount of mandatory social security and health insurance contributions, as well as advance payments for income tax, thus obtaining disposable income. On this basis, it was assumed that the average net salary is 71.47%

of the gross salary. For the purpose of the calculations, the usable area of the apartment was assumed to be 50 m<sup>2</sup>, which is a size close to the average for the selected cities and corresponding to the preference of 2-3 person households. It was assumed that in this case income is earned by two adults. The detailed results of the calculations are shown in Table 4.

**Table 4.**

*Affordability index of apartments for sale in six largest cities in Poland in 2010-2024 (first half of 2024)*

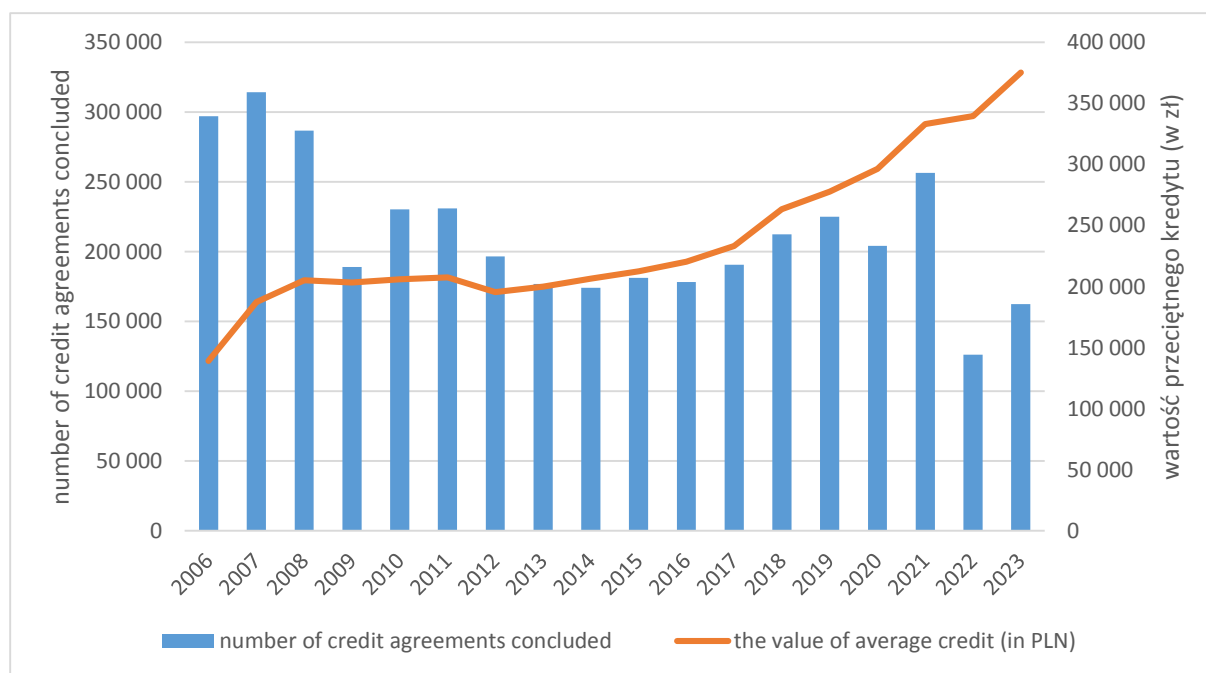
City	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Gdańsk	3,87	3,87	3,84	3,51	3,32	3,21	3,32	3,60	3,55	3,58	3,77	3,85	3,68	3,28	3,29
Kraków	5,37	5,12	4,76	4,52	4,45	4,27	4,04	3,81	3,64	3,60	3,72	3,66	3,73	3,41	3,61
Łódź	3,89	3,44	3,22	3,10	2,87	2,69	2,62	2,68	2,72	2,78	2,92	2,93	2,97	2,67	2,97
Poznań	4,38	4,21	3,82	3,72	3,72	3,56	3,42	3,35	3,35	3,26	3,26	3,35	3,31	2,98	3,20
Warszawa	5,23	4,87	4,61	4,14	4,16	4,00	3,95	3,95	3,97	3,89	4,04	4,20	4,21	3,78	4,18
Wrocław	4,39	4,26	3,91	3,87	3,55	3,36	3,30	3,19	3,20	3,19	3,39	3,52	3,58	3,39	3,71

Source: own elaboration based on the Local Data Bank of the Central Statistical Office and data form AMRON-SARFIN.

Considering the interpretation of the value of the housing affordability index and the temporal and spatial scope of the conducted research, it can be clearly stated that in most cases apartments were moderately unavailable (Krakow and Warsaw), unavailable (Gdansk, Poznan, Wrocław) and partially available - Lodz. During the period studied, there were clear changes in the housing affordability index from extremely high values in 2010, meaning that apartments were severely unavailable (Krakow, Warsaw), unavailable (Poznań, Wrocław) and moderately available (Gdańsk, Łódź), to a relative improvement in the value of the index in 2014-2016, which was the effect of stabilization and even correction of apartment prices in Poland's largest cities, and then further deterioration of housing affordability in the surveyed centers. An exceptional year in the period under review is 2023, in which, despite dynamic increases in housing prices, their affordability improved. In the first half of 2024, the affordability of housing in Poland's six largest cities again deteriorated significantly.

Mortgage market activity in Poland in 2008-2023 was closely linked to the economic situation, monetary policy and housing programs introduced to support both demand, but indirectly affected supply and housing prices (Figures 4 and 5).

The decline in the number and value of loan contracts made immediately after the financial crisis (2008-2009) was an inevitable consequence of the economy. Mortgage availability declined and economic growth slowed. In the 2012-2020 period, the reduction of interest rates by the National Bank of Poland, which also stimulated an improvement in the availability of mortgages, contributed to a rapid increase in housing prices, especially in large cities. In 2019-2021, the mortgage market reached historic records in terms of the number of loans granted, fueling the real estate boom.

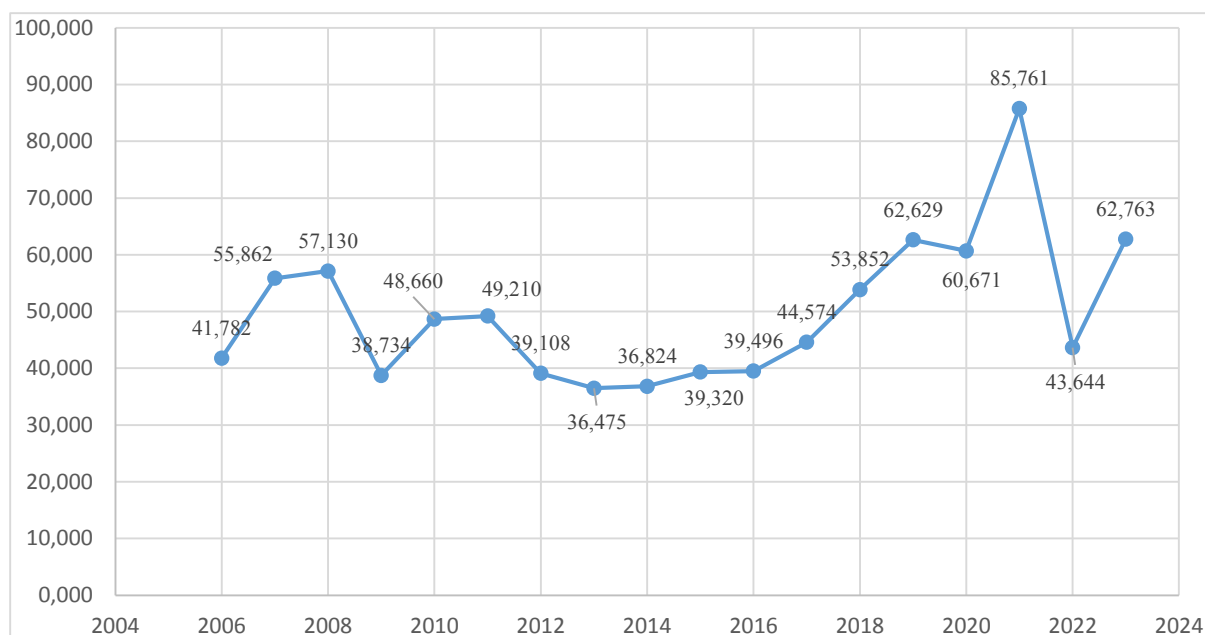


**Figure 4.** Number of credit agreements concluded and the value of the average mortgage from 2006 to 2023.

Source: AMRON-SARFIN.

During the period under review, the state's proposed housing programs contributed to this situation. The increase in interest rates in 2022 and 2023 caused a significant increase in the cost of servicing loans, which reduced the creditworthiness of many households. The mortgage market slowed sharply in 2022-2023, and the number of new loan applications fell dramatically. For this reason, various forms of assistance for borrowers began to be implemented in 2023, including a credit vacation to provide relief to those with mortgages, including the Safe Credit 2% program, which allows people under the age of 45 to purchase their first home on preferential terms, offering low interest rates on loans for the first 10 years. The program was met with great interest (101888 loan applications had been submitted by Dec. 28, 2023), but the consequence was a rapid increase in prices.

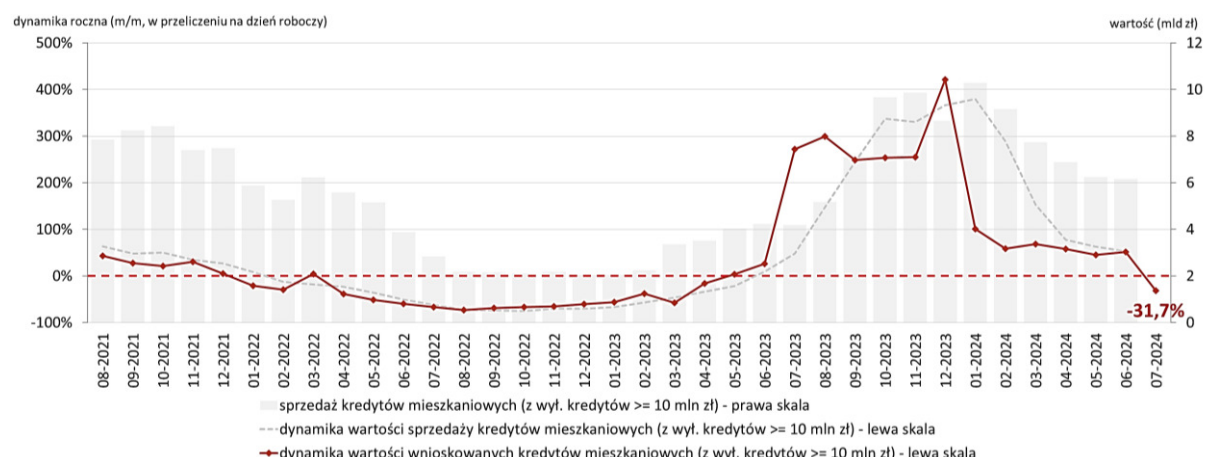




**Figure 5.** Value of new contracts in the mortgage market from 2006 to 2023.

Source: Credit Information Bureau (BIK).

Highlighting the tremendous interest on the part of borrowers in the Safe credit 2% program, it is worth tracing the BIK Home Loan Demand Index at the end (Figure 6).



**Figure 6.** BIK Housing credit demand index.

Source: Credit Information Bureau (BIK).

In July 2024, 30.63 thousand potential borrowers applied for a housing loan, compared to 43.44 thousand a year earlier (that's when the call for applications under the program under review began), which translates into a y/y decrease of almost 30%. Compared to June 2024, however, the number of housing loan applicants increased by 11.6%. On the other hand, the average value of a housing loan applied for in July 2024 was PLN 435.88 thousand and was 6.2% higher than in July 2023. Compared to June 2024, however, it fell slightly by 1.6%. This confirms the most important effects of the program, including, among others, an increase in housing prices as a consequence of increased demand and a strong reduction in market supply.

## 5. Conclusions

The assessment of the tools used by the Polish government to improve the housing situation in the country over the period 2008-2023, presented in the article, focuses on selected housing policy instruments, such as social housing support programs and mechanisms aimed in principle at increasing the availability of housing for middle- and low-income earners. It was emphasized that during the period under review a number of measures were implemented, such as the Family on its own, Apartment for the young and safe credit 2% programs, which were aimed at facilitating the purchase of housing.

Undoubtedly, the last program had the greatest impact on the housing market, which between July 2023 and February 2024 resulted in loans of more than PLN 30 billion (BIK, 2024). In comparison, the total value of loans under the Family on its own program is nearly PLN 35 billion (over 7 years) and Apartment for the young is PLN 20 million (over 5 years). According to the analysis, this program also contributed to the highest increase in housing prices, influencing lower affordability.

In conclusion, the authors point out the need for further reforms and adaptation of housing policy tools to real social needs to increase the availability of housing in Poland to a greater extent. In the face of further pro-population tools like the planned introduction of the Housing Credit #naStart program, its potential impact on the market should be carefully analyzed. Such a program, offering interest-free mortgages, could have a number of effects, both positive and potentially negative. The introduction of the Housing Credit #naStart program would, on the one hand, most likely significantly stimulate the residential real estate market, leading to an increase in demand, but on the other hand, it would increase housing prices. This would increase the availability of credit to a larger group of people, but at the same time could create the risk of a real estate bubble and over-indebtedness among households. The introduction of such a program would require strict supervision to avoid negative effects in the long term.

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## THE CONTEMPORARY TRENDS OF SCIENTIFIC RESEARCH ON ESG AND NON-FINANCIAL REPORTING

Maciej KOSZEL

Poznan University of Economics and Business; maciej.koszel@ue.poznan.pl, ORCID: 0000-0003-1613-2334

**Purpose:** The article addresses the issue of contemporary directions of ESG research with particular emphasis on non-financial disclosure (non-financial reporting) of companies. The aim of the study is to identify areas of ongoing scientific research in the subject.

**Design/methodology/approach:** The conducted research has the character of meta-analysis. The focus was on achievements in two main scientific disciplines: economics and finance, and management and quality sciences. The research covered publications related to non-financial reporting, with ESG aspects - environmental (environmental), social (social) and corporate governance (governance) - as a common thread.

**Findings:** The study of ESG and non-financial reporting is a rapidly evolving area of contemporary research in economics and management. The volatility is driven, on the one hand, by the needs of companies themselves as they adapt to changes in the operating environment, while, on the other hand, ESG and non-financial reporting activities are significantly influenced by regulations that cover an increasingly wide range of companies. Increasingly, researchers are using statistical analysis methods for this purpose, which is slowly becoming a separate sub-discipline in methodology as a science. The development of research tools, including advanced statistical packages, can lead to significant changes in the range of analysis methods - from qualitative methods, based on descriptions, to statistical analysis, using measures of centrality, frequency, or so-called burst-terms analysis.

**Research limitations/implications:** The main limitation of the study is the time scope of the research. Only articles from 2004-2021 were included in the main analysis, which was determined by the availability of databases at the time the source material was collected. The research conducted shows the directions of change in the scientific exploration of ESG issues and non-financial reporting, which can be exploited for further analyses by researchers, students, and other entities working on the subject.

**Originality/value:** The research not only show past and current trends in ESG research, but also a change in research methodology, which increasingly uses quantitative methods. This thread represents an attractive area for further scientific exploration.

**Keywords:** ESG, non-financial disclosure, bibliometric analysis.

**Category of the paper:** literature review.

## 1. Introduction

Growing environmental pressures, negative consequences of business activities, increasing public awareness and tightening legislation are motivating efforts to mitigate the negative impact of companies. As a result, companies are becoming increasingly attentive to 1) environmental, 2) social and 3) corporate governance issues in their operations and are taking specific actions in these areas, known as ESG (Li et al., 2021; Chen, Xie, 2022). An example of companies' commitment to ESG issues is the implementation of solutions, monitoring of effects and reporting in the areas of corporate social responsibility (CSR) and corporate sustainability. ESG has also become an important area of research globally (Khan, 2022; Senadheera et al., 2022; Jain, Tripathi, 2023). Actions taken by companies in ESG areas are increasingly regulated by national and international laws (Kawacki, 2022). A consequence of the newly established legislation is also an increase in the range of entities to which specific measures, such as non-financial reporting, are required. (Hoang, 2018; Doni et al., 2020; Błażyńska, 2022) In the context of the inclusion of an increasing number of companies under non-financial reporting obligations in ESG areas, such as CSRD Directive of the European Union Parliament (Directive 2022/2464), a key practical and research problem is becoming the organizational preparation of companies for this task (Jackson et al., 2019; Chen, 2022; Ellili, 2022).

For the purpose of this article, a review of studies on ESG and non-financial reporting was conducted. The focus was put on studies of a meta-analysis nature, which used methods of umbrella review, systematic literature review and bibliometric analysis. This made it possible to identify the main areas and contemporary research directions on ESG, which was the main objective of the study. The paper is a critical review of the literature on the subject and is a synthesis of scientific achievements addressing ESG topics.

## 2. Literature review on ESG and non-financial reporting

ESG, as a term referring to the three key areas of corporate activities, i.e. environmental, social and corporate governance was first introduced in the 2004 (Jain, Tripathi, 2023). The report entitled *Who Cares Wins: Connecting the Financial Markets to a Changing World?* includes an analysis and recommendations for integrating ESG-related activities into the operations of public enterprises. The report's authors suggested that an integrated ESG-sensitive approach could lead to more sustainable markets and better corporate performance (Kell, 2021). Since then, the linkage between ESG and financial performance has become a major research topic in that field (Friede et al., 2015; Fatemi et al., 2018; Wong et al., 2020; Alsayegh et al.,

2020; Signori et al., 2021) Measuring the effects of companies' ESG-related activities is currently a significant challenge from various perspectives: managers, shareholders, customers, society. In this context, indexes of public companies that report non-financial activities (non-financial disclosure) in accordance with global standards such as European Sustainability Reporting Standards (ESRS) are useful. Research indicates that companies with better ESG performance (broad coverage, progress monitoring, transparent reporting) have lower debt costs (Eliwa et al., 2022) and face fewer barriers to raising capital (Cheng et al., 2014).

A specific niche is currently represented by studies involving meta-analysis of ESG issues conducted using systematic literature review (SLR) and methods of statistical analysis (Li et al., 2021; Khan, 2022; Wan et al., 2023; Zhao et al., 2023). The essence of SLR is to conduct a structured analytical procedure leading to the identification of key research areas focused around a central problem. A common SLR tool is the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which has its own unified methodology for the research procedure, which is framed in simple diagrams such as a flow diagram or an analysis criteria checklist (Page et al., 2021). The use of the PRISMA method entails compliance with all formal requirements, including the submission of an appropriate due diligence statement. ([prisma-statement.org](http://prisma-statement.org)) Similar to any research procedure, SLR requires the identification of basic research scopes that enable the extraction of a database of publications subject for further analysis, such as bibliometric analysis using statistical methods. The basic scopes for the extraction of publications is the determination of: 1) objective scope, i.e. what is/will be studied (scientific publications containing the keyword, the research problem to be searched and studied), 2) subjective scope, which are databases aggregating scientific publications containing the searched keyword (e.g. Web of Science, Scopus), 3) time scope, which covers the period relevant to the research, 4) spatial scope, which defines the geographical scope of the impact of the research problem - due to the general access to databases, a global spatial scope is usually assumed and includes publications in English. In addition to the basic criteria defining the base of publications subjected to in-depth analysis, it is necessary to specify additional criteria (often in the form of filters) that will narrow the scope of analysis (e.g. type of publication, citation indexes, minimum number of citations, language of publication). Most ESG studies conducted using SLR employ the Web of Science (WOS) or Scopus database for this purpose (e.g. Li et al., 2021; Zhao et al., 2023) and the following citation indexes: Social Science Citation Index (SSCI), Science Citation Index Expanded (SCIE), Arts & Humanities Citation Index (A&HCI) and Emerging Science Citation Index (ESCI). All the indexes indicated are based on the resources of the Web of Science Core Collection database (WOSCC).

The use of bibliometric review and analysis methods, which, based on statistical analysis tools, enable objective identification and evaluation of research directions on a selected research problem, is now very popular (Donthu et al., 2021; Paul et al., 2021; Lim et al., 2022)

Bibliometric review methods include citation analysis, keyword frequency and centrality analysis, mapping, cluster analysis, or burst terms analysis, for example (Zhao et al., 2023).

The widespread popularity of ESG topics, especially in the context of non-financial reporting, is evident in both international (Orens et al., 2010; Gao et al., 2015; Doni et al., 2020; Raimo et al., 2023) and Polish studies (Walińska, 2015; Świdarska et al., 2016; Fijałkowska, 2016; Lament, 2017; Śnieżek et al., 2018; Rubik, 2018; Skoczylas, 2019; Różańska, 2022). These studies clearly point out key trends: 1) an increase in the number of entities publishing non-financial disclosures (Fijałkowska, 2019) and 2) the growing importance of non-financial reporting for value creation and company evaluation (Bek-Gaik, Rymkiewicz, 2015; Fijałkowska, Zyznarska-Dworczak, 2017), as well as 3) the need to standardize these reports (Michalak, 2010; Tschopp, Nastanski, 2014; Erkens et al., 2015; Różanska, 2015). Non-financial reporting, like ESG, has become the subject of extensive academic research using meta-analyses (Manes-Rossi, 2018; Fijałkowska et al., 2019; Jackson et al., 2020; Turzo et al., 2022; Diwan, Sreeraman, 2023).

### **3. Methodology**

For the purpose of this study, an in-depth analysis of selected scientific articles was carried out using umbrella review methodology (Belbasis et al., 2022; Bonczar et al., 2022; Cant et al., 2022; Choi, Kang, 2023). The main focus was put on the articles revolving around the research that uses bibliometric analysis methods, a systematic literature review and statistical analyses based on citations and keywords. Publications from the Web of Science Core Collection (WOSCC) database, indexed in: Social Science Citation Index (SSCI), Science Citation Index Expanded (SCIE), Arts & Humanities Citation Index (A&HCI) and Emerging Science Citation Index (ESCI). The critical analysis of the literature carried out allowed the identification of the main research problems and research directions related to ESG in the period from 2004 to 2021. The timeframe adopted for the analysis conducted is, as a starting year, the year in which the concept of ESG appeared in the 'Who Cares Wins' report (2004) and 2021, which was considered the last year for which it was possible to give significant academic visibility to the research findings. The time frame adopted for the analyses conducted is subjective, but based on the achievements of other Authors conducting research of a similar scope (Ellili, 2022; Galletta et al., 2022; Lim et al., 2022; Zhao et al., 2023), such a scope is justified. Given the need to present the most up-to-date state of the art, the sources used in the study are also later papers that used SLR and bibliometric analysis methods.



## 4. Results

An in-depth analysis of the content of scientific publications dealing with the topic of ESG and non-financial reporting made it possible to identify the main research directions. Table 1 presents the results obtained, detailing the main research problem, the specific research topic and examples of ongoing research - their authors.

**Table 1.**

*Main ESG and non-financial reporting issues and examples of research 2004-2021*

Main research problem	Topics	Examples of research conducted
Stakeholder involvement	Stakeholder interest	Ning et al. (2021), Gao, Zhang (2006)
	Inclusiveness	Farooq et al. (2021), Guix, Font (2020)
	Mitigating climate change	Haque et al. (2016), Siew et al. (2013)
	Sustainable development	Guix, Font (2020), Lokuwaduge, Heenetigala (2017), Murgula, Böhling (2013), Tokos et al. (2012), Maharaj, Herremans (2008)
ESG	Business performance	Danisch (2021), Buallay (2021), Sharma et al. (2020), Buallay et al. (2020), Rezaee, Tuo (2017)
	Integrated reporting	Gerwanski (2020), Bektur, Arzova (2020), Albitar et al. (2020), Mervelskemper, Streit (2017), Maniora (2017), Camilleri (2017)
Social impact	Culture of sustainability	Buallay (2021), Rezaee, Tuo (2019), Shrivastava, Addas (2014)
	Reducing the carbon footprint	Helmets et al. (2021), Goel (2019), Babin, Nicjolson (2011)
	Sustainable society	Woschnack et al. (2021), Trireksami, Djajadikerta (2016)
	Sustainability practices and reporting	Robertson, Samy (2020), Das et al. (2020), Akisik, Gal (2020), Antoncic (2020), Hossain et al. (2019)
	Institutional approach	Mahmood, Uddin (2020), Hassan et al. (2019), Camilleri (2018), Bu et al. (2017), Bice, Coates (2016), Herremans et al. (2009)
	Social and environmental responsibility and CSR practices	Donnell, Wickham (2020), Demir, Min (2019), Adel et al. (2019), Skouloudis et al. (2019), Akisik, Gal (2017), Hossain, Alam (2016), Looser, Wehrmeyer (2015), Weber et al. (2014), Mobus (2012), Breitbarth et al. (2010), Sutantoputra (2009)
	Ethics	Nobanee, Al.-Suwaidi (2021), Adel et al. (2019), Sabbaghi (2016), Weber et al. (2014), Mittal et al. (2008)
Corporate governance	Responsibility	Farooq et al. (2021), Haque et al. (2016), Euler (2014), Gill (2014), Thalassinis, Liapis (2011), Koh et al. (2007)
	Auditing	Velte, Stawinoga (2020), Bruckman et al. (2019), Abdullah et al. (2018), Safari (2017), Brown, Popova (2016), Godha, Jain (2015), Peters, Romi (2014), Gill (2013), Monen (2011)

Source: own compilation based on: (Diwan, Sreeraman, 2023).

The analysis of keywords related to ESG and non-financial reporting that constitute the chosen research problem can focus on the analysis of the frequency of co-occurring keywords and their centrality. Based on Li's research with his team (2021, pp. 7-8), the most frequently co-occurring keywords with ESG include corporate social responsibility, performance, sustainability, governance, financial efficiency, company, impact, social responsibility, leadership and strategy. The centrality analysis, which is a measure of the relevance of the nodes (keywords) in the network, indicates that the most relevant keywords studied so far were:

company, behaviour, influence, strategy, competitive advantage, corporate social responsibility, management, sustainability, leadership, organization. In doing so, it should be pointed out that the keywords that appeared earlier have already managed to ‘anchor’ themselves in the ground of ESG-related scientific theory, and their impact is therefore much greater than the themes raised relatively later. Statistics on the frequency of ESG-related keywords and their centrality are included in Table 2.

**Table 2.**  
*Frequency and centrality of ESG-related keywords*

No.	Keyword	Year	Frequency	Centrality
1.	corporate social responsibility	2004	234	0,08
2.	performance	2004	140	0,06
3.	sustainability	2007	125	0,07
4.	management	2004	113	0,08
5.	financial performance	2006	83	0,06
6.	firm	2004	80	0,16
7.	impact	2004	80	0,12
8.	social responsibility	2007	80	0,06
9.	governance	2006	74	0,07
10.	Strategy	2007	71	0,10
11.	organization	2005	61	0,07
12.	framework	2004	61	0,06
13.	perspective	2006	44	0,07
14.	behavior	2004	38	0,13
15.	business	2007	37	0,04
16.	market	2005	33	0,04
17.	responsibility	2006	33	0,02
18.	company performance	2010	30	0,02
19.	value for shareholders	2011	29	0,03
20.	innovations	2007	29	0,03
21.	cost	2008	27	0,06
22.	identity	2011	27	0,04
23.	legitimacy	2005	27	0,03
24.	risk	2013	24	0,01
25.	institutional theory	2011	23	0,02

Source: (Li et al., 2021).

A tool that enables further investigation is burst terms analysis. It consists of identifying keywords related to the main research problem that are dynamically gaining importance, which is reflected in the number of publications using the keyword and the strength of their impact, which is derived from the frequency of co-occurrence with the primary term and the number of citations. A burst terms analysis conducted by Li and team (2021) identified the dominant ESG-related keywords between 2004 and 2020, and is presented chronologically in Table 3.

**Table 3.**  
*ESG-related burst terms 2004-2020*

Burst term	Impact	Beginning	End	Duration	Range of years
company	4,36	2004	2009	5	●●●●●○○○○○○○○○○
framework	4,31	2005	2014	9	○●●●●●●●●○○○○○○
technology	3,98	2006	2010	4	○○●●●●○○○○○○○○○○
perspective	3,37	2006	2009	3	○○●●●○○○○○○○○○○
altruism	3,14	2006	2012	6	○○●●●●●○○○○○○○○
capability	2,99	2008	2011	3	○○○○●●●○○○○○○○○
competition	3,66	2010	2013	3	○○○○○○●●●○○○○○○
consumption	3,17	2012	2013	1	○○○○○○○○●○○○○○○
choice	3,07	2012	2013	1	○○○○○○○○●○○○○○○
stakeholders theory	2,97	2012	2013	1	○○○○○○○○●○○○○○○
organization	3,28	2013	2014	1	○○○○○○○○●○○○○○○
philanthropy	4,63	2015	2018	3	○○○○○○○○○○●●●○○
self-regulation	4,32	2015	2018	3	○○○○○○○○○○●●●○○
standard	3,00	2015	2016	1	○○○○○○○○○○●○○○○
financial performance	4,75	2016	2017	1	○○○○○○○○○○●○○○○
company value	3,67	2017	2020	3	○○○○○○○○○○●●●●
moderator role	3,2	2018	2020	2	○○○○○○○○○○●●●
incentive	3,18	2018	2020	2	○○○○○○○○○○●●●
director	2,91	2018	2020	2	○○○○○○○○○○●●●

Source: (Li et al., 2021).

The analysis of burst terms shows a high volatility of ESG-related keywords, which is characteristic of new research problems, theories and scientific concepts that are in a formative stage, are embedded in other theories and concepts and, above all, are dependent on legal regulations that determine the formal framework for the application of practical tools and instruments and are dependent on the broader context constructed by different interest groups. The first period of academic research on ESG is characterized by a strong association of the term with concepts that present a theoretical framework for the operation of ESG-using companies, hence the notions of a model (framework) to make sense of the company's activities in line with ESG objectives (e.g. through sustainability goals), technology - as a key area for the application of practical solutions, especially in the environmental area, a perspective related to the company's long-term strategy in which the company declares that it will achieve specific ESG-related results. Interestingly, one of the identified burst terms is altruism, which was a leading theme of academic research on ESG between 2006 and 2012, continuing, as it were, in the later period, where there was a 'rash' of studies addressing the issue of philanthropy. These threads have now been rendered obsolete due to the introduction of regulations requiring selected public companies to apply specific ESG regulations - most notably the non-financial disclosure obligation. The middle phase of ESG research is characterized by a short period of dominance of selected research threads, it is a period of searching for more niches, further structuring and systematization of ESG research theory. Finally, the last phase is a focus around the threads of financial efficiency, corporate value and the role of key influencers and accountability to different stakeholder groups.

Given the dynamic development of ESG and non-financial reporting in this area, it is also worth pointing out future potential research directions, which according to Li and his team (2023) include:

- clarifying key definitions related to the ESG concept,
- consolidating the theoretical layer,
- deepening the research problems explored so far,
- improving evaluation systems for ESG activities,
- detailed ESG practices of organizations.

Leaving aside the purely academic context and focusing on the practical aspect of ESG, it is worth pointing out other potential research areas related to ESG and non-financial reporting:

- the costs of implementing ESG and non-financial reporting and their distribution among different interest groups,
- good practices in ESG and non-financial reporting,
- ethical aspects of ESG and non-financial reporting,
- the differentiation of barriers and constraints to the implementation of ESG tools and reporting on the part of companies according to differentiating criteria such as sector of activity, company size, business profile,
- ESG and non-financial reporting and the availability of external capital.

The plurality of contexts, interconnections, scientific disciplines addressing the issue and, finally, the scientific efforts of researchers undoubtedly contribute to a better understanding of the nature and role of ESG and non-financial disclosure from the point of view of different interest groups. The development of available methods and tools of analysis that allow a different perspective on the issue and frame it in statistical analyses, as in the case of bibliometric analysis methods, is also not without significance. In addition to the frequency of co-occurrence of keywords, the number of citations, or the clusters and linkages generated in the form of graphical visualizations and maps, it is also important for the development of science related to ESG and non-financial disclosure that the output also bears the hallmarks of utilitarianism from the perspective of different audiences.

## **5. Discussion and conclusions**

It is formally presumed that the concept of ESG came into circulation two decades ago. At the same time, it still represents a rich area of scientific exploration as a result of dynamically changing contexts in three main areas: environmental, social and corporate governance (Ellili, 2022). Literature research conducted using the methods of systematic literature review and

bibliometric analysis confirms the high level of diversity in academic research on ESG, which is reflected in the leading themes and research topics over the last several years. Academic research in the disciplines of economics and finance and management on ESG conducted in 2004-2021 is largely related to the issues of corporate social responsibility, business performance, corporate sustainability and financial performance, as evidenced by the results of the keyword co-occurrence frequency and burst terms analysis. The subject of ongoing scientific research on ESG has changed over time (Li et al., 2021). Not insignificant for the directions of ESG development and research is the issue of legal regulation, both at the international level (legal regulations of European Union bodies) and at the national level. Especially the level of national legal regulations covering ESG is an attractive area of interest due to the necessity to adapt and harmonize national regulations, their implementation, enforcement, supervision, which constitutes a complexity in the practical dimension of ESG application (Manes-Rossi et al., 2018; Kawacki, 2023). From a cognitive perspective, covering the achievements and results of companies applying ESG tools and instruments, an important area of research in the near future will be how companies cope organizationally with the implementation of guidelines arising from regulations and directives of EU bodies and acts of national law (e.g. the Accounting Act) (Primec, Belak, 2022). Given the above, ESG can be seen as another of the factors forcing companies to become more agile and flexible in their operations, often also taking an emergent approach to strategy building in key areas (Cosma et al., 2022). Further conclusion on the issue of ESG and non-financial reporting allows for a statement in which a picture of a positive impact on the companies and their stakeholders is created (Signori et al., 2021; Wong et al., 2021). There are fewer threads of the negative effect of ESG on, among other things, the financial performance of companies, operational costs associated with the implementation of ESG practices and non-financial reporting (operationalization of ESG strategies, performance monitoring, reporting, audits), the prospect of ESG costs being passed on to contractors and customers of companies (Gao et al., 2022; Xue et al., 2023). Many of the research threads on ESG and non-financial reporting are ‘ambivalent’ in nature, as evidenced by the ambiguous research findings on the correlation occurring between financial performance and ESG performance of companies. The question arises about the nature of this dilemma, a kind of paradox, does better ESG performance lead to better financial performance, or does better financial performance allow for better ESG performance? In light of today's research, the determination of this type of dilemma is still ambiguous. Given previous experiences with CSR or sustainable development issues, there are also pre-existing dilemmas, often linked to business ethics (Jackson et al., 2019). It can be speculated that as the environmental and social awareness of society increases, the importance of ESG and non-financial disclosure will grow, and there is no doubt that in this context, the transparency of companies' actions and their “agility” in adapting to change will be crucial.

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## IMPLEMENTATION OF TEAL ORGANIZATION IN THE SALES DEPARTMENT OF AN INTERNET MARKETING AGENCY – CASE STUDY

Janusz KRAŚNIAK<sup>1\*</sup>, Szymon GORLAK<sup>2</sup>

<sup>1</sup> Poznań University of Economics and Business; janusz.krasniak@ue.poznan.pl,  
ORCID: 0000-0003-1864-9687

<sup>2</sup> Collegium Da Vinci, Poznań; szymon.gorlak@cdv.pl

\* Correspondence author

**Purpose:** The article attempts to answer the following research questions: What are the main challenges associated with implementing a teal organization in the sales departments of marketing agencies? What actions were taken to shape the attitudes and values desired by the studied company, which are characteristic of the teal organization model? What benefits were achieved as a result of the actions taken?

**Design/methodology/approach:** Attempting to answer the research questions required a literature review and conducting research procedures. The case study method was used in the research process. The aim of the study was to describe a typical case of implementing the teal organization model in the studied company. Additionally, the research employed direct observation techniques, surveys, interviews, and organizational documentation.

**Findings:** The effective implementation of the teal organization model requires methodical actions that focus the efforts of organizational participants around the values and attitudes desired by the organization. Identifying the key values and attitudes of a teal organization and recognizing gaps in these values and attitudes within the sales department enabled actions that contributed to transforming the existing organization into a teal organization.

**Practical implications:** The analysis of actions taken by the studied company leads to the conclusion that they contributed to raising employees' awareness of the teal organization principles and embedding its values and assumptions within the organization. Considering the research findings, it can be assumed that the teal organization model has a place in modern management. This assumption is based on the desire to work in an environment that nurtures human values; the employees' contribution, their engagement, feedback culture, and trust. Barriers in implementing the teal organization model often include a lack of trust in the concept, which relies on empowering employees and relinquishing traditional control over the work process.

**Originality/value:** The innovation lies in highlighting the need to incorporate values and attitudes characteristic of the teal organization concept in the implementation process, identifying actions that contribute to shaping these values and attitudes, and determining how an effectively implemented teal organization can impact the development of sales departments in marketing agencies.

**Keywords:** teal organization, teal organization attitudes and values, teal organization implementation.

**Category of the paper:** Case study.

## 1. Introduction

In the context of managing sales departments in internet marketing agencies, the importance of modern management models and organizational forms that prioritize people and their potential is increasingly emphasized. One such model is the teal organization. The teal organizational model is based on values such as responsibility, transparency, decision-making ability, safety, and learning (Laloux, 2014, p. 13). This model differs significantly from traditional organizational models, emphasizing deeply ingrained trust in the organizational culture (Wzrorek, 2019, p. 103). Laloux highlights that organizations adopting values of mutual trust, autonomy, and collective rather than individual development — focused on individuals — achieve better results, as confirmed by his research (Laloux, 2014, pp. 272-274). Although management based on trust and collectivism had been previously analyzed (Blikle, 2019), it is Laloux's literature and research that has contributed to the popularization of the idea of self-managing teams. In response to the challenges faced by modern organizations, such as bureaucracy, an excess of meetings, or frequent internal conflicts, Laloux proposes an alternative approach to overcome these problems (Laloux, 2014, pp. 72-77). Increasingly, management teams are seeking more efficient ways to replace traditional methods that do not meet the expectations of the 21st century. In sales departments of marketing agencies, where innovation, flexibility, and a fast-paced work environment are key elements of organizational growth, the implementation of the teal organizational model can bring numerous benefits. On the other hand, sales departments in internet marketing agencies may also face significant challenges when implementing this approach. The key question, therefore, becomes how to implement the teal organizational model and what benefits can result from its implementation.

Identification and understanding of these challenges and benefits are crucial for sales department leaders in internet marketing agencies who are considering implementing this innovative approach. The aim of this article is to answer the following research questions:

- What are the main challenges associated with implementing the teal organization in sales departments of marketing agencies?
- What actions were taken to shape the desired attitudes and values characteristic of the teal organizational model in the company under study?
- What benefits were achieved as a result of these actions?

The answers to these questions will help to better understand how the teal organization can influence the development of sales departments in marketing agencies and what steps need to be taken to successfully implement this organizational model.

## **2. The Teal Organizational Model vs. Traditional Models – According to F. Laloux**

F. Laloux, in his book *Reinventing Organizations*, presents the concept of organizational evolution, based on an in-depth analysis of research and theories related to the development of human consciousness. Drawing on these models, Laloux describes how organizations evolve from Red to Teal, where the key factor in transitioning to a higher, more innovative organizational and management model is the development of people's consciousness and the pursuit of a collective organization based on a culture of transparency.

In Red organizations, there is a lack of formal hierarchy and established roles, aside from the dominant position of a leader who imposes their authority through the use of force. The boss has direct control over the management of the entire organization and its structure. Today, some organizations still operate based on the Red model, manifesting in the privileged placement of family members in key positions (nepotism) and maintaining control over employees through fear (Laloux, pp. 30-32).

Amber organizations emerged in response to significant advances in human consciousness, combined with the development of agriculture, the creation of city-states, civilizations, and bureaucratic and religious structures. Amber organizations are characterized by development through slow but steady growth, order, and predictability, basing future actions on past experiences. They operate under the belief that there is one right way of doing things and that the world is static and does not need change to continue its development. Their main problem is resistance to change, making them struggle in the face of competition, as they aim for monopoly and market dominance (Wzrorek, pp. 41-43). In modern times, the Amber approach can be observed in government institutions, public schools, as well as in religious and military organizations (Laloux, p. 33).

Orange organizations introduce three key changes: innovation, accountability, and meritocracy. However, they still retain the pyramidal structure typical of Amber organizations, though they begin to implement certain modifications (Wzorek, p. 54). Leaders in these organizations are open to change, viewing innovation not as a threat but as an opportunity for further growth. The pursuit of modern solutions is a constant element in their operations. In organizations where the Orange management style prevails, there are well-developed sales, marketing, and R&D (Research and Development) departments. Management is based on goal achievement, a bonus system for accomplishments, and meritocracy, where

roles can be dynamically assigned depending on performance and generated profits. The Orange management style predominantly dominates in corporations (Laloux, pp. 36-37).

The Green management model is characterized by a significant shift towards empowerment, a culture of values, and inspiring through a shared purpose, while considering the interests of all stakeholders involved. Although Green organizations still maintain a hierarchical structure, most decisions are delegated to lower levels, giving frontline employees considerable freedom to make decisions without the need for supervisor approval. The introduction of decentralization and empowerment means that upper and middle managers must actually relinquish some control and share power. In the Green model, the leader plays a servant role, focusing on supporting, motivating, and developing their employees (Laloux, pp. 46-47). The Green management model can be found in small consulting firms and large enterprises that emphasize a good atmosphere, values, and a sense of community.

The Teal organizational model refers to a new, holistic form of managing organizations, where key elements include trust, employee autonomy, open feedback, and self-organizing teams (Januszko-Szakiel, 2020).

The Teal management model is distinguished by the absence of hierarchy, decentralized decision-making, and a strong emphasis on shared values and organizational goals that transcend traditional divisions within the organization. In Teal organizations, employees have full autonomy in managing their tasks and projects, fostering innovation and creativity. Moreover, this creates a work environment that promotes team member satisfaction, within a specific time and context, supporting their self-motivation in developing competencies, autonomy, and relationships with others (Ryan, Deci, 2018).

This model rejects classic control and motivational structures based on punishments and rewards, replacing them with systems of collaboration, support, and personal development. It also strives to integrate spiritual and personal values with professional life, leading to a more engaged and responsible approach to work. Rzepka (2021) argues that organizations that have successfully implemented certain elements of the Teal organization have reaped several benefits. In these organizations, a faster pace of development, improved financial situations, greater employee engagement, higher job satisfaction, and lower turnover rates have been observed.

### **3. Values of Teal Organizations**

In Teal organizations, values are the key foundations for three main principles: self-management, wholeness, and evolutionary purpose. These values act as a compass that guides the desired attitudes and behaviors within the organization. Additionally, they support the decision-making process for both employees and the organization as a whole (Pluta, 2022).

The implementation of the Teal model requires organizations to cultivate desired values and attitudes. The values and attitudes characteristic of Teal organizations are presented in Table 1.

**Table 1.**  
*Values and Attitudes of Teal Organizations*

Values of the Organization	Attitudes of Teal Organizations
Trust	Trust, especially at the supervisor-employee level, naturally accelerates and shapes the desired relationships within the team. Trust strengthens confidence in the decisions made by both supervisors and their subordinates.
Mutual Responsibility	Each member of the organization bears full responsibility for its functioning. Every participant in the organization is obligated to take the necessary actions to ensure the smooth operation of the organization, regardless of their personal interests or roles. At the same time, each individual is accountable for fulfilling their own duties.
Transparency	Transparency means access to complete information about the organization's operations. It facilitates insight into the organization, its successes, and its mistakes. Transparency within the organization prevents undesirable intentions and enables quicker responses in crisis situations.
Decision-Making	Trust, responsibility, and transparency lead to the belief that employees are capable of making sound decisions based on their knowledge, skills, and personal experiences. Additionally, it is assumed that group decision-making is more effective than decisions made by individuals, which is why decisions made through a consultative process are preferred.
Sense of Safety	The organization provides an emotionally and spiritually safe environment where employees can fully be themselves. Mutual respect is a priority, and openness to employees' emotions and needs is actively promoted.
Learning	Every difficulty becomes an opportunity for learning and gaining insights. The organization embraces failures and mistakes as a natural part of the learning process. Through a culture of feedback and mutual respect, employees support each other in developing and improving their skills.

Source: Own elaboration based on Laloux, 2014, pp. 275-278.

The values presented, along with their associated attitudes, create a synergy that is an inseparable part of the process of implementing the Teal organizational model. Each of these elements—from trust to continuous learning—defines the essence of a Teal organization, one that prioritizes the values of the group rather than selected individuals or a rigid, top-down hierarchy (Robertson, 2016). A lack of autonomy, trust, and responsibility can lead to an absence of psychological safety (Edmondson, 2018), which can cause problems in daily communication among employees, hinder knowledge exchange, and discourage seeking support from supervisors.

In the Teal model, the organization becomes a space full of energy for its employees. This potential ceases to be the property or co-ownership of stakeholders. Managers are tasked with uncovering the creative potential of the organization to support it in fulfilling its mission, which is connected to its unique self-management, wholeness, and evolutionary purpose (Laloux, 2014, p. 221).

#### 4. Research Methodology

The case study method will be used in the research process. The aim of the research was to describe a typical case of the implementation of the Teal organizational model in the company under study. To achieve this objective, the following were described:

- the process of identifying values and attitudes characteristic of the Teal organizational model,
- a typical case of a company implementing the Teal organizational model,
- actions taken to shape the desired attitudes and values characteristic of the Teal organizational model in the company under study,
- the benefits resulting from the implemented actions.

In the research process, the techniques of direct observation, surveys, interviews, and organizational documentation were used. The starting points for the implementation of Teal organizational values and attitudes were the values and attitudes presented in Table 1, namely: trust, responsibility, transparency, decision-making, safety, and continuous learning.

An evolutionary approach to organizational change was applied during the implementation of the Teal model, assuming that it would focus the actions of the organization's participants around the values and attitudes desired by the organization.

The company under study is an internet marketing agency that exclusively serves the Polish market. The services provided by the agency were aimed at serving clients from the SME sector. These services mainly included: website SEO, creating paid marketing campaigns, and building websites and online stores. The agency consisted of four departments: marketing, finance, HR, and sales.

The primary rationale for the decision to attempt the implementation of the Teal organization by focusing the actions of the organization's participants around the values and attitudes desired by the organization was the management's decision. This decision was made in response to emerging issues, such as unsatisfactory sales results and increasing employee turnover, especially in the sales department. The sales department was selected for the implementation of the Teal organization. Among the employees of this department, 10 people were chosen for the experimental team (representing 50% of the sales department's workforce), who would participate in the implementation of the Teal organization by taking actions that contribute to reinforcing the values and attitudes desired by the agency. The duration of the experiment was set at 6 months. The identification of the most important values and attitudes of the Teal organization, along with the identification of gaps in these values and attitudes within the sales department, allowed actions to be taken that contributed to transforming the existing organization into a Teal organization.



## **5. Implementation of Teal Organizational Values and Attitudes in the Organization – Research Results**

In the research process, the actions undertaken in the studied company contributing to the implementation of values and attitudes characteristic of a Teal organization were characterized. These actions included:

### **1. Trust**

An expression of trust was granting employees autonomy in carrying out their tasks. Brock defines autonomy as the degree to which a person can make significant decisions without the approval of others. Autonomy in an organization begins at the individual level, where a person has top-down permission to make decisions — from the company's management and/or its managers — and then this autonomy passes to individual members of the organization, provided that the organization and its authorities approve of individual autonomy (Brock, 2003). An employee who is granted the right to make decisions becomes more inclined to do so, and therefore engages more effectively in completing the tasks assigned (Wzorek, 2019).

In the process of implementing the Teal organization, the selected group of salespeople involved in the study was granted full autonomy in their decision-making. As a result, they no longer needed to consult with their supervisors before making changes. During the first week, an increased willingness and motivation to perform their duties was observed among the salespeople. It is important to note that these were salespeople with several years of experience in the internet marketing industry and several years of tenure in the organization. The granting of autonomy was based on mutual trust. Management trusted their subordinates in their decision-making, and the subordinates trusted their supervisors in terms of the complete removal of control during the attempt to implement the Teal organizational model. Supervisory oversight was limited to reviewing a weekly report prepared by the salespeople involved in the study. In this report, the salespeople provided detailed descriptions of their workweek, the number of tasks completed, and predictions of their expected sales results for the upcoming week and the full month of collaboration.

### **2. Mutual responsibility**

The development of awareness in employees' decision-making within the organization is closely linked to the growth of organizational responsibility. Awareness development is a construct used to describe the changes that occur in individuals as they pass through different stages of life (Kormanik, 2002). In relation to organizational life, awareness development is the process in which individuals or teams within an organization experience changes resulting from transitioning through various stages of business development, such as structural, technological, or cultural changes. These changes affect how individuals think, make decisions, and adapt to new market and organizational conditions (Morrison, Phelps, 1999).

Employees, as well as their supervisors, under the influence of the development of organizational awareness, show a greater tendency to complete the tasks assigned to them (Galat, 2018, pp. 35-46). On the other hand, employees have a sense of responsibility and a greater ability to assess whether they can successfully complete a given task or project. As awareness develops within the organization, employees naturally become more assertive when they foresee potential failure. Additionally, collective (organizational-level) responsibility transforms into the achievement of goals. In order to foster greater responsibility among the sales department employees involved in the study, they were granted autonomy in the decision-making process across all of their duties. Responsible employees are those who can rely on their colleagues and collaborate effectively with their supervisors (Wzorek, 2019). Thus, the implementation of the Teal organizational model, where responsibility is a core value, translates into employees taking the necessary actions for the efficient operation of the organization.

### **3. Transparency**

A transparent organization limits the occurrence of conflicts within the organization and reduces their spread (Wasiluk, 2022, pp. 647-658). As M. Wzorek (2019) rightly points out, the implementation of the Teal organizational model primarily involves ensuring its key value, which is transparency. In the analyzed company, the implementation of the value of transparency primarily took place during daily meetings among the employees involved in the study. The sales department employees participated in these meetings, which were held in 10-minute slots. Previously, such meetings did not take place in the organization. During the meetings, employees addressed the most important issues concerning their work or performance levels. The meetings featured presentations on:

- sales results and plans,
- strengths and weaknesses of collaboration with clients,
- selected techniques that helped employees achieve specific goals,
- barriers that hindered achieving the expected results.

The sales department manager did not participate in the meetings; only the salespeople involved in the study attended. The meetings were characterized by an open and informal exchange of information. Their purpose was to share experiences among employees and improve the execution of sales plans.

### **4. Decision-Making**

In the analyzed case, the sales department employees were given full freedom in the decision-making process regarding all aspects of client collaboration. These decisions included:

- changes to the contract terms,
- modifications to the offer conditions,
- amendments to the contract conditions,
- granting a higher discount than 10% off the final contract price,

- non-standard conditions that the client considered essential for cooperation, taking into account: choice of communication channel, communication outside of working hours, and the possibility of meeting with the client outside the company's premises.

Previously, the above-mentioned decisions had to be approved by a supervisor, which made the process tedious, time-consuming, and greatly limited the flexibility of the salespeople's work. This, in turn, reduced their motivation to work and resulted in a lack of engagement in achieving the desired outcomes for the organization.

### **5. Sense of Safety**

Teal organizations based on holarchy provide a safe environment where employees can fully realize their potential. Referring to Wilber's integral theory, holarchy is a broad morphogenetic field that creates conditions for the development and evolution of human potential (Wilber, 2020, pp. 22-25). The safety of the space is built on two key pillars: an open communication model and shared values.

In relation to the studied organization, safety was based on open and transparent communication, as well as collaboration grounded in equal and shared values. Each of the employees involved in the study could count on transparency and openness. Ideas were not criticized, and questions were not overlooked. Through the application of transparency, employees admitted that they felt more at ease, were more willing to discuss their goals, and were not afraid of unexpected criticism. Building a sense of safety based on highly developed transparency and acceptance has a direct impact on the quality of employees' work and their sense of belonging to the organization or desire to leave it (Xiaoxing, 2021). According to the employees surveyed, the shared values made the pursuit of a common goal simpler and more tangible. Each of them felt a weakening of hierarchy and an equal status among all participants in the organization. This described sense of safety not only helped them build a strong sense of value within the organization but also improved their relationships with other team members. The final result was a regular increase in achieving planned goals.

Such a foundation allows employees to be authentic and open with each other. The surveyed sales department employees received full support during the implementation of the Teal model to realize themselves in their roles while feeling secure. In this case, building a sense of safety among employees was based on collaboration between supervisors and employees. Each sales department employee felt that they were an active part of the organization, rather than merely executing commands. The sense of safety and belonging directly translated into increased sales results.

### **6. Learning**

The effect of the regular meetings was the generation of ideas that emerged during discussions. Employees were free to implement these ideas into their daily work plans. The solutions implemented were not evaluated by their supervisor, only their outcomes. If a task proved beneficial, the supervisor would ask for details about the solution, how it was implemented, and the time it took. Likewise, if a task ended in failure, the supervisor would

request a presentation of the task and an explanation of the reasons the employee believed the solution did not succeed.

One of the implemented solutions was dividing work into time blocks. Employees divided the workday into three blocks, including:

- Team meeting and analysis of the upcoming day plan (1 hour).
- Time for making calls (3 hours).
- Time for correspondence with clients (3 hours), most often conducted via email or through another communicator (LinkedIn, WhatsApp, etc.).

Within a few weeks of implementing the described meetings, the attitude of the employees changed significantly; they became less prone to conflicts and more willing to collaborate with each other. The introduction of regular meetings and the change in employee attitudes resulted in a 20% increase in the total sales performance of the surveyed employees in the sales department over the six-month study period. After the testing phase of the Teal organization implementation process among the surveyed employees, a survey was conducted to answer the question: how do employees and their supervisors evaluate the change in the management model within their team? The conducted survey research demonstrated that the employees of the studied sales department are positively inclined toward changing the current management model to the Teal management model. This model was accepted by all employees surveyed. Among the perceived benefits of changing the organizational model, the following were highlighted:

- liberation from organizational hierarchy,
- execution of tasks according to a coherent value system,
- improvement of relationships with other team members,
- increased trust between employees and their supervisors,
- influence on employees' salary levels through greater agency in carrying out daily responsibilities in client relations.

The analysis of the actions taken by the studied company leads to the conclusion that they contributed to raising employees' awareness of the principles of the Teal organization and anchoring its values and assumptions within the organization. The authors of the article are aware that the implementation of the Teal organization is an ongoing process. It requires undertaking many actions that will contribute to shaping and reinforcing the values and attitudes characteristic of this organizational model. In addition to the actions taken by the studied company, these efforts must also include: a rational employment policy, the development of employee career paths, fostering an appropriate organizational culture, and modifying motivational systems to ensure alignment between employees' traits and expectations and the requirements of a Teal workplace.

## 6. Conclusion

The Teal management model can evoke extreme emotions in today's highly competitive business environment, especially in the field of internet marketing. It resembles a realm of consciousness and spirituality more than scientifically validated principles of contemporary management concepts. Its foundations may seem abstract, and its assumptions almost naïve when confronted with the hard market realities that modern companies face. Nevertheless, it is important to consider that businesses that have adopted or are in the process of implementing principles referred to as Teal are grounded in the rational belief that individuals operate most effectively in an atmosphere of transparency, freedom, trust, partnership, and collaboration (Laloux, 2014). These same companies are transforming current workplaces into environments conducive to creative realization, replacing competition with collaboration, abandoning traditional hierarchical management in favor of self-organization, and shifting from hierarchical structures to process-oriented ones based on interpersonal relationships (Wzorek, 2019). To achieve success in fulfilling the organization's mission and goals, all its members—employees, leaders, and owners—must change their perspectives on interpersonal relationships and their approach to work. They should learn to express their needs without the risk of rejection, build mutual trust, and take responsibility for both themselves and their tasks.

Considering the research conducted on the sales department described above, it can be assumed that the Teal organizational model will find its place in the realm of contemporary management. The premise for this assumption is the irresistible desire to work in an environment that nurtures human values; the contributions of employees, their engagement, a culture of feedback, and unconditional trust. These aspirations can directly stimulate innovation in the area of internet marketing and lead to relational and financial success for Teal organizations. More and more companies are adopting the Teal management model, and many organizations are introducing its elements into their operations. The biggest obstacle to implementing the Teal management model often turns out to be a lack of trust in a concept that is based on empowering employees and relinquishing traditional control over work processes and decision-making by team leaders (Tracy, 2014, pp. 62-64). Doubts may arise regarding the success of a project based on relationships, transparency in collaboration, and trust in management and colleagues. An additional challenge may be the issue of employees accepting full responsibility for the tasks they carry out. Nevertheless, the Teal model offers the possibility of greater employee engagement, significantly higher productivity, and consistent achievement of set goals. The Teal model bases its values on self-organizing teams, which is also a response to their self-organization and responsibility. However, as the conducted research indicates, employees in the field of internet marketing are more inclined—provided the conditions allow it—to take greater risks and have more autonomy than to follow established paths that hinder their professional and financial growth.

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## HUMAN-ROBOT COLLABORATION IN THE WORKPLACE PERCEPTION OF TECHNICAL AND SOCIAL SCIENCE STUDENTS IN POLAND

Justyna LITWINEK

Maria Curie-Skłodowska University in Lublin; justyna.litwinek@mail.umcs.pl, ORCID: 0009-0008-2789-0716

**Purpose:** The article investigates the perception of human-robot collaboration (HRC) in the workplace among students with diverse fields of study (social and technical). The primary objective was to identify differences in attitudes, interests, and emotional responses towards robots, providing insights into their acceptance and future integration into professional environments.

**Design/methodology/approach:** The research employed a survey-based approach, collecting data from 130 students: 69 from social sciences and 61 from technical fields using the CAWI technique. It focused on analysing students' interest in technology and science fiction, their associations and emotions linked to robots, preferences for robot appearance, and opinions on robot functionality in various contexts.

**Findings:** The results show some statistically significant differences in the perception of robots and cooperation with robots in the workplace, depending on the field of study.

**Research limitations/implications:** The study's limitations include its reliance on a survey method, small sample size, and differences in gender participation across the study's fields.

**Practical implications:** The results suggest that the perceptions of both robots and collaboration in the workplace differ across the groups analysed. This indicates the need for tailored workplace strategies to reduce discomfort and enhance collaboration with robots.

**Social implications:** The research highlights the importance of functional and user-friendly designs for robot designers and the importance of preparing students for future HRC scenarios through theoretical and practical experiences.

**Originality/value:** This research sheds light on the connections between education, psychology, and robotics, delving into the constructs related to the perception and acceptance of robots in the workplace and contributing to a broader discourse on factors related to the acceptance and perception of technology by the generation entering the workforce.

**Keywords:** Human-Robot Collaboration (HRC), Human-Robot Interaction (HRI), robots, workplace robotics.

**Category of the paper:** Research paper.

## 1. Introduction

The rapid advancement of robotics and artificial intelligence (AI) has significantly transformed modern workplaces, intensifying interactions between humans and robots. According to the latest *World Robotics* report published by the International Federation of Robotics (IFR) in September 2024, collaborative robots accounted for 10% of robot installations, totalling 57,000 units in 2023 (IFR, 2024). This trend reflects the growing implementation of Industry 4.0 technologies, which pose organizational, technical, and social challenges (Wolniak, 2024). Addressing these challenges requires strategic planning, phased implementation, robust data management systems, comprehensive employee training, and a balanced integration of human and technological capabilities (Wolniak, Tomecki, 2024, p. 634). Recently, the concept of Industry 5.0 has gained prominence in academic and professional discourse, complementing Industry 4.0 by emphasizing the symbiotic relationship between humans and technology (Wieczorek, 2024). Central to this discourse is the concept of human-robot collaboration (HRC), which refers to synergistic partnerships where humans and robots work together toward shared objectives, leveraging human cognitive abilities alongside robotic precision and efficiency. HRC has the potential to enhance productivity, safety, and work quality, yet its effectiveness depends on both technological capabilities and human attitudes toward working with robots (Ruffaldi et al., 2023). Achieving seamless human-robot collaboration requires improved team performance and fostering positive perceptions of both the robots and the collaborative process (Noormohammadi-Asl et al., 2025).

This paper aims to explore students' perceptions of robots and their potential collaboration in the workplace, focusing on social and technical disciplines. Specifically, it seeks to identify differences in attitudes, interests, and emotional reactions toward robots, offering insights into their acceptance and potential integration into professional environments. The study's research question examines whether students' field of study significantly influences their responses. The selected research group—students from social and technical disciplines—provides a compelling sample due to their contrasting educational and professional perspectives. While technical students typically possess greater familiarity with technology, potentially fostering openness and trust in robotics, social students may emphasize ethical and societal implications, offering valuable insights into the broader impacts of robotics on interpersonal relationships.

## 2. Human-robot interaction and collaboration in workplace

The integration of robots into the workplace has advanced significantly in recent years, mainly due to technological advances in robotics and artificial intelligence (AI). Human-robot interaction (HRI) focuses on communication and collaboration between humans and robots to improve functionality and user experience. Human-robot collaboration is a specific type of interaction in which tasks outside a shared workspace are performed jointly with direct physical contact and context awareness, distinguishing it from coexistence and collaboration (Jahanmahin et al., 2022). Collaborative robots, or cobots, are designed to work alongside humans in a variety of tasks, from manufacturing to healthcare (Colgate et al., 1996; Villani et al., 2018). Studies have shown that effective HRI depends on factors such as trust, perceived usefulness, and the ability of robots to adapt to human needs. Hancock et al. (2011) conducted a meta-analysis highlighting trust as a critical factor in successful collaboration. They found that the predictability and transparency of robot actions are crucial for building trust and increasing productivity and safety in collaborative tasks. Robots as intermediaries in work processes can also represent a new dimension of differentiation of labour resources. This leads to a new area of human and humanoid resource management. A new organizational culture is emerging to which robots belong (Rakowska, 2022a). In manufacturing, collaborative robots are widely used to increase efficiency and reduce the physical burden on workers. For example, robots designed by Universal Robots have been integrated into automotive assembly lines, where they perform repetitive tasks, while humans focus on quality control and complex decision-making (Weiss et al., 2021). This division of labour illustrates the potential of symbiotic human-robot collaboration. Healthcare is another field in which HRI plays a key role. Robots like the da Vinci Surgical System have revolutionized minimally invasive surgery, providing greater precision and reducing surgeon fatigue (Calo et al., 2011). Furthermore, robots such as PARO, a therapeutic robot designed to assist in the care of the elderly, have demonstrated the importance of emotional interaction in healthcare settings (Wada et al., 2007).

Despite these advances, challenges remain. One key issue is the “valley of anxiety” phenomenon, where robots that are too human cause discomfort among users (Mori et al., 2012). Appel et al. (2020) emphasized that robots should balance functionality and appearance to ensure acceptance in the workplace. This is because employees are one of the key factors for the successful implementation of robots in organizations. This emphasizes the importance of understanding how the human characteristics of robots affect employee interaction and acceptance (Rakowska, 2022b). In addition, ethical concerns such as job replacement and data privacy remain significant barriers to widespread adoption (Brynjolfsson, McAfee, 2014). Future developments in HRI aim to address these challenges by focusing on adaptive algorithms, intuitive interfaces, and user-centred designs. Villani et al. (2018) argue that

interdisciplinary research combining engineering, psychology, and ergonomics is essential to creating robots that integrate seamlessly into various work environments.

### 3. Materials and Methods

This study aimed to identify students' perceptions of robots and their potential collaboration with robots in the workplace. The central research question was: To what extent does the field of study influence perceptions of robots and the willingness to collaborate with them in professional settings? To address this question and achieve the research objectives, a quantitative study was conducted in March and April 2023 using the Computer-Assisted Web Interviewing (CAWI) technique.

The online survey involved 130 participants, consisting of 69 students from social science disciplines (e.g., logistics, management, economics, economic analysis, finance and accounting, and psychology) and 61 students from technical fields (e.g., automation, robotics, computer science, mechanical engineering, energy, mechatronics, transport, electronics, and telecommunications). Participants were recruited through targeted outreach to academic groups and segmented based on their fields of study, ensuring alignment with the study's objectives and assumptions. Participants received a link to the survey via email and university communication channels. The survey was anonymous, and informed consent was obtained electronically before participation. Respondents were assured that their data would be used solely for academic purposes and handled in compliance with ethical research standards.

The primary data collection instrument was a custom-designed online questionnaire based on a review of existing literature on perceptions of robots (Piçarra et al., 2016; Giger et al., 2017; Riek et al., 2011; Goetz et al., 2003; Wasilewska, Łupkowski, 2021) and the field of human-robot interaction (e.g. Koverola et al., 2022). The survey instrument consisted of 20 questions containing Likert-scale items ranging from 1 (strongly disagree) to 7 (strongly agree) and multiple-choice and open-ended questions to obtain qualitative insights into emotions and associations with robots. In the structure of the research tool, we can distinguish the following areas:

- perceptions of robots: associations (e.g., "future", "technology", "helper"), emotions, interest in new technologies and the science fiction genre,
- interaction preferences: Questions on preferred robot designs (appearance) for different contexts, e.g., collaboration or customer service,
- attitudes toward workplace collaboration with robots: Assess trust, perceived usefulness, and discomfort in interacting with robots (physical contact, communication, joint tasks, and workspace sharing with the robot),
- sociodemographic information: gender, course and year of study, professional status.

Data analysis was conducted using statistical software- SPSS and Orange Data Mining. Descriptive statistics, such as means, medians, and standard deviations, were computed for Likert-scale items to summarize the data. Chi-square tests were applied to categorical data to assess the relationships between the study field and categorical responses. Mann-Whitney U tests were employed for ordinal data (Likert-scale items) to compare responses between the two student groups. A significance threshold of  $p < 0.05$  was used to determine statistical significance differences between groups. The results were checked for reliability and validity to ensure robustness.

#### 4. Results

The sample included 130 participants, with 69 students from social sciences and 61 from technical sciences (Table 1). Gender distribution varied, with a higher proportion of females in the social sciences group (81.13%) compared to the technical sciences group (18.87%), which had a more balanced gender representation. The majority of participants were undergraduate students, and a smaller subset was employed part-time or full-time.

**Table 1.**  
*Sociodemographic data of the respondents*

Characteristic	Answers	N	%
Gender	Female	53	40.80%
	Male	76	58.50%
	I do not want to answer	1	0.80%
Total		130	100.00%
Level of study	First degree	77	59.20%
	Second degree	53	40.80%
Total		130	100.00%
Field of study	Social field (e.g. Logistics, Management, Economics, Business analysis, Finance and Accounting)	69	53.10%
	Technical field (e.g. Automation, Robotics, Computer science, Mechanics and Machine construction, Energy, Mechatronics, Transport, Electronics and Telecommunications)	61	46.90%
Total		130	100.00%
Professional status	Studying	75	57.70%
	Studying and working	55	42.30%
Total		130	100.00%

Source: own elaboration based on conducted research.

Moving to the part of the research results related to robot perception, the interest in new technologies and the science fiction genre was examined, as well as emotions and associations with the word robot. Students from technical sciences reported a significantly higher interest in new technologies (mean = 5.90) compared to their social science counterparts (mean = 5.09), with a Mann-Whitney U test confirming statistical significance ( $U = 1228$ ,  $p < .001$ ). Similarly,

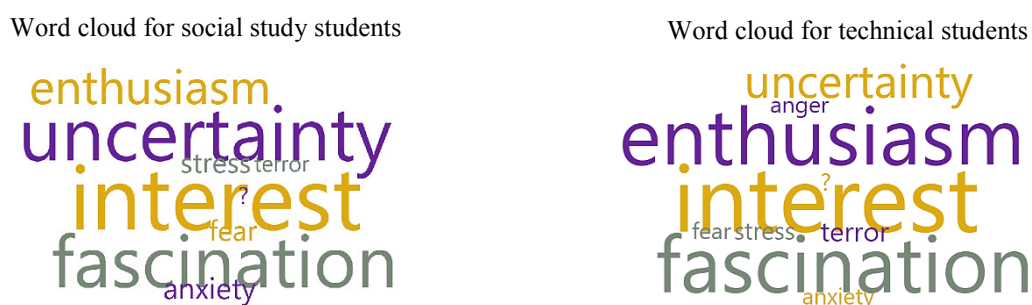
interest in science fiction was higher among technical students (mean = 5.08) than social science students (mean = 4.32), also statistically significant ( $U = 1560.5$ ,  $p = .01$ ). When analysing associations with the word "robot," students collectively provided 328 associations. The most frequently mentioned association was technology, which appeared 102 times (social sciences students: 56, technical students: 46). Future was indicated 66 times (social sciences students: 33, technical students: 33), while new opportunities was mentioned 55 times (social sciences students: 26, technical students: 29). Social sciences students significantly more often associated robots with toys ( $\chi^2 = 4.485$ ,  $p = .034$ ) and household help ( $\chi^2 = 4.617$ ,  $p = .032$ ) compared to technical students. All associations from social sciences students (right) and technical students (left) were visualized as word clouds (Figure 1), where the size of each word represents the frequency of the given response.



**Figure 1.** Word clouds of the associated with robots.

Source: own elaboration based on conducted research.

Among social sciences students, 110 instances of positive emotions were recorded (including enthusiasm, fascination, and interest), along with 63 instances of negative emotions (including anxiety, uncertainty, fear, terror, stress, and anger). Technical students reported more than 2.3 times fewer negative emotions compared to social sciences students and indicated 20 more instances of positive emotions, despite having fewer overall responses within this group. Statistical analysis revealed significant differences in emotional responses between groups (e.g., enthusiasm:  $\chi^2 = 20.43$ ,  $p < .001$ , fear:  $\chi^2 = 4.056$ ,  $p = .044$ , uncertainty:  $\chi^2 = 13.416$ ,  $p < .001$ ). All emotions were visualized as word clouds (Figure 2), where the size of each word represents the frequency of the given response.



**Figure 2.** Word clouds of the emotions with robots.

Source: own elaboration based on conducted research.

The next section of the results discusses aspects related to interaction preferences in the willingness to work and be operated by a robot focused on the robot design. To investigate robot appearance preferences, students were shown images of the following robots: „Carindinal” Amazon; „BellaBot” Pudu; “Moxi” Diligent Robots, “Atlas” Boston Dynamics; “Ameca” Engineered Arts; “Sophia” Hanson Robotics. The indicated robots differed in their construction and humanoidity. Both groups showed a preference for non-humanoid robots for workplace tasks. However, technical students were more open to humanoid robots with mechanical features (“Ameca” Engineered Arts), while social science students preferred designs that incorporated friendly or familiar aesthetics, such as screen-based faces („BellaBot” Pudu) ( $\chi^2 = 30.416$ ,  $p < .001$ ). The most favoured robot for interaction (as a client) was "BellaBot," likely influenced by its appearance and prior exposure in commercial settings. The most negative experiences and ratings in all contexts were obtained by the Hanson Robotics robot “Sophia”, which is a robot with a high level of humanoidness.

The last area of focus in the research findings involves attitudes toward workplace collaboration with robots. The focus was in particular on assess trust, perceived usefulness, and discomfort in interacting with robots (physical contact, communication, joint tasks, and workspace sharing with the robot). Social science students expressed greater discomfort with sharing a workspace or directly interacting with robots (mean discomfort = 3.84) compared to technical students (mean discomfort = 2.98). Similarly, social science students were more skeptical about robots replacing human jobs or contributing positively to workplace dynamics. This may result from a higher sense of human irreplaceability - the perception of the uniqueness of human nature. Mann-Whitney U test confirmed significant associations between field of study and responses to key survey items, including

- discomfort with direct robot interaction: direct cooperation with the robot (physical contact, communication) ( $U = 1271.5$ ,  $p < .001$ ) and sharing workspace with a robot (safety, psychological comfort) ( $U = 1518.5$ ,  $p < .006$ ),
- positive perception of robot utility in handling routine tasks ( $U = 1441.5$ ,  $p < .001$ ).

In summary, the findings presented in this section indicate that interests and the chosen field of study may be an important factor in differentiating perception of robots.

## 5. Discussion

The results of this study provide important insights into how technical and social science students perceive human-robot collaboration (HRC) in the workplace. The observed differences in attitudes, interests and emotional reactions towards robots highlight the role of education in shaping perceptions of robotic technology. Looking at the literature, it is clear that these results are not inconsistent with the observations of researchers working on human-robot interactions

and perceptions of robots, including various studies conducted, for example, by Giger (Giger et al., 2017a, 2017b), Nomura (Nomura et al., 2006; Nomura, 2014), Piçarra (Piçarra et al., 2016a; 2016b), Groom (Groom et al., 2009) or Mori, MacDorman, Kageki (Mori, MacDorman, Kageki, 2012).

Giger, Moura, Almeida, and Piçarra's research found that individuals with a greater interest in science fiction tend to have more positive attitudes toward robots, likely due to their familiarity with depictions of robots and futuristic scenarios (Giger et al., 2017a; 2017b). This finding aligns with the results of the present study, where students who showed a significantly higher interest in the science fiction genre and technological development—particularly engineering students—expressed more positive attitudes toward robots and collaboration with them. In addition, empirical research suggests that direct (but also virtual) exposure to robots can significantly shape individuals' attitudes toward human-robot interactions. Nomura, Suzuki, Kanda, Kato's (2006) and later Nomura's (2014) study found that individuals who had previously observed real robots in action or through media showed less negativity toward interactions with them than individuals who had not had such experiences. The specificity of technical fields of study may increase the opportunities for direct exposure and interaction with robots during studies, compared to social students, which may also influence the level of acceptance and the formation of a more positive attitude towards robots. Research by Piçarra et al. (2016a; 2016b) indicated that associations and pre-existing images of robots influence the perception of their functionality and role in different contexts. The associations (images) obtained in the study differed by the field of study - technical students indicated an industrial and technological context, while social students indicated an everyday context (home help). This was reflected in the indicated emotions and perceived functionality of the robots.

Groom et al.'s (2009) study found that more anthropomorphic robots received more positive ratings overall compared to purely functional ones. However, excessive human resemblance can lead to discomfort, as described in the "valley of anxiety" phenomenon (Mori, MacDorman, Kageki, 2012). This is consistent with results obtained with Polish students, in which participants showed a dislike for highly human-like robots, while preferring designs that strike a balance between familiarity and mechanical aesthetics.

## 6. Conclusion

The key findings revealed that technical students showed greater interest in new technologies and science fiction, along with lower discomfort levels regarding direct collaboration with robots. Both groups preferred robots with moderate humanoid features, avoiding highly human-like designs. Social science students viewed robots primarily as tools



to handle routine tasks, whereas technical students emphasized their functional utility. Emotional responses differed significantly, with technical students expressing more positive emotions. Both groups demonstrated limited willingness to engage with highly humanoid robots, favoring simpler designs with suggestive facial features like screens.

The scope of this study does not fully encompass all issues related to the factors influencing perceptions and attitudes toward robots, nor does it address the entire concept of Human-Robot Interaction (HRI) and Human-Robot Collaboration (HRC). Future research could benefit from incorporating additional variables for analysis, such as age, nationality, different fields of study, or aspects related to the perception of human uniqueness. To this end, qualitative research methods, such as interviews or individual case studies, as well as experiments involving direct interaction with robots, could be employed to provide a more in-depth characterization of attitudes toward these issues. The study's findings provide valuable insights for management professionals, robot designers, and academic educators. They demonstrate that differing perceptions of robots and potential collaboration require appropriate introduction and adaptation of young employees, thoughtful robot design (e.g., appearance that reduces feelings of discomfort), and adequate theoretical preparation (grounded in academic knowledge) concerning the capabilities and interactions with robots.

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## CROWDINVESTING AS A MODERN FORM OF CROWD INVOLVEMENT (PRELIMINARY RESEARCH RESULTS)

Miłosz ŁUCZAK<sup>1\*</sup>, Piotr J. SENKUS<sup>2</sup>

<sup>1</sup> Poznań University of Economics and Business, Poland; milosz.luczak@ue.poznan.pl,  
ORCID: 0000-0002-3209-9645

<sup>2</sup> University for Peace, Santa Ana, Costa Rica, piotr.senkus@gmail.com, ORCID: 0000-0001-9033-6437

\* Correspondence author

**Purpose:** Presented study examines the evolution of crowdinvesting awareness among Polish university students. It compares survey results from 2020 and 2023. The aim of the research is to evaluate changes in understanding, participation, and attitudes toward various forms of crowdfunding.

**Design/methodology/approach:** The study consists of a comparative analysis of two surveys conducted among second-year undergraduate economics students. The 2023 survey replicates the methodology of the 2020 study, although a simple research framework was structured around a three-stage model of crowd involvement that highlights: awareness, interest, and engagement. Google Forms was used to collect data on crowdfunding awareness, interest, and engagement.

**Findings:** The results reveal a significant decline in crowdfunding awareness, with the percentage of students who had never heard of equity crowdfunding increasing from 17% in 2020 to 50,7% in 2023. However, engagement patterns show stability, with approximately 35% of respondents participating in crowdfunding campaigns. Notably, while donation-based crowdfunding remains dominant, its share decreased from 62,9% to 50,7%, with slight increases in investment-oriented forms.

**Research limitations/implications:** The main study's limitation is a relatively small sample size. It also focuses only on economics students, which may not represent the broader population. The comparison between different groups of respondents presents methodological constraints. Analysis of the evolution of the same group responses would be more appropriate.

**Practical implications:** The findings suggest a need for enhanced educational initiatives and improved communication strategies in the crowdfunding sector. It applies both companies and platforms seeking to attract younger investors.

**Social implications:** The research highlights potential gaps in understanding and acknowledging of opportunities that arise for future entrepreneurs and investors through better awareness of alternative financing methods.

**Originality/value:** This study provides comparative analyses of how crowdfunding awareness changed among Polish students. That offers insights into patterns of financial engagement of future investors.

**Keywords:** crowdfunding, crowd engagement, alternative finance.

**Category of the paper:** research paper.

## 1. Background and problem statement

Crowdfunding, also known as equity crowdfunding or crowdfunding for investments, is one of the newest financing methods that allows a large number of individuals to invest smaller amounts of money in a business, project, or venture in exchange for equity or shares in the company (see Vulkan, Åstebro, Sierra, 2016; Mochkabadi, Volkmann, 2020; Coakley, Lazos, 2021). It leverages the importance of online platforms in connecting entrepreneurs with a diverse group of investors (see Lukkarinen, Teich, Wallenius, Wallenius, 2016; Vismara, 2016). This approach democratizes investment opportunities, making it easier for entrepreneurs to access funding and for investors to support exciting.

While existing research has extensively documented the mechanisms and success factors of crowdfunding platforms (see Ahlers, Cumming, Günther, Schweizer, 2015), there remains a significant gap in understanding how awareness and engagement with crowdfunding evolve over time, particularly among younger potential investors. This gap is especially noteworthy in emerging markets like Poland, where the crowdfunding ecosystem is still developing. Previous studies have primarily focused on static measurements of crowdfunding awareness, leaving the temporal dynamics of market development and public understanding largely unexplored.

Crowdfinancing, from the crowd's perspective, represents a dynamic shift in the way individuals engage with financial opportunities. However, the real meaning (benefits) of crowdfunding may result from the analysis of a broader concept – crowdfunding. In this sense, it empowers people to become active participants in shaping the success of innovative projects and initiatives that resonate with their values and interests (see Valanciene, Jegeleviciute, 2013; Hervé, Schwienbacher, 2019). Their motivations can range from the desire to be part of something groundbreaking to contributing to causes they passionately believe in. This democratized approach to finance not only diversifies investment portfolios but also fosters a sense of community and collaboration as contributors play a pivotal role in helping ideas come to life.

Understanding this shift requires examining how awareness and participation patterns change over time. While initial research by Gemra and Hościłowicz (2021) provided valuable baseline data on crowdfunding awareness among Polish students in 2020, there has been no subsequent analysis of how this awareness has evolved, particularly in light of rapid market developments and regulatory changes in the intervening years.

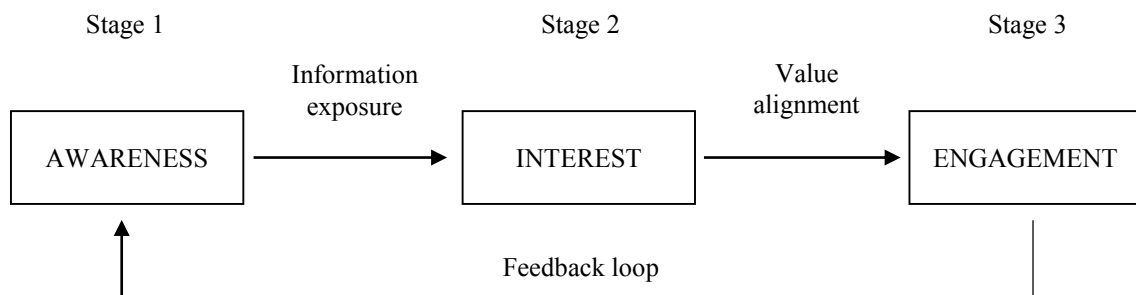
This research gap becomes particularly significant when considering that young, educated individuals, especially those studying economics and business, represent a crucial demographic for the future of crowdfunding markets. Their level of awareness, understanding, and willingness to participate in crowdfunding can serve as leading indicators for the sector's growth potential. Moreover, tracking changes in awareness and attitudes over time can provide

valuable insights for both platform operators and regulators in shaping the development of this emerging market.

The paper addresses this gap by conducting a comparative analysis of crowdfunding awareness and engagement between 2020 and 2023, focusing specifically on how understanding and attitudes toward crowdfunding have evolved among university students in Poland. This longitudinal perspective offers unique insights into the development of crowdfunding markets and the effectiveness of current market education and engagement strategies.

## 2. Objectives and methods

The theoretical framework of this study is built upon a three-stage model of crowd involvement in crowdfunding (Figure 1). This model conceptualizes the progression of individual participation through distinct yet interconnected stages: awareness, interest, and engagement.



**Figure 1.** Link between awareness, interest and engagement of the crowd in crowdfunding.

Source: own work.

The awareness stage represents the initial exposure to crowdfunding concepts and opportunities. During this phase, individuals encounter crowdfunding through various channels, including social media, news outlets, and word-of-mouth communication. This passive recognition phase is crucial as it forms the foundation for potential future involvement.

The interest stage marks a transition from passive awareness to active curiosity. At this point, individuals begin to explore crowdfunding platforms, understand mechanics, and evaluate potential benefits. This stage is characterized by information-seeking behavior and value assessment, where individuals align crowdfunding opportunities with their personal interests and investment goals.

The engagement stage represents active participation in the crowdfunding ecosystem. This involvement can take multiple forms, from financial contributions to project advocacy. Notably, engagement often creates a feedback loop, enhancing awareness and interest in new opportunities, thus making the model cyclical rather than purely linear.

The transition through these stages is not always linear, and some individuals may skip stages or oscillate between them. Moreover, the awareness, interest, and engagement in crowdfunding can be influenced by various factors, including the quality of campaigns they encounter, their personal passions, and the level of trust they have in the crowdfunding ecosystem.

This three-stage model serves as an analytical framework for understanding the evolution of crowdfunding participation and helps identify potential barriers or catalysts at each stage of involvement.

Understanding this three-stage model can help both companies and potential investors in the crowdfunding area to impact their approaches to effectively engage with and mobilize the crowd. One of the studies on crowdfunding awareness was conducted in 2020 by Gemra and Hościłowicz (2021) among undergraduate students at the SGH Warsaw School of Economics. The reference for that analysis was research conducted by a German portal crowdfunding.de under the name „Crowdfunding Barometer” (Harms, 2018). In response to the postulated need for further education in the area of crowdfunding and the need for further research, a similar study was undertaken in late 2023 among 2nd year undergraduate students at the Poznań University of Economics and Business. Similarly to the studies from 2020, the Google Forms tool was used to collect answers to questions related to awareness, interest and engagement in crowdfunding. The statistical analysis followed a two-stage approach. First, descriptive statistics were calculated to summarize the survey responses, including frequency distributions and percentages for all categorical variables. Second, a comparative analysis was performed to examine differences between the 2020 and 2023 survey results. So far, 71 completed questionnaires have been received. Although this might be a significant limitation, authors decided to continue the study. The statistical analysis followed a two-stage approach. First, descriptive statistics were calculated to summarize the survey responses, including frequency distributions and percentages for all categorical variables. Second, a comparative analysis was performed to examine differences between the 2020 and 2023 survey results.

The aim, was to check the answers to the set of similar questions after 3 years and how the results had changed. The authors acknowledge the issues arising from comparing the responses of two distinct groups of respondents. Considering that both groups comprised second-year students in economics, the authors opted to validate the findings.



### 3. Preliminary research results

The analysis of the three stages of the model presented above was made directly by asking respondents direct questions. The first question concerned knowledge of the concept of crowdfunding. A comparison of the results of the current study with the results previously obtained by Gemra and Hościłowicz (2021) is presented in Table 1.

**Table 1.**

*Have you ever heard of the concept of equity crowdfunding?*

Possible options	2023	2020
Yes, I have heard and understand this concept	14.1%	45%
Yes, I've heard of it, but I don't know the specific definition of this term	35.2%	38%
No, I've never heard of this concept	50.7%	17%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

The analysis of the first 71 responses indicates that 14% of respondents have encountered the concept of crowdfunding and understand the concept, 35% have heard of it, while over half of the respondents have not encountered it before. It is surprising to compare the results with the study from 3 years ago, when the results for the two extreme groups were almost opposite. Only those who have heard of it but do not fully understand it constitute nearly 40% of respondents. This suggests several concerning trends in financial education and market development. Despite growing global popularity of crowdfunding platforms, observed decrease may indicate a potential gap in economic education failing to follow evolving financial markets, limited effectiveness of crowdfunding platforms' marketing strategies or possible shift in students' attention toward other emerging financial instruments (e.g., cryptocurrencies). Moreover, the increase in the number of respondents who have never heard of crowdfunding (from 17% to 50.7%) stays in opposition to the expectations of the "digital age". The paradoxical finding that willingness to participate in crowdfunding has increased, suggesting that while general awareness has decreased, those who do understand the concept see greater value in it.

**Table 2.**

*Have you ever managed to support a crowdfunding project financially (not necessarily in the form of equity crowdfunding)?*

Possible options	2023	2020
Yes – 1 time	8.4%	13%
Yes – more than 1 time	26.8%	21%
No	64.8%	66%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

The second question concerned current involvement in crowdfunding campaigns (not necessarily equity crowdfunding). The results presented in Table 2 indicate a similar proportion of respondents who participated in such actions (approx. 35%) to others (approx. 65%) in the study from 2020 and 2023. It is worth noting that the number of answers

for repeated participation in such actions increased. Thus, further investigations should concern the identification of factors causing the willingness to participate in crowdfunding projects again (the same or different ones).

**Table 3.**

*In what form did you manage to get involved in the crowdfunding project?*

Possible options	2023	2020
Crowdfunding based on pre-sales	28.2%	31%
Debt crowdfunding	5.6%	0%
Equity crowdfunding	18.3%	11.1%
Reward-based crowdfunding	16.9%	16.6%
Donation crowdfunding	50.7%	62.9%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

Analysis of the forms in which respondents engage in crowdfunding (see Table 3) still reveals donations as the most numerous group, although their share has dropped from almost 63% to 50,7%. This may be related to strong media promotion, especially in social media. It is these actions that students may hear about most often. Crowdfunding based on pre-sales also ranks second (approximately 30%). This type most likely reflects those interested in a given offer, waiting for the product or service to appear. Among the remaining forms, a slight increase in interest in crowdfunding from an investment perspective can be observed, however, the indicated results may result from the lack of appropriate promotion.

The decrease in donation-based crowdfunding compared to increases in equity (11,1% to 18,3%) and debt (0% to 5,6%) crowdfunding suggests a sophistication in user behavior. This shift from philanthropic to investment-oriented participation indicates that while fewer students may be aware of crowdfunding, those who do participate are engaging in more complex forms of crowd-based financing, previously non-existent in the 2020 study.

**Table 4.**

*Which equity crowdfunding platforms in Poland have you heard about?*

Possible options	2023	2020
Crowdway	5.6%	7.7%
CrowdConnect (INC Brokerage House Platform)	2.8%	6%
Wspolnicy.pl	7%	9.5%
Beesfund	1.4%	28.6%
I haven't heard of any of the platforms mentioned	84.5%	63.7%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

The most interesting results are the awareness of the existence of equity crowdfunding platforms. Data for the Polish market are presented in Table 4. It turns out that awareness of their existence decreased within 3 years, 84,5% of respondents “haven't heard of any of the platforms mentioned”. Only a few respondents indicate knowledge of presence of individual platforms. Similar results were obtained for similar platforms operating around the world (see Table 5), the percentage of people who “had not heard of any of them” increased from 71% to 83%.

**Table 5.***Which equity crowdfunding platforms in the world have you heard about?*

Possible options	2023	2020
AngelLetter	2.8%	-
CircleUp	5.6%	
Fundable	9.9%	
Seedrs	1.4%	
Crowdcube	1.4%	
Companisto	1.4%	
None of the above	83.1%	71%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

Currently, slightly less than 9% of respondents know whether crowdfunding is subject to any regulations. This is a decrease compared to previous studies by almost two thirds. The most important observation is that as many as 91.5% of respondents admit that they “do not know it” (see Table 6). This result corresponds to previous data regarding the understanding of the concept of crowdfunding in general.

The declining awareness of crowdfunding platforms, both domestic and international (from 36,3% to 15,5% for Polish platforms and from 29% to 16,9% for international platforms), reveals a concerning fragmentation in the crowdfunding market. Several reasons may explain this trend. First, it suggests that despite increased digitalization during the post-pandemic period, crowdfunding platforms have struggled to maintain their visibility. Second, the sharp decline in awareness of Beesfund (from 28,6% to 1,4%) might indicate problems with platform marketing strategies.

**Table 6.***Is the equity crowdfunding market in Poland a legally regulated market?*

Possible options	2023	2020
Yes	8.5%	19%
No	0%	9%
I don't know	91.5%	72%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

A positive change in answers can be seen in relation to the question regarding the willingness to engage in co-investment in projects that interest respondents. The results are presented in Table 7. The number of people who categorically do not intend to participate in such campaigns decreased from 15% to 7%. In the current study, over 56% of respondents gave an affirmative answer, and 36% indicated that they “had not decided yet”. Compared to the decreasing awareness of what crowdfunding is, the results are promising.

**Table 7.**

*Imagine that you have found a project or undertaking that interests you and is related to your passion. Its organizers initiate a capital raising campaign in the form of an equity crowdfunding campaign. Would you be ready to take part in such an action?*

Possible options	2023	2020
Yes	56.3%	84.9%
I don't know	36.6%	-
No	7%	15.1%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

The answer to the question about the size of potential involvement from future investors has changed slightly (see Table 8). The survey reveals that most respondents tend to invest smaller sums than the previous survey showed. This result is probably related to the fact that the respondents are students who often have a limited budget. Nevertheless, these results indicate that the power of crowdfunding is manifested in the participation of many investors committing smaller sums.

**Table 8.**

*How much money would you be willing to spend on a single equity crowdfunding campaign?*

Possible options	2023	2020
Up to PLN 100	67.6%	52.8%
From PLN 100 to PLN 1,000	26.8%	37.7%
Over PLN 1,000	5.6%	9.4%

Source: own work based on Gemra, Hościłowicz, 2021, pp. 67-90.

The apparent paradox between decreased awareness and increased willingness to invest requires careful analysis. This trend, combined with the preference for smaller investment amounts (67,6% preferring investments up to PLN 100, up from 52,8%), may suggest a growing risk perception among potential young investors. The increased preference for smaller investments, despite higher inflation rates and general economic uncertainty during the study period, might indicate a more cautious and experimental approach to crowdfunding participation. This behavioral pattern aligns with modern portfolio theory's emphasis on diversification through smaller positions, especially in investment instruments.

## 4. Conclusion

The results presented in the preceding section should be viewed as an initial analysis based on the first 71 questionnaires collected in the ongoing study. While comparing these results to the data from the 2020 study does not reveal a substantial improvement, several trends are worth highlighting, and these trends are somewhat linked to the initial model employed in this research.

First and foremost, it is evident that students' awareness of crowdfunding and its various forms has not seen significant growth. This might be due to the possibility that a higher level of awareness already exists among other groups who have a predisposed interest in the subject. However, given that crowdfunding fundamentally involves "the crowd", one would expect a higher level of awareness across the board.

Secondly, the increase in interest, although present, is relatively modest. The presence of a substantial group of undecided respondents is intriguing. It could be associated with a lack of understanding regarding the benefits that stem from participating in crowdfunding. In this regard, effective communication and the encouragement of the right attitudes among potential backers become imperative.

Thirdly, there is a discernible rise in commitment, albeit a minor one. This increase may be attributed to certain gaps in project communication, particularly in the initial phases of creating awareness and generating interest among respondents.

These observations serve as a valuable guide for more comprehensive and in-depth research in the future. Moreover, they hold practical implications for entrepreneurs seeking to harness crowdfunding as a source of financing. The findings of this study highlight several implications for practitioners. Key recommendations include: developing targeted educational programs, implementing simplified onboarding processes with lower investment requirements for young investors, and focusing on clear risk communication strategies. These steps could help bridge the identified awareness gap with more informed participation in crowdfunding markets.

Future research should address current limitations and expand understanding of crowdfunding dynamics. Priority areas include: conducting longitudinal studies tracking investors engagement over time, investigating the psychological factors influencing the transition from awareness to active participation, and evaluating the effectiveness of various educational approaches in increasing crowdfunding literacy. Additionally, examining the relationship between traditional investment behavior and crowdfunding participation could provide valuable insights for market development.

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## FACTORS INFLUENCING APPLICATIONS PER SPOT IN HIGHER EDUCATION: EXAM RESULTS, AGE, AND STRATEGIES

Roman MACHUGA

Institute of Management and Quality Sciences, Faculty of Economic Sciences, University of Warmia and Mazury in Olsztyn; roman.machuga@uwm.edu.pl, ORCID: 0000-0002-5333-494X

**Purpose:** The study aims to identify key factors influencing the number of applications per spot in undergraduate and integrated master's programs, focusing on high school exam results, candidate age, and application strategies. The research provides insights to optimize university recruitment policies.

**Design/methodology/approach:** The research employs a quantitative approach based on statistical analysis of data from university admission records. Methods include descriptive statistics, linear regression models, and t-tests to examine the relationships between high school exam results, candidate age, and the number of applications per spot. The study also leverages Power BI tools to visualize and prioritize key factors influencing application trends.

**Findings:** The study revealed that mathematics and English high school exam results significantly influence the number of applications per spot, with mathematics having a stronger impact. Younger candidates (<20 years) demonstrated more active application strategies, submitting multiple applications, which increased the average number of applications per spot. The findings also emphasize the diversity in application trends based on candidate age and academic performance.

**Research limitations/implications:** The study is limited to data from a single university in Poland, which may affect the generalizability of the findings to other institutions or countries. Future research could expand the analysis to include multiple universities or international contexts. Additionally, incorporating qualitative methods could provide deeper insights into candidate motivations and application strategies.

**Practical implications:** The study primarily contributes to understanding application behaviors in university recruitment. While its direct practical implications are limited, findings could help universities refine recruitment strategies and support programs.

**Social implications:** The study primarily focuses on university recruitment processes, with limited direct societal impact. However, its findings could support policies promoting inclusivity in higher education.

**Originality/value:** The paper offers a novel perspective on university recruitment by integrating high school exam results, candidate age, and application strategies into a comprehensive analysis. It provides valuable insights for university administrators and policymakers aiming to optimize recruitment strategies and enhance inclusivity.

**Keywords:** higher education admissions, number of applications per spot, high school exam results, candidate application strategies, candidate age.

**Category of the paper:** Research paper.

## 1. Introduction

The popularity of higher education has significantly increased in recent decades, particularly in developed countries. The expansion of access to university education and the growing societal awareness of its economic and social benefits have led an increasing number of young people to pursue further education after high school. As a result, the recruitment process for higher education has become more competitive, and the number of applications per spot has become a key indicator of a university's popularity and selectivity. This phenomenon has gained prominence in the context of the growing number of applications to prestigious institutions, often viewed as gateways to better career and social opportunities.

In the field of higher education, particular attention is given to studies focusing on candidates' choices of study programs and their behaviors during the application process. Analyzing candidates' decisions provides deeper insight into the mechanisms shaping the popularity of specific academic fields, as well as the motivations behind these choices. These decisions are often correlated with expectations regarding future careers, salaries, and professional prestige. At the same time, individual factors such as academic performance, the age of applicants, and the availability of information about offered programs play a significant role. Understanding these relationships is crucial for developing effective recruitment strategies and tailoring educational offerings to candidates' needs.

The recruitment process for higher education is becoming increasingly complex due to changing educational requirements and evolving societal expectations of candidates. The growing number of applications to universities, particularly the most prestigious ones, highlights the rising importance of educational quality and academic prestige in candidates' application decisions. The number of applications per spot is not only an indicator of institutional popularity but also a measure of the selectivity of the recruitment process.

This study offers a novel perspective on university recruitment by integrating candidates' high school exam results, age, and application strategies into a comprehensive analysis. Unlike prior research, this work identifies specific threshold scores in Mathematics and English that significantly influence application behaviors, providing actionable insights for recruitment policies. The findings contribute to the existing literature by exploring the diverse strategies employed by candidates of different age groups, highlighting underexamined trends in higher education admissions. These considerations make this research particularly relevant for scientific journals focusing on educational management and policy.



## **2. Analysis of previous research**

### **2.1. Academic performance as a decision-making factor**

One of the most important factors influencing the number of applications per spot is candidates' academic performance. Research conducted by Reardon, Baker, and Klasik (2012) indicates that students with high school and test scores are more likely to apply to selective universities, thereby increasing the number of applications per spot at these institutions. Espenshade and Radford (2009) emphasize that elite universities attract candidates with the highest academic achievements, which translates into greater competitiveness. Academic performance not only serves as an indicator of academic potential but also reflects the ability to handle the demands of higher education.

The "test-optional" policy has created new opportunities for candidates. As noted by Hossler et al. (2020), allowing applicants to choose whether to submit SAT or ACT scores has increased the number of applications, particularly among candidates with lower test scores. Belasco et al. (2015) demonstrated that this policy has contributed to greater demographic diversity among applicants, attracting individuals who previously lacked access to adequate educational resources.

### **2.2. Age of applicants**

The age of candidates also influences their application behaviors. Younger applicants, often without professional experience, tend to submit more applications in an effort to increase their chances of admission (Tinto, 2012). Older applicants, who usually have work experience, approach the selection of programs and universities more selectively, resulting in fewer applications per spot in this group (Grodsky, Jones, 2007). Older applicants often choose study programs that align with their professional needs, which sets them apart from younger candidates who are more frequently guided by social aspirations and expectations.

### **2.3. Other factors influencing the number of applications**

The location of a university, its academic prestige, education costs, and the availability of financial support are equally significant factors. Marginson (2006) highlights that globalization and the growing number of international students contribute to increased competition at prestigious universities. At the same time, internet marketing plays an increasingly important role in candidates' application decisions, particularly in Poland, where universities are beginning to utilize social media and digital tools more effectively (Kisiołek, 2020).

Numerous other academic publications address this topic. For example, Black et al. (2020) analyze how racial and ethnic differences influence candidates' application behaviors in the United States, identifying factors such as academic performance and demographic constraints. Murphy and Wyness (2020) examined the impact of predicted grades on the application decisions of disadvantaged candidates, noting that incorrect predictions can lead to mismatches between applications and actual achievements. Estevan et al. (2019) studied the effects of an affirmative action program in Brazil, demonstrating that such policies improve access to higher education for disadvantaged groups while minimizing negative impacts on academic outcomes.

Marcinkowski et al. (2020) explored the ethical implications of using artificial intelligence in recruitment processes, revealing that algorithms can both support and limit equitable access to education. Bordón et al. (2020) analyzed the influence of gender on the choice of study programs in Chile, showing that these differences are linked to societal expectations and stereotypes. Bravo and Nistor (2022) examined the acceptance of technology in quality management in higher education, emphasizing the role of demographic factors such as age and gender in adopting new tools. Michel et al. (2019) provided a systematic review of the literature, identifying key factors influencing recruitment decisions, such as academic performance and motivational letters. Yusoff (2019) assessed the effectiveness of "mini-interviews" as a recruitment tool in higher education, demonstrating that this method minimizes gender and demographic biases. Finally, Rusanen et al. (2019) investigated students' motivations for choosing STEM fields and the relationship between mathematics selection and university admission, underscoring the critical role of math performance in the recruitment process.

#### **2.4. Summary of previous research**

The analysis of previous research indicates that the number of applications per spot depends on various factors, such as academic performance, candidate age, recruitment policies, and university promotional strategies. Understanding these relationships enables better alignment of educational offerings with societal and economic needs, as well as more effective management of the recruitment process. Research in this area is crucial for the development of higher education. Recommendations from these analyses can contribute to designing more effective recruitment strategies and improving access to higher education for diverse groups of candidates.

However, previous studies have not addressed the following topics:

1. The influence of the number of applications per spot in the context of results in specific high school subjects, such as mathematics, English, and Polish, with consideration of different score ranges.

2. The role of candidate age in decision-making regarding the number of applications and the competitiveness of the recruitment process, particularly among candidates over the age of 20.
3. The differentiation in application strategies among candidates submitting multiple applications, especially in relation to their scores and the prestige of selected programs.

The author believes that addressing these topics will positively contribute to expanding the available knowledge on university recruitment processes and enhancing the efficiency of management in higher education institutions.

Based on the conducted analysis, the **primary objective of this study** is to identify key factors influencing the number of applications per spot in undergraduate and integrated master's programs, with particular emphasis on academic performance, candidate age, and application strategies, as well as to evaluate their impact on recruitment processes across different candidate segments.

**The subject of this study** is the recruitment process for undergraduate and integrated master's programs, with a focus on key factors affecting the number of applications per spot, such as high school exam results, candidate age, and application strategies.

The author proposes the following **research hypotheses**:

- H1. Exam results in mathematics and English are key factors influencing the number of applications per spot.
- H2. Younger candidates are more likely to submit multiple applications to different programs, thereby increasing the average number of applications per spot.

### 3. Research methods and tools

The study was conducted based on statistical data from the University of Warmia and Mazury in Olsztyn for the academic years 2018/2019-2023/2024. The initial dataset included 92,678 recruitment applications. After eliminating unpaid applications, applications from candidates without completed high school exams, and applications for second-cycle programs, 77,348 applications were included in the analysis. Applications for second-cycle programs were excluded because the study focused solely on high school exam results, which are the basis for recruitment to undergraduate and integrated master's programs. The final dataset covered 17 faculties and 94 programs.

The analysis included high school exam results in English, mathematics, and Polish, as these are mandatory subjects for all candidates taking the exam. Their results thus provide a unified benchmark for assessing the general level of candidates' preparedness, regardless of additional subjects chosen or study programs selected.

The following software was used for the study:

- Data preprocessing, integration, and cleaning – MS Excel 365 (with the Power Query add-in).
- Data visualization – MS Excel 365, Power BI Desktop (version 2.138.1452.0).
- Statistical analyses – IBM SPSS Statistics (version 29.0.0.0).

The selection of these tools enabled a comprehensive approach to data processing, detailed statistical analyses, and visualizations.

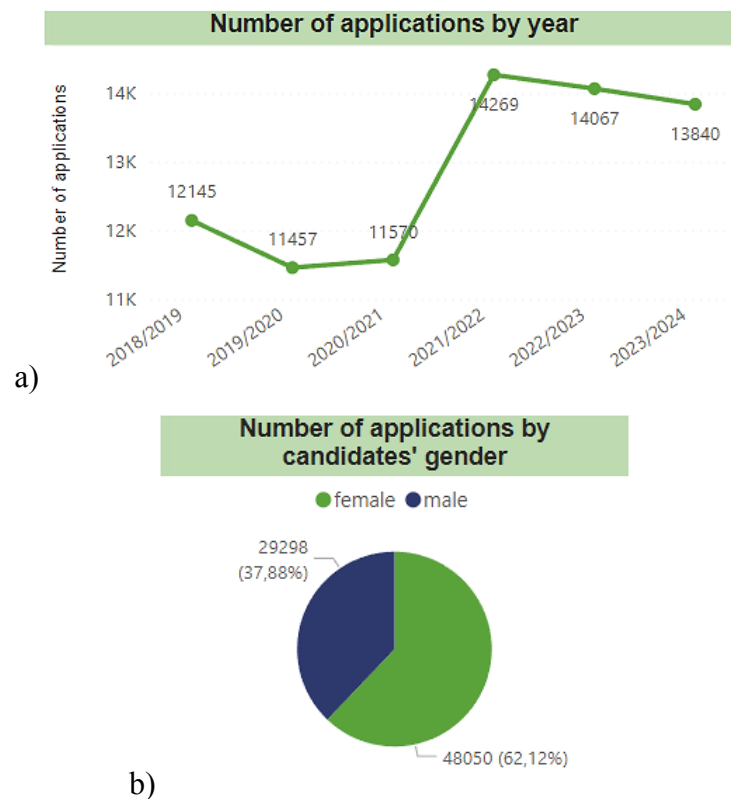
The following tools and statistical methods were applied during the study:

- Correlation analysis – used to determine the relationships between variables such as high school exam results, candidate age, and the number of applications per spot. These methods allowed the identification of the strength and direction of these relationships.
- Multivariate modeling – conducted using Power BI's "Key Influencers" tool, which allows for the hierarchical ranking of variables based on their impact on the dependent variable (number of applications per spot).
- Descriptive statistics – used to characterize the dataset, including measures such as means, standard deviations, and distributions, to better understand the sample.
- Linear regression analysis – applied to verify Hypothesis H1, determining the influence of mathematics and English exam results on the number of applications per spot.
- T-test for two groups – conducted to verify Hypothesis H2, comparing the average number of applications between younger and older candidates.

### 3.1. Characteristics of the research sample

The research sample analyzed in this study included recruitment data from the academic years 2018/2019-2023/2024. The key features of the sample are presented below:

1. Number of applications over time: The number of recruitment applications varied significantly during the analyzed period. After an initial decline from 12,145 applications in 2018/2019 to 11,457 in 2019/2020, an increase was observed, peaking at 14,269 applications in 2021/2022. In subsequent years, there was a slight decrease, reaching 13,840 applications in 2023/2024 (Figure 1a).
2. Number of applications by gender: Women accounted for 62.12% of all applications (48,050), while men represented 37.88% (29,298). The significant predominance of women in the application structure indicates a greater interest among female candidates in studying at the University (Figure 1b).

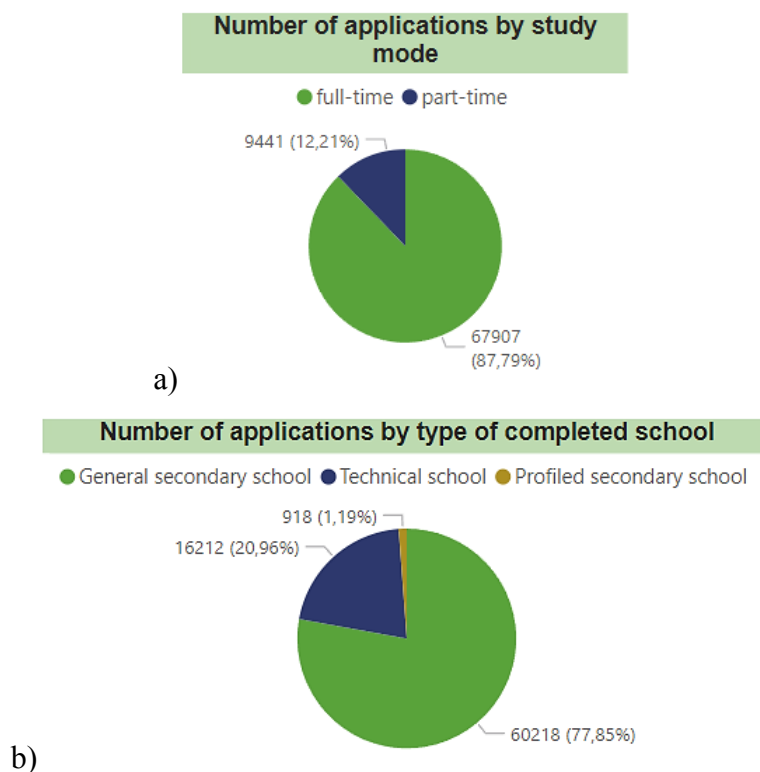


Note. The figure consists of two parts. Part (a) shows the total number of applications submitted to the university over the analyzed years, while part (b) breaks down the data by gender. The figure highlights the predominance of female candidates across all years and illustrates the overall trends in application numbers, including periods of growth and decline.

**Figure 1.** Number of applications by year and gender.

Source: Own study.

3. Form of Studies: Full-time studies were the preferred form of education, accounting for 87.79% of applications (67,907). Part-time studies, on the other hand, attracted 12.21% of applications (9,441), confirming the dominant role of full-time programs in the university's offerings (Figure 2a).
4. Type of Completed School: The vast majority of candidates graduated from general secondary schools (77.85% of applications, 60,218), while a significantly smaller proportion came from technical schools (20.96%, 16,212). Applications from specialized secondary schools were marginal (1.19%, 918) (Figure 2b).

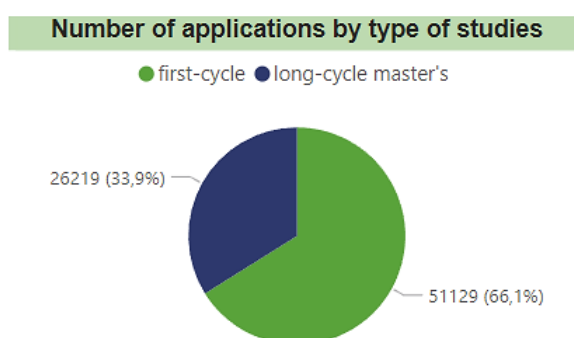


Note. The figure consists of two parts. Part (a) displays the number of applications by form of study, distinguishing between full-time and part-time programs. Part (b) presents the distribution of applications based on the type of secondary school completed by candidates. The figure emphasizes the dominance of full-time studies and the significant proportion of candidates graduating from general secondary schools.

**Figure 2.** Number of applications by form of study and type of completed school.

Source: Own study.

5. Type of Studies: Undergraduate programs were the most frequently chosen by candidates (66.1% of applications, 51,129), while integrated master's programs accounted for 33.9% of applications (26,219) (Figure 3).



Note. The figure illustrates the distribution of applications by type of study, distinguishing between undergraduate and integrated master's programs. It highlights the predominance of applications for undergraduate programs, reflecting their greater popularity among candidates.

**Figure 3.** Number of applications by type of study.

Source: Own study.

The above characteristics indicate the diversity of the sample in terms of both the form and type of studies as well as the demographic features of the candidates. Notably, attention should be drawn to the predominance of women among the candidates and the dominance of general secondary school graduates in the application structure.

#### 4. Results of scientific analysis

After collecting and preparing the source data, the first stage of analysis involved determining descriptive statistics. Their application provides insights into the general trends and diversity of the studied sample. These statistics are presented in Table 1.

The characteristics shown in Table 1 highlight:

- Diversity in English scores: High variability in results may indicate differing levels of preparation among candidates in this subject.
- Asymmetry in mathematics and Polish scores: The results suggest that many candidates achieve scores close to the lower end of the distribution.
- Variability in total points: A wide range in total scores points to significant differences in candidate levels.
- Role of candidate age: The presence of older candidates in the sample may indicate specific educational needs within this group.

**Table 1.**  
*Descriptive statistics*

Characteristic	English	Mathematics	Polish	Total points	Candidate age
Mean	103.25	67.87	70.13	260.78	19.63
Standard Error	0.19	0.10	0.11	0.37	0.01
Median	94	65	63	250	19
Mode	0	62	60	212	19
Standard Deviation	53.05	27.07	29.46	102.89	3.04
Sample Variance	2,814.65	732.89	867.78	10,586.19	9.24
Kurtosis	-0.87	2.22	3.00	-0.46	45.71
Skewness	0.06	0.97	1.59	0.30	5.76
Range	200	200	200	600	65
Minimum	0	0	0	0	16
Maximum	200	200	200	600	81
Sum	7,986,435.20	5,249,760.50	5,424,253.70	20,096,074.30	1,518,718.00
Count	77,348	77,348	77,348	77,061	77,348

Note. The table presents descriptive statistics for key variables analyzed in the study, including exam scores in English, Mathematics, and Polish, as well as total scores and candidate age. The statistics include measures of central tendency (mean, median, mode), variability (standard deviation, variance, range), and distribution characteristics (skewness, kurtosis). These metrics provide insights into the diversity of candidates' academic performance and demographic characteristics.

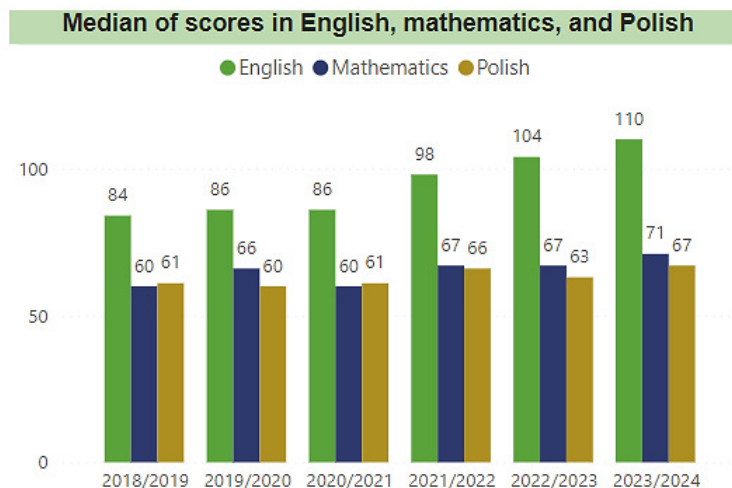
Source: Own study.

The identified characteristics and relationships, such as the diversity of results, asymmetries in distributions, and the specific needs of older candidates, require further investigation to better understand the mechanisms influencing application decisions and recruitment strategies.

After conducting descriptive statistics, the author deemed it purposeful to analyze the dynamics of high school exam results, enabling a general assessment of candidates' preparedness over the years. Median was chosen as the measure of central tendency for this analysis due to its greater resistance to outliers, which may occur in exam results and distort the true picture of candidates' preparedness when using the mean.

The chart in Figure 4 presents the median high school exam results in English, mathematics, and Polish for the academic years 2018/2019–2023/2024.

1. English: The median English scores systematically increased over the analyzed period, from 84 points in 2018/2019 to 110 points in 2022/2023, followed by a slight decline to 104 points in 2023/2024. This growth indicates improved preparation among candidates in this subject.
2. Mathematics: Mathematics scores were characterized by stability over the analyzed period, with the median ranging between 60 and 67 points. The lack of significant fluctuations suggests a relatively constant level of candidates' skills in this area.
3. Polish: The median Polish scores also remained consistent, ranging between 60 and 71 points. In recent years (2022/2023–2023/2024), a slight increase was observed, which may indicate improved preparation in this subject.



Note. The figure shows the median results of high school exams in English, Mathematics, and Polish across the analyzed academic years. It highlights the upward trend in English exam results and the relative stability of results in Mathematics and Polish, providing insights into the changes in candidates' academic preparedness over time.

**Figure 4.** Median high school exam results compared to the number of applications.

Source: Own study.

Based on the above, the following conclusions can be drawn:

- English stands out compared to the other subjects, both in terms of higher scores and its noticeable upward trend.



- Mathematics and Polish exhibit greater stability in their median scores, which may result from smaller changes in curricula or other educational factors.
- The analysis of median scores allows for detailed comparisons of candidates' preparedness across different areas, providing a basis for further research into the causes of observed trends.

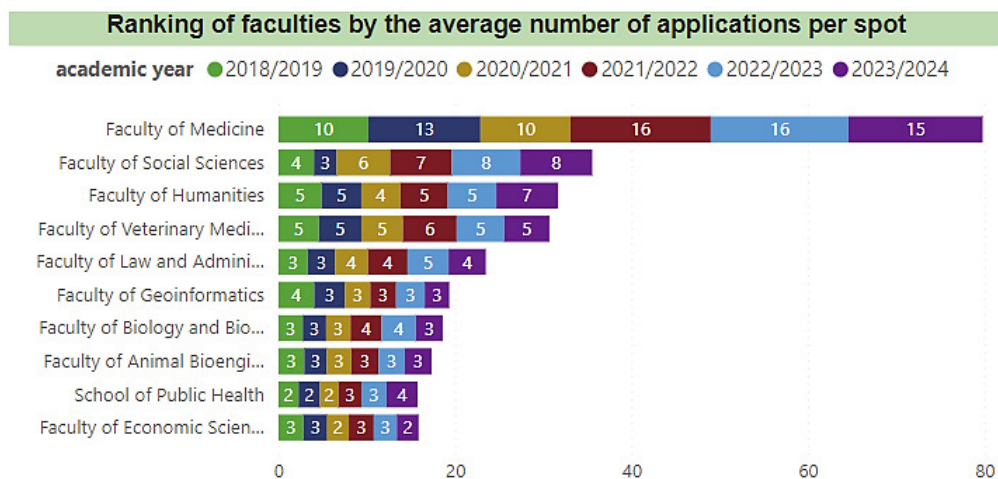
In the next stage of the scientific investigation, the author analyzed the popularity of faculties and programs among candidates. This popularity was measured not by the total number of applications for a specific faculty or program but by the number of applications per spot. According to the author, considering only the total number of applications would not accurately reflect actual popularity, as this figure largely depends on the available number of spots in a given program. A more realistic view can be obtained by analyzing the number of applications per spot.

The charts presented in Figures 5 and 6 show the rankings of faculties and programs based on the average number of applications per spot in individual academic years. This analysis provides a better understanding of trends in popularity among candidates over time.

The data shown in Figure 5 reveal the following patterns:

1. Most Popular Faculties:

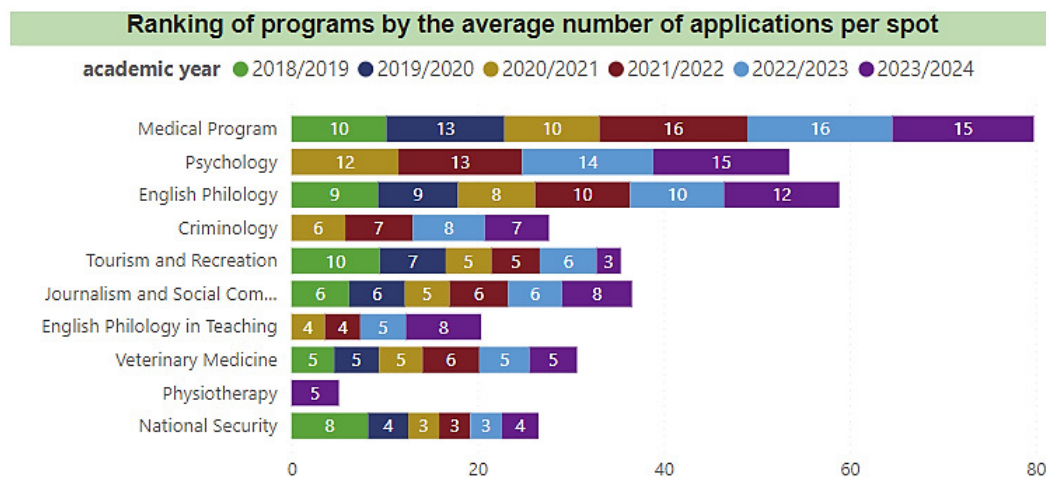
- The Faculty of Medicine consistently enjoyed the highest popularity throughout the analyzed period, with an average number of applications per spot ranging from 10 in 2018/2019 to 16 in 2021/2022-2022/2023, and 15 in 2023/2024. The high number of applications may stem from the prestige of the medical profession and the limited number of spots available.
- The Faculty of Social Sciences ranked second in most years, peaking in popularity in 2021/2022 with 8 applications per spot.



Note. The figure shows the average number of applications per spot across faculties during the analyzed years. It highlights the consistent popularity of the Faculty of Medicine, which ranks highest, and contrasts it with the lower interest in other faculties.

**Figure 5.** Popularity of faculties among university applicants.

Source: Own study.



Note. The figure illustrates the average number of applications per spot for the most popular study programs during the analyzed years. It highlights the dominance of the Medical Program, followed by Psychology, and provides a comparative view of candidate interest in various fields of study.

**Figure 6.** Popularity of study programs among candidates.

Source: Own study.

## 2. Variability in the Popularity of Other Faculties:

- The Faculty of Humanities and the Faculty of Veterinary Medicine maintained stable positions in the middle of the ranking, with the number of applications per spot ranging from 5 to 7 across different years.
- Other faculties, such as the Faculty of Economic Sciences and the School of Public Health, recorded the lowest number of applications per spot (2-3 applications), indicating lower interest among candidates.

## 3. Trends Over Time:

- The high stability in the popularity of the Faculty of Medicine reflects consistent interest in this field of study, despite changes in the overall educational market.
- Faculties with fewer applications (e.g., the Faculty of Economic Sciences) exhibited similar results across all years, possibly due to the specific nature of their educational offerings.

The observed patterns allow for the following conclusions:

- The analysis of the average number of applications per spot highlights significant differences in the popularity of individual faculties, which may result from both the prestige of offered programs and the specific expectations of candidates.
- The Faculty of Medicine dominates the ranking, reflecting strong interest in medical education.
- Lower interest in certain faculties suggests a need to analyze their educational offerings and marketing strategies to enhance their competitiveness among candidates.

The next chart illustrates the popularity of the ten most in-demand study programs. The University offers a highly diverse range of 94 programs, but only some attract significant interest from candidates. The data presented in Figure 6 reveal the following:

1. Most Popular Programs:

- The Medical Program clearly dominates throughout the analyzed period, with the number of applications per spot ranging from 10 in 2018/2019 to 16 in 2021/2022-2022/2023, and 15 in 2023/2024. This high popularity may result from the prestige of the program and the limited number of available spots.
- Psychology ranks second in most analyzed years, with applications per spot ranging from 12 in 2018/2019 to 15 in 2022/2023. The growing interest in this program may be linked to the increasing demand for specialists in this field.

2. Language Programs:

- Programs such as English Philology and English Philology with Foreign Languages maintain stable positions in the ranking, with applications per spot ranging from 8 to 12. Their popularity may be attributed to the demand for language skills in many professions.

3. Other Programs:

- Programs such as Criminology, Tourism and Recreation, and Veterinary Medicine also enjoy stable interest, with applications per spot ranging from 5 to 8 across various years.
- National Security has shown declining interest in recent years, dropping from 8 applications per spot in 2018/2019 to 3-4 in recent years.

4. Trends Over Time:

- The growing popularity of programs such as the Medical Program and Psychology may reflect changing labor market needs, and the prestige associated with these professions.
- The decreasing interest in programs such as National Security could result from labor market saturation in this field or changing preferences among candidates.

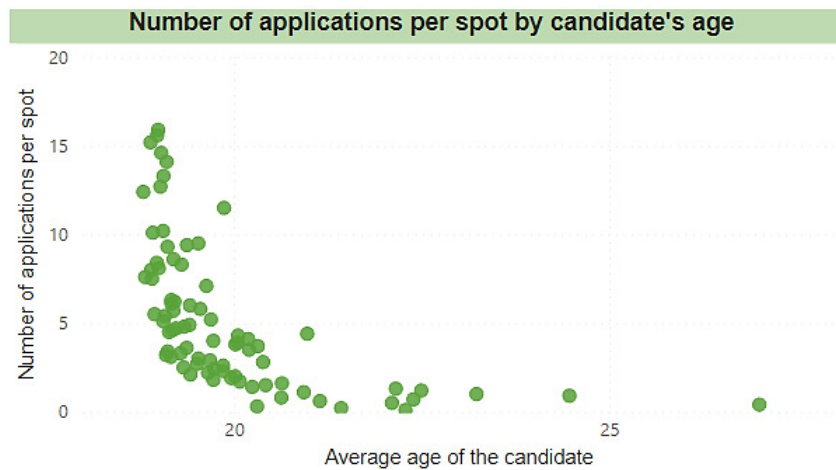
The observed relationships allow for the formulation of several significant conclusions:

- The ranking of study programs shows that some, such as the Medical Program and Psychology, have consistently attracted the highest number of candidates per spot over the years.
- Language programs, such as English Philology, remain consistently popular, highlighting the importance of language skills in today's job market.
- The declining popularity of certain programs, such as National Security, may signal the need for universities to adapt their educational offerings to the evolving needs of the labor market and candidate interests.

After analyzing the popularity of faculties and study programs, the next step was to examine the impact of candidates' demographic characteristics on their educational choices.

In this context, particular attention was given to the relationship between the average age of candidates and the number of applications per spot. This analysis may provide additional insights into the diversity of age groups among candidates and their preferences regarding the selection of study programs.

Based on the accompanying chart, a clear trend can be observed. The number of applications per spot decreases as the average age of candidates increases. This indicates that younger candidates are more likely to apply for a single spot than older ones (Figure 7).



Note. The figure shows the relationship between candidates' average age and the number of applications per spot. It highlights a clear trend where younger candidates submit more applications per spot compared to older candidates, reflecting differences in application strategies across age groups.

**Figure 7.** Impact of candidates' age on the number of applications per spot.

Source: Own study.

Possible conclusions from this observation are as follows:

1. Greater competition among younger candidates: Younger candidates, fresh out of high school, may be more active in applying to various programs to increase their chances of admission. This strategy could result from greater societal pressure to pursue higher education immediately.
2. Fewer options for older candidates: Older candidates may face limited application options due to specific program requirements, such as mandatory exams or a restricted selection of programs aligned with their interests and needs.
3. Experience and the number of applications: Older candidates, with more professional experience, may be more aware of their educational goals. They often apply to fewer programs but choose those that better match their qualifications and career plans.
4. Specific needs of older candidates: Older candidates may prefer programs offering more flexible forms of education, such as part-time studies, which decreases their interest in competitive programs with high application rates.
5. Limited promotion of educational offerings for older age groups: It is possible that educational offerings or their promotion are more targeted toward younger candidates, affecting the interest levels of older groups. Universities could consider adopting a more

diversified approach in communicating with potential candidates across different age groups.

6. Social pressure and personal aspirations: Younger candidates may be more inclined to apply intensively due to career aspirations and societal pressure to achieve academic success. In contrast, older candidates often focus on programs that meet their current professional needs.

In the higher education recruitment process, candidates employ various application strategies, reflecting their approach to selecting study programs and assessing their chances of admission. This study specifically analyzed the number of applications submitted by candidates within a single academic year. Examining these strategies provides a deeper understanding of candidates' behaviors and the factors influencing their application decisions, aligning with the main objective of this study: identifying the key elements impacting recruitment processes.

The data presented in Table 2 and Table 3 enable an assessment of how often candidates apply to more than one program and what the dominant behavioral patterns in this regard are.

Conclusions drawn from the analysis presented in Tables 2 and 3 include:

1. Increase in the number of applications and changing application strategies. Over the years, the number of applications has systematically grown, which may result from both an increase in the number of candidates and a higher number of applications submitted by individual candidates. Table 2 shows a rise in the percentage of candidates submitting more than one application (from 53.25% in 2018/2019 to 57.37% in 2023/2024). This may indicate an increasingly informed and strategic approach by candidates to the application process.

**Table 2.**

*Number of applications and percentage of candidates applying to more than one program*

Academic year	Total applications	Number of candidates (>1 application)	% of candidates (>1 application)	Number of unique applications	Number of unique candidates (>1 application)	% of unique candidates (>1 application)
2018/2019	12,145	6,467	53.25%	8,520	2,842	33.36%
2019/2020	11,457	5,812	50.73%	8,160	2,515	30.82%
2020/2021	11,570	6,368	55.04%	7,867	2,665	33.88%
2021/2022	14,269	7,697	53.94%	9,757	3,185	32.64%
2022/2023	14,067	7,835	55.70%	9,395	3,163	33.67%
2023/2024	13,840	7,940	57.37%	9,087	3,187	35.07%
Total	77,348	42,119	54.45%	48,231	16,721	34.67%

Note. The table summarizes the total number of applications and the percentage of candidates who submitted more than one application for each academic year. It highlights the growing trend of candidates adopting multiple-application strategies over time, indicating an increase in competitiveness and strategic planning in the university admission process.

Source: Own study.

**Table 3.**

*Distribution of the number of applications submitted by a single candidate within one academic year*

Number of applications in 1 year	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	Total
1	5,678	5,645	5,202	6,572	6,232	5,900	33,039
2	1,945	1,762	1,724	2,095	1,998	1,972	11,183
3	674	548	661	730	776	775	4,098
4	159	148	190	242	253	247	1,249
5	42	42	52	79	81	103	395
6	12	10	18	26	32	33	131
7	7	7	7	9	11	15	56
8	2	1	6	9	2	13	33
9	1	-	1	4	-	-	6
10	-	1	-	-	-	-	1
11	-	-	-	-	1	-	1
16	-	-	-	-	-	1	1
Total	8,520	8,160	7,867	9,757	9,395	9,087	48,231

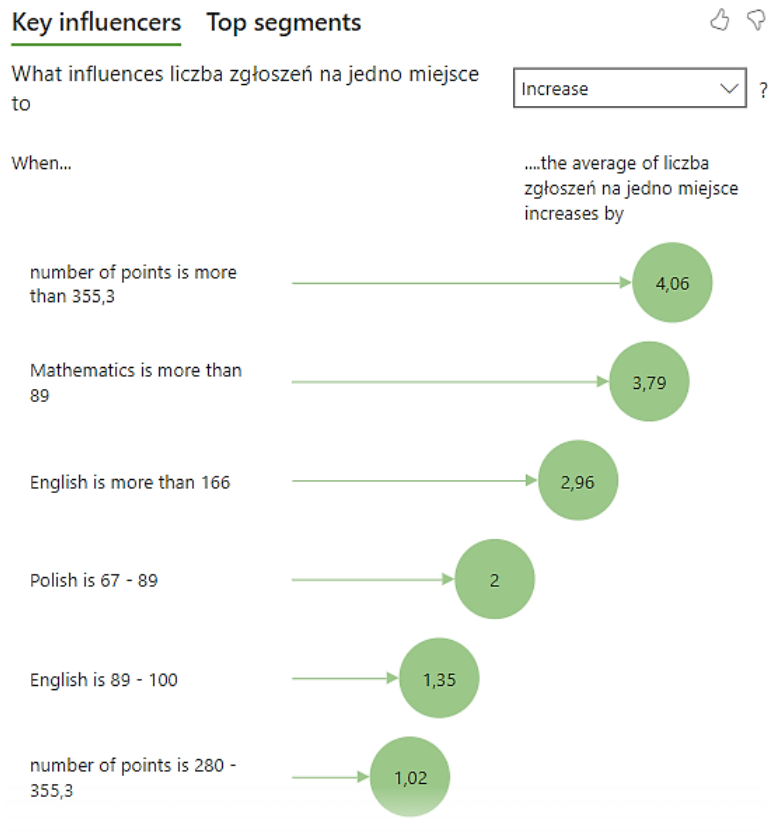
Note. The table presents the distribution of the number of applications submitted by individual candidates within a single academic year. It illustrates the prevalence of single and multiple applications, showing that most candidates submit one or two applications, while a smaller group employs more extensive application strategies.

Source: Own study.

2. Distribution of applications within a single academic year. Data in Table 3 reveals that most candidates submit one or two applications, which may reflect their specific preferences or a limited number of suitable study programs. At the same time, there is a group of candidates submitting five or more applications, suggesting riskier strategies aimed at maximizing admission chances.
3. Growing competition. The increase in the number of applications, coupled with a higher percentage of candidates submitting multiple applications, points to growing competition in the recruitment process. Candidates are increasingly trying to improve their chances by applying to several programs simultaneously.
4. Significance of unique applications. The stable growth in the number of unique candidates (Table 2) reflects rising interest in higher education, potentially driven by greater accessibility to education or changes in the labor market. It is noteworthy that the number of unique candidates submitting applications to more than one program is also systematically increasing, emphasizing the diversity of application strategies.

To understand the key factors influencing the average number of applications per spot, an analytical tool available in Power BI, named "Key Influencers," was utilized. This tool enables the identification of variables that significantly determine the dependent value under study – in this case, the number of applications per spot. This analysis facilitates a detailed examination of the relationships between candidates' results (e.g., scores in specific high school subjects) and their application decisions.

The results presented in Figure 8, based on data processed in the Power BI environment, provide practical insights into factors influencing recruitment processes. This enabled the identification of threshold exam scores that have a critical impact on increasing the average number of applications per spot.



Note. The figure presents the results of the key influencer analysis conducted in Power BI, identifying variables with the most significant impact on the number of applications per spot. It highlights the importance of high exam scores in Mathematics and English, as well as overall total scores, in shaping application behaviors.

**Figure 8.** Analysis of key influencers affecting the number of applications per spot.

Source: Own study.

Similar analytical approaches are used in the scientific literature. For instance, research conducted by Black, Cortes, and Lincove (2020) analyzed factors influencing applicants' decisions in the United States. Advanced statistical methods were employed to identify key variables determining candidates' educational choices. Similarly, Estevan, Gall, and Morin (2019) highlighted the specific characteristics of candidates within the context of affirmative action programs, representing another example of the application of key influencer analysis.

The bubble chart in Figure 8 presents the key factors influencing the average number of applications per spot, which aligns with one of the primary goals of this study. The analytical tool in Power BI facilitated the identification of these variables and their hierarchical impact, making a significant contribution to understanding recruitment mechanisms.

1. Key factors influencing the number of applications:
  - The most influential factor is the total score exceeding 355.3 points, which increases the average number of applications by 4.06. This finding confirms that candidates with high scores are more likely to apply for popular programs.
  - A mathematics score above 89 (impact: 3.79) and an English score above 166 (impact: 2.96) highlight the critical role of these subjects in candidates' application strategies.
  - A Polish language score between 67–89 (impact: 2.00) also contributes to an increase in the number of applications, albeit to a lesser extent.
2. Segmentation of candidates:
  - The chart clearly segments candidates into groups based on their exam results. The group of candidates scoring above 355 points is the most active in terms of applications, while candidates scoring between 280–355 points demonstrate a lower average number of applications (1.02).
3. Significance of academic performance in the context of the research goal:
  - The results indicate that the key factors influencing the number of applications per spot are high scores in mathematics and English, as well as the overall score. This analysis directly supports the main objective of the research, which is to identify the determinants of application numbers. These findings provide valuable insights into which candidate characteristics are most significant in the recruitment process.

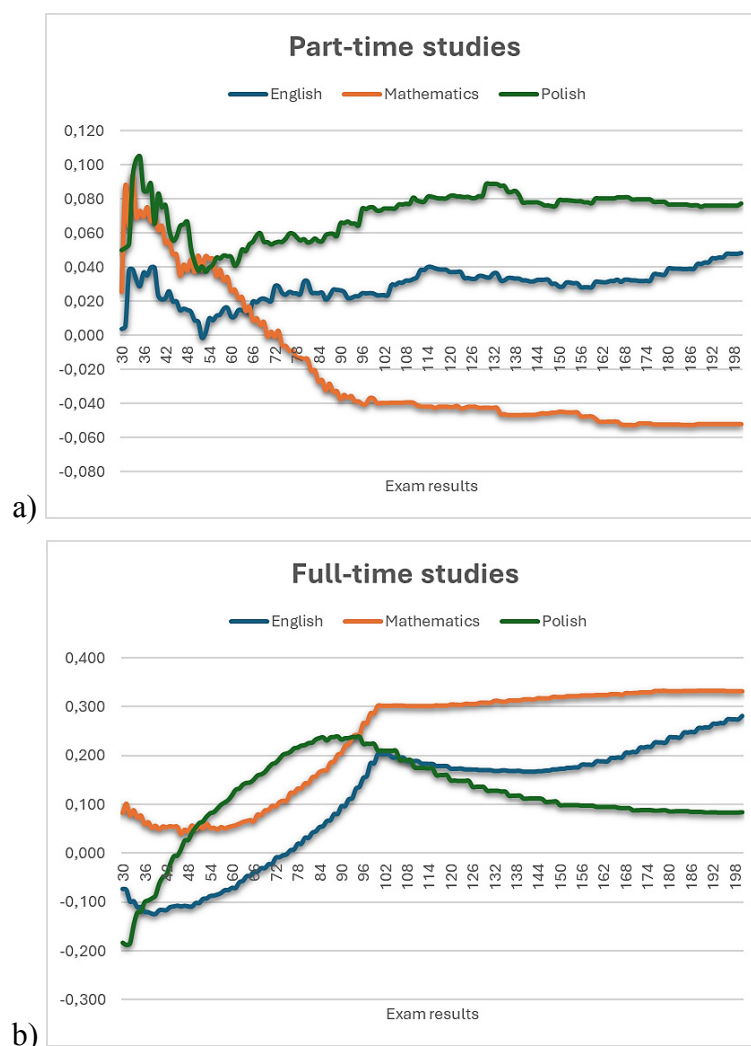
Based on the conducted analyses, the following conclusions can be drawn:

- Universities can use this data to optimize their recruitment processes by focusing on candidate groups with the highest scores in mathematics and English.
- Candidates may realize that improving their performance in key subjects can increase their chances of success when applying to highly competitive programs.

It is worth noting that the data in Figure 7 demonstrates a significant correlation between age and the number of applications per spot. However, multivariate analysis (Figure 8) indicates that in the context of other variables, such as the total score or performance in mathematics and English, age is not one of the key factors influencing the number of applications. This suggests that, although age has some relevance, its impact is relatively smaller compared to other elements.

Correlation analysis enables the identification of relationships between variables and explains how performance in key high school subjects can influence the popularity of specific forms of study. The charts presented in Figure 9a and Figure 9b show the correlations of high school exam scores in English, mathematics, and Polish concerning the study formats – full-time and part-time. Separating these two formats provides a better understanding of the differences in preferences among candidates applying for different study modes, as well as the key factors influencing application decisions.





Note. The figure contains two charts illustrating the correlations between the number of applications per spot and high school exam results in English, Mathematics, and Polish. Part (a) shows correlations for part-time studies, while part (b) focuses on full-time studies. The charts highlight the stronger influence of Mathematics and English results on full-time applications, compared to more varied patterns in part-time applications.

**Figure 9.** Correlations between the number of applications per spot and high school exam results: a) part-time, b) full-time.

Source: Own study.

A detailed analysis of the charts is presented below, considering key observations and conclusions.

#### 1. Part-time studies (Figure 9a):

- **English:** The correlation for English scores is stable and positive for higher score ranges, meaning that candidates with better results are more likely to choose part-time studies. For lower score ranges, the correlation is negative, suggesting less interest in this format among candidates with lower scores.
- **Mathematics:** Mathematics scores show a clear negative correlation for low score ranges, which may indicate that part-time studies are less popular among candidates with lower results in this subject. However, for higher scores, the correlation gradually stabilizes around zero.

- Polish: The correlation for Polish scores is positive and most stable, suggesting that this subject has a moderate influence on the choice of part-time studies.
2. Full-time studies (Figure 9b):
    - English: The correlation is negative for low scores but gradually increases and reaches a stable positive level for higher scores. This indicates greater interest in full-time studies among candidates with better results in English.
    - Mathematics: The correlation for mathematics scores is clearly positive and the highest among the analyzed subjects. This suggests that mathematics plays a key role in the choice of full-time studies.
    - Polish: The correlation for Polish scores remains stable and positive but is lower compared to mathematics and English, indicating that it plays a lesser role in application decisions for full-time studies.

Based on the presented charts, key conclusions were formulated, considering significant relationships and observations.

1. Differences between study formats:
  - For full-time studies, mathematics has the greatest influence on candidates' decisions, whereas this correlation is less significant for part-time studies.
  - English scores are important for both study formats but differ in their impact for low and high score ranges.
  - Polish has the least influence on the choice of study format, but its correlation remains stable in both cases.
2. Candidate preferences:
  - Candidates with higher scores in key subjects prefer full-time studies, which may be related to the higher academic demands and prestige of this study format.
  - Candidates with lower scores in mathematics are more inclined to choose part-time studies.
3. Application strategies:
  - Differences in correlations suggest that candidates employ different application strategies, depending on the study format and their high school exam results.

The analyses conducted in this section enabled the verification of the research hypotheses, which are discussed in detail in the next part of the article.

## 5. Verification of research hypotheses and conclusions

As part of this section of the article, the research hypotheses were verified based on the conducted analyses. Subsequently, conclusions were drawn from the obtained results, addressing both theoretical implications and practical aspects of managing recruitment processes.

The conducted research successfully achieved the main objective of the article, which was to identify key factors influencing the number of applications per spot in undergraduate and integrated master's programs. Analyses considering high school exam results, candidate age, and application strategies allowed for a detailed understanding of the mechanisms determining recruitment processes and their impact on different groups of candidates. The achieved results also enabled the verification of research hypotheses, which is presented in detail in the subsequent sections of the article.

### 5.1. Preliminary verification of research hypotheses

**Hypothesis H1.** *Exam results in mathematics and English are significant factors influencing the number of applications per spot*

Evidence from previous analyses:

1. Key influencers (Figure 8):
  - The number of points in mathematics above 89 and in English above 166 was identified as a key factor, confirming that high scores in these subjects have a substantial impact on the number of applications per spot.
  - The influence of mathematics (3.79) and English (2.96) is significant, highlighting their dominant role in the application process.
2. Correlations between results and study formats (Figure 9a and 9b):
  - In both study formats (full-time and part-time), mathematics and English scores show clear positive correlations with the number of applications, particularly in higher score ranges.
  - Mathematics demonstrates a stronger influence on the choice of full-time studies, further supporting its importance.

**Preliminary conclusion:** Hypothesis H1 finds strong support in the analyzed data, allowing for its preliminary confirmation. However, it is advisable to complement this verification with statistical tests to confirm the significance of the observed relationships.

**Hypothesis H2.** *Study formats differ in terms of factors determining candidates' choices*

Evidence from previous analyses:

1. Correlations between results and study formats (Figure 9a and 9b):
  - Full-time studies (Figure 9b):
    - ✓ Mathematics plays a key role, with a clearly positive correlation, indicating the importance of high scores in this subject.
    - ✓ English also shows a positive correlation, but it is smaller compared to mathematics.
  - Part-time studies (Figure 9a):
    - ✓ Mathematics has a lower correlation, suggesting that scores in this subject are less significant for this study format.
    - ✓ The correlation with Polish is more stable, which may indicate that this subject plays a greater role in the choice of part-time studies.
2. Distribution of results across individual subjects:
  - Full-time studies attract candidates with higher scores in mathematics and English, while part-time studies appeal to a more diverse group in terms of results.

**Preliminary conclusion:** Hypothesis H2 is supported by the observed differences between study formats. To fully verify it, statistical analyses should be conducted to compare differences between groups.

**Conclusions for further actions:**

1. Hypotheses H1 and H2 can be considered preliminarily confirmed based on the available data.
2. Further statistical analyses may provide evidence of the statistical significance of the observed differences and relationships.

## 5.2. Final verification of research hypotheses

### Hypothesis H1

The linear regression analysis confirmed that mathematics and English results are statistically significant predictors of the number of applications per spot. The coefficient of determination  $R^2 = 0.155$  indicates that 15.5% of the variability in the number of applications can be explained by these results.

The regression coefficients show that:

- The mathematics score ( $\beta = 0.0431, p < 0.001$ ) has a greater impact on the number of applications than the English score ( $\beta = 0.0178, p < 0.001$ ).
- Both factors are positively correlated with the number of applications per spot.

These results confirm Hypothesis H1, indicating that both mathematics and English play a key role in increasing the number of applications per spot.

## Hypothesis H2

The results of the t-test comparing the average number of applications per spot between younger (<20 years old) and older ( $\geq 20$  years old) candidates indicate a statistically significant difference:

- Statistic ( $t = 41.25, p < 0.001$ ).
- Younger candidates have a higher average number of applications per spot compared to older candidates.

These findings align with Hypothesis H2, suggesting that younger candidates adopt more active application strategies, contributing to a higher average number of applications per spot.

Based on the conducted statistical analysis, hypotheses H1 and H2 were positively verified, confirming the significant impact of high school exam results in mathematics and English on the number of applications per spot, as well as the more active application strategies employed by younger candidates.

## 5.3. Discussion

1. Significance of the results in the context of research. The results emphasize the critical role of high school exam performance, particularly in Mathematics and English, in shaping application behaviors. This finding highlights the importance of STEM and language education in fostering broader access to higher education.
2. Novelty of the findings compared to previous knowledge. Unlike prior studies focusing solely on overall application numbers, this research identifies specific threshold scores in Mathematics and English that significantly increase the likelihood of multiple applications per spot. This detailed perspective provides actionable insights for university recruitment policies.
3. Similarities and differences in the results. The study confirms existing findings regarding the prevalence of younger candidates submitting multiple applications, while also demonstrating a lesser-explored pattern of older candidates opting for fewer, more targeted applications. This contrast underscores the diverse strategies employed by different age groups.

## 5.4. Conclusions

1. The impact of high school exam results on the number of applications (H1). Statistical analysis confirmed that results in mathematics and English are key factors influencing the number of applications per spot. Mathematics scores have a greater impact than English scores, highlighting the importance of competencies in STEM subjects for the recruitment process. The findings suggest that improving high school exam results in these subjects can increase candidates' chances of success when applying to popular programs.

2. Differences in application strategies by age (H2). Younger candidates (<20 years old) are more likely to submit multiple applications to various programs, increasing the average number of applications per spot. This phenomenon is driven by more active application strategies in this group, potentially motivated by social pressure and the desire to maximize admission chances. Older candidates, though fewer in number, demonstrate a more selective approach to program choice.
3. The role of study formats. The analysis revealed differences in correlations between high school exam results for full-time and part-time studies. Full-time studies attract candidates with higher mathematics scores, which may be due to the higher academic demands of these formats. Part-time studies are more diverse in terms of candidate scores, suggesting greater accessibility.
4. Usefulness of applied methods. The use of linear regression analysis, t-tests, correlation analysis, and multivariate modeling in Power BI enabled a comprehensive assessment of key factors influencing the number of applications per spot. These findings provided valuable insights for both recruitment practices and further research into candidate behaviors.
5. Practical implications. The findings can help universities better understand recruitment mechanisms. In particular:
  - Additional support could be considered for candidates with lower mathematics and English scores to improve their competitiveness.
  - Analyzing younger candidates' application strategies could help tailor educational offerings to their needs.
  - Adjusting promotional and informational policies for older candidates may increase their interest and participation in recruitment processes.
6. Future research perspectives. The results highlight the need for further exploration of demographic and psychological factors that may influence candidates' choices. Additionally, it would be worthwhile to investigate how changing market and societal conditions shape recruitment processes in the coming years.

## 5.5. Recommendations

The results of this study provide several practical recommendations for universities aiming to optimize their recruitment strategies:

1. Targeted promotion for less popular programs: Faculties and programs with consistently lower numbers of applications per spot could benefit from enhanced promotion. Tailored communication strategies should highlight the unique strengths and career opportunities associated with these programs.
2. Support for candidates with lower exam scores: Given the significant role of Mathematics and English exam results in application strategies, universities might

consider offering preparatory courses or additional support for candidates with lower scores to improve their competitiveness.

3. Adapting to the needs of older candidates: Older candidates often submit fewer applications, potentially due to different needs or barriers in the application process. Introducing more flexible study options, such as part-time or hybrid programs, could attract a broader range of applicants.
4. Leveraging data for informed decision-making: Universities should continue using tools like Power BI to analyze key factors influencing applications. Such analyses can provide insights for adjusting recruitment policies and optimizing application processes.

By implementing these recommendations, universities could not only increase the number of applications but also ensure a more inclusive and efficient recruitment process.

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## ANALYSIS OF THE ACTIVITY OF AMREST AND MCDONALD'S GASTRONOMIC NETWORKS AS THE BASIS FOR VERIFICATION OF THE SUSTAINABLE GASTRONOMY MODEL

Ewa MALINOWSKA<sup>1\*</sup>, Renata PŁOSKA<sup>2</sup>, Mariusz CHMIELEWSKI<sup>3</sup>

<sup>1</sup> Uniwersytet Gdański, Katedra Strategicznego Rozwoju, Zakład Zrównoważonego Rozwoju i Nauk o Jakości; ewa.malinowska@ug.edu.pl, ORCID: 0000-0002-9409-7856

<sup>2</sup> Uniwersytet Gdański, Katedra Strategicznego Rozwoju, Zakład Zrównoważonego Rozwoju i Nauk o Jakości; renata.ploska@ug.edu.pl, ORCID: 0000-0002-1716-4496

<sup>3</sup> Uniwersytet Gdański, Katedra Strategicznego Rozwoju, Zakład Zrównoważonego Rozwoju i Nauk o Jakości; mariusz.chmielewski@ug.edu.pl, ORCID: 0000-0002-0775-621X

\* Correspondence author

**Purpose:** The aim of this paper is to verify and improve the sustainable gastronomy model developed by the authors and presented in Malinowska et al. (2024). The verification and refinement of the model is based on the results of the analysis of the sustainable activities carried out by two large global food service chains, AmRest and McDonald's.

**Design/methodology/approach:** The article uses the method of critical literature analysis, analysis of secondary data, case studies, and the method of synthesis and logical inference.

**Findings:** The analysis of the two food service chains' operations confirmed that the developed sustainable gastronomy model consists of properly defined main components. Furthermore, based on the findings of an analysis it was possible to refine some elements of the model and add new ones. The result is the improved version of the sustainable gastronomy model.

**Research limitations/implications:** The study is based on an analysis of two global food service chains, operating largely or exclusively in the area of system gastronomy - fast food. The analysis, which formed the basis for the verification and refinement of the sustainable gastronomy model, was based only on information made public by both chains in their sustainability reports and on their websites.

**Practical implications:** The conclusions of the research, in the form of the revised and refined sustainable gastronomy model, can serve as inspiration and a set of basic guidelines for food service companies to design and carry out sustainable changes to their operations and offers.

**Social implications:** The proposed model of sustainable gastronomy can be used to build and raise public awareness in identifying the characteristics of sustainable gastronomy and quantifying their importance, thereby developing responsible consumer attitudes. It can also serve as a tool to assess the sustainability of companies operating in the food service market.

**Originality/value:** The revised model is the author's proposal to describe the specifics of sustainable gastronomy.

**Keywords:** sustainable gastronomy, sustainable development, system gastronomy, fast food.

**Category of the paper:** original article.

## 1. Introduction

The concept of sustainable development, which has been present in the public debate for more than five decades (Burchard-Dziubińska et al., 2014; Dvořáková, Zborková, 2014; Hull, 1993) undoubtedly influences many areas of social and economic life. This also applies to various industries and sectors, where many initiatives and activities can be observed, aimed at making the idea of sustainable development a reality. These changes are increasingly deeply interfering with the day-to-day functioning of businesses: the decisions made and processes implemented within them (Farooq et al., 2019; Hardy et al., 2002; Henninger et al., 2016; Jones et al., 2017; Vadakkepatt et al., 2021).

The idea of sustainable development is based on the belief that the current socio-economic model should be transformed into one that creates opportunities for existence, development and satisfaction of the needs of both present and future generations (WCED, 1987). It is most often pointed out that the key to the success of this transformation is the harmonization of the three dimensions: economic, ecological (environmental) and social (Giddings et al., 2002; Rogall, 2010; Schaefer, Crane, 2005; Strezov et al., 2017; Wiśniewska, Grybek, 2022). Due to the complexity of the entire process of change, it is necessary to involve all participants in socio-economic life, including both sides of the market relations: buyers and suppliers of goods and services.

Companies are confronted with increasing pressure to take actions that will result in changing the way they operate and their product or service offerings to a more sustainable one. This pressure is related to both legislative changes, particularly noticeable in EU countries (Chiti, 2022; Cifuentes Faura, 2022; Hummel, Jobst, 2024), and social changes - related, e.g. to the growing environmental awareness of societies (CBOS, 2020; European Commission, 2024). From the point of view of companies, changes in the area of consumer behavior are of particular importance, and related to the inclusion of sustainability issues in purchasing processes (Mazur-Wierzbicka, 2016; Zalega, 2013; Zalejski, Faszczewska, 2012). This is no different in the case of the food service industry, as also with regard to food products, consumers increasingly declare that they are interested in buying those that are environmentally friendly or sustainable (Civero et al., 2021; DiPietro et al., 2013; Jaros, 2016).

In response to buyers' expectations, taking into account sustainability issues, companies are seeking and implementing further changes, both within the goods and services they offer and any processes they implement to meet those expectations. A number of such activities are being undertaken by companies in the agri-food sector, including the food service industry (Nascimento, 2023; Sloan et al., 2015; Stangierska, 2016; Yoon et al., 2020).

In order for these activities to be effective and efficient, it is essential to understand them, which requires both the ability to see their individual components and a holistic approach. Various types of standards or guidelines that provide practical knowledge on solutions for

implementing sustainability in companies can help in this process (e.g. GRI, 2024; ISO, 2010; ISO, 2024; OECD, 2018). A similar role can be fulfilled by various types of publications, including scientific ones, which present such solutions in a comprehensive yet clear manner. Undoubtedly, such a function can be performed by models of various concepts or phenomena. However, in order for such models to serve as a reliable source of inspiration or guidance for businesses, care must be taken to ensure that they reflect reality and the assumptions of the presented concept as closely as possible, and this requires not only diligence at the stage of their creation, but also verification and improvement.

The purpose of this article is to verify and refine the model of sustainable gastronomy developed by the authors and presented in their previous publication (Malinowska et al., 2024). The verification and refinement of the model is based on the results of the analysis of the sustainable activities carried out by two large global food service chains, AmRest and McDonald's. It was assumed that, due to the nature and scope of their operations, these entities are under particular pressure to implement the principles of sustainable development and have experience in this regard. For the purpose of achieving the goal, the method of critical analysis of literature, analysis of secondary data, case studies, and the method of synthesis and inference was used. The conclusions of the research were used to verify and refine the author's model of sustainable gastronomy, an updated version of which is presented in the conclusions.

## **2. Sustainable gastronomy**

Gastronomy is defined as the art of eating well, in which the relationship between food, culture and tradition plays a large role (Parasecoli, Rodriguez-Garcia, 2023). Already in this definition, the interaction of gastronomy with other areas is evident, which has resulted in, among other things, the concept of sustainable gastronomy. Looking through the prism of various interactions between gastronomy and the phenomena occurring in the ecological, economic and social areas, it can be concluded that there is an intensive development of the phenomenon of sustainable gastronomy. According to the UN, sustainable gastronomy is a concept that essentially means a cuisine that sources and processes ingredients in a sustainable manner - taking into account the origin of the ingredients, how the food is grown and how it gets to markets and ultimately to consumers' plates (What is Sustainable Gastronomy?, 2024).

The literature highlights the change in attitudes of both consumers and food service workers toward the phenomenon of sustainability in this area. Filimonau et al. (2022) presented evidence that consumers are more likely to use food service establishments that care about the environment. Hu et al. (2010) found, based on their research, that there is a close relationship between consumers' knowledge of sustainable restaurant practices, environmental concern and green behavior, and their willingness to visit "green" restaurants. Such a relationship was also

confirmed by Wang et al. (2018) and Nicolau et al. (2020), who in their research proved that consumers are more willing to pay for the services of “green” restaurants. The literature highlights that, e.g. Spanish consumers of eating establishments are showing a growing interest in sustainability aspects in the context of food consumption away from home (Moral-Cuadra et al., 2020), and a positive attitude toward shorter and therefore more environmentally friendly food supply chains (Elghannam et al., 2019).

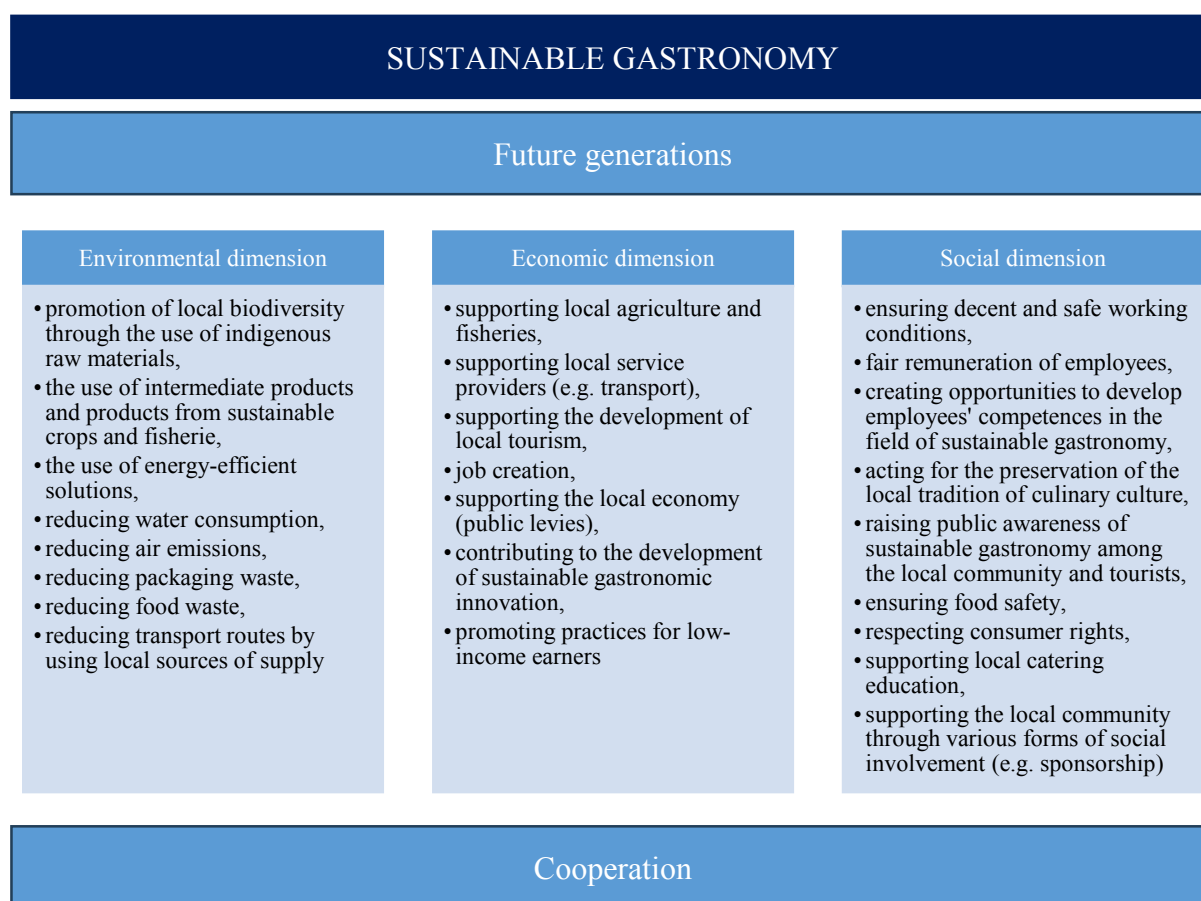
However, in order for consumer expectations to be met, an understanding of a sustainable approach to the operation of a food service establishment must also exist on the part of the organisation's employees. Many authors in their publications address the issues of food waste during catering production (Kasavan et al., 2019; Dhir et al., 2020; Lévesque et al., 2022), which, in addition to the unfavorable image in terms of sustainability, also affects lower profitability and causes significant financial losses (Gonçalves et al., 2023). The cause of this phenomenon is not necessarily just poor staff organisation, but also consumers themselves, who leave an unconsumed portion of their meals on their plates because, e.g. the appearance or taste of the dishes do not meet their expectations, or the meal portion is too large (Dhir et al., 2020). To prevent or mitigate the effects of this phenomenon, appropriate, educational measures should be implemented (Martin-Rios et al., 2018) and a preventive approach should be taken to reduce the amount of wasted food – e.g. by adopting a limited menu (Lévesque et al., 2024). An equally important aspect is the approach to the observed problem taken by restaurant managers (Blennow, Persson, 2009; Richardson, Fernqvist, 2024). They are the ones who are primarily responsible for the training programs of the crew, but also for the effective organisation of work. They should inspire appropriate actions such as: implementing effective waste monitoring systems, educating staff on inventory management and portion control, and encouraging sustainable food practices based on, e.g. a donation program (Gonçalves et al., 2023). According to Richardson and Fernqvist (2024), a sustainability-conscious chef can influence others to have more sustainable food values, behaviors and practices, thus leading to a more sustainable food system. They emphasise the role of actively educating chefs, then sharing that knowledge with customers to stimulate curiosity and build knowledge (Pereira et al., 2019). Looking at the changes that are taking place in society and the economy, one can conclude that sustainable gastronomy is no longer just about how to make gastronomy itself more sustainable. Gastronomy can be viewed as a social approach that can contribute to sustainability beyond issues directly related to food consumption (Östergren et al., 2023). Presented in the author's model (Malinowska et al., 2024), the elements mentioned above support the thesis that a multidimensional approach that takes into account long-term thinking, the needs of future generations and stakeholder cooperation is important in sustainable gastronomy.

The authors, on the basis of their previous research (Malinowska et al., 2024), defined the concept of sustainable gastronomy as “a business activity focused on meeting the nutritional needs of consumers based on the processing of food raw materials into ready-to-eat food and beverages, and offering them to purchasers, also by making them available for consumption at

the point of sale (with additional services to meet other needs, e.g. entertainment, leisure), which:

- takes into account the need to act in the spirit of sustainable development, by applying solutions that favour the economic objectives of the operators and the region, enable the achievement of social objectives and improve the well-being of individuals and communities, and contribute to limiting negative effects on the environment;
- takes a long-term view, also taking into account the well-being of future generations;
- is based on interaction between different stakeholders”.

This definition emphasises the need to operate according to the principles of sustainability, taking into account solutions that favor the economic goals of stakeholders, the possibility of achieving social goals, as well as contributing to the reduction of negative effects on the environment (Malinowska et al., 2024). The authors emphasise the link between sustainable gastronomy and three basic areas: ecological, economic and social (Figure 1).



**Figure 1.** Sustainable gastronomy model.

Source: (Malinowska et al., 2024).

Complementing the author's original concept of sustainable gastronomy was the inclusion of the perspective of future generations as an important point of reference for planning and implementing activities within the three dimensions mentioned above, and cooperation as a necessary element for the implementation of these intentions.

### 3. Methodological basis for model verification

The process of model development is a common one, both in science and among practitioners. In the economic context, researchers and entrepreneurs attempt to develop models with the primary aim of bringing about various types of improvements in the organisation's operations (e.g. Sidhu et al., 2015; Hozer, Kokot, 2002). Often, the concepts developed are only an outline of a model, as the modelling process is very complex and time-consuming.

Modelling is a method of research and cognition based on the formulation of basic properties of the model object (model). It also allows new regularities occurring in issues already described to be presented (Wolska, 2023). A review of the literature reveals a lack of a uniform definition of the term 'model'. Glinkowska (2010), after analysing selected definitions, stated that 'a model is a certain image of reality, a possible shape of it, an extraction of the essential elements of this reality. It can be constructed using many variables, also in a way that gives an approximate picture of some future.' Refining this definition, Wolska emphasises that 'models are a mental representation of a simplified (schematic) image of the object under study, which is created using specific elements' (Wolska, 2023).

Among the various classifications of models, one can note cognitive models, the essence of which is the study of reality. They are divided into descriptive models (they provide a description of the studied reality) and predictive models, which explain cause-and-effect relationships occurring in the studied present and future reality. In addition to cognitive models, one can find decision models - created in order to shape the studied reality, to make changes in it and project models, which are models of implementation activities related to shaping the studied reality (Glinkowska, 2010).

In the face of ongoing development, it should be borne in mind that the theories, models presented may need to be evaluated after some time. It may be noted that a certain element of the model has devalued, while others have emerged that the authors of the model did not notice (Macdonald, 2023). Such a situation may occur, e.g. after the model has been applied in practice (Vancouver et al., 2020). Therefore, it is important to continuously revise models and update them to the needs of practice (Nasevich, 2021). In light of these considerations, the authors decided to revise the cognitive (descriptive) model of sustainable gastronomy developed earlier.

Two fast food chains operating worldwide, AmRest Holdings SE and McDonald's, were selected to verify and then refine the developed sustainable gastronomy model. AmRest manages the following brands: KFC, Pizza Hut, Burger King, Starbucks, La Tagliatella, Blue Frog, and KABB. The company focuses primarily on European and Asian markets, but also has limited operations in North America and Africa. AmRest is one of the largest franchisees of Yum! Brands worldwide. McDonald's operates globally exclusively under its brand.

Both chains have a global reach - with AmRest operating in 26 countries around the world (AmRest, n.d.) and McDonald's in over 100 countries (McDonald's, n.d.). The scale of operations conducted by both chains makes them organisations that are recognised practically all over the world. Undoubtedly, the food service chains analysed have a major impact on their



surroundings from the point of view of every aspect of sustainability: ecology, economics and social impact.

Verification of the proposed sustainable gastronomy model is key to assessing its practicality. For its purposes, data was collected on the operations of the entities selected for analysis, AmRest and McDonald's, published in sustainability reports and made public on their websites. For the purposes of this study, the most up-to-date available sustainability reports from 2023 were used. These sources provided data that was used for benchmarking and assessing to what extent the developed theoretical model is consistent with the standards implemented by the analysed entities. As a result, the model can be evaluated in the context of the actual data and operations of large food service chains, which significantly increases its reliability and practicality.

#### 4. Verification of the author's model of sustainable gastronomy

The key, from the point of view of the essence of sustainable development, is to think in the long term - much longer than the traditionally accepted time horizon of a few or even a dozen years in strategic plans. The concept of sustainable development is characterised by taking into account the needs of future generations. This perspective is therefore also an integral part of the concept of sustainable gastronomy. Similar conclusions were reached by Richardson and Fenqwist (2024), who concluded from their research that a long-term sustainability perspective is one of the key elements of any sustainable gastronomy strategy. For the purpose of verifying the analysed model, the approach to this issue was reviewed in both surveyed food service chains - the results are presented in Table 1.

**Table 1.**

*The perspective of actions*

Criterion	AmRest	McDonald's
	Model	
Future generations	-	- emphasising forward thinking, in the context of the company's impact
	Other	
Communities in various countries/ regions	- highlighting the importance of relations with local communities and the contribution to the development of the countries and regions in which the restaurants operate	- identifying feeding and supporting communities as a key objective, - emphasising global thinking and local action, - highlighting the unique connections and impact on communities around the world

Source: Own elaboration based on (AmRest, 2024; AmRest, n.d.; McDonald's, 2024; McDonald's, n.d.).

The analysis shows that the proposed perspective - of future generations - is worth broadening to include an intra-generational perspective that includes not only local communities but also the wider international community. This will be particularly advisable in the case of enterprises, such as the food service chains under study, operating on the international market. But it can also apply to businesses with a smaller geographical scope, which, due to increasingly strong globalisation processes, also affect different communities to some extent (e.g. through the use of raw materials, sourced from different parts of the world).

The model analysed refers to the, already mentioned, three pillars (dimensions) of sustainable development. As the first, the environmental dimension is indicated. The activities of the AmRest and McDonald's chains identified in this dimension are presented in Table 2.

**Table 2.**

*Environmental dimension*

Criterion	AmRest	McDonald's
	Model	
Promotion of local biodiversity through the use of indigenous raw materials	-	- supporting sustainable agricultural practices and working with local farmers, - promoting regenerative agriculture that supports biodiversity and soil health
The use of intermediate products and products from sustainable crops and fisheries	- sourcing certified raw materials e.g. palm oil, - declaring continuous improvement of animal welfare standards, - responsible sourcing of raw materials	- presenting commitments to source raw materials (e.g., coffee palm oil, soy, fiber) from certified sources, - sourcing the fish used in Filet-O-Fish products from certified sustainable sources, - supporting local farmers through sustainable farming practices programs (Flagship Farmers Program), - engaging in endangered species conservation
The use of energy-efficient solutions	- use of systems for monitoring and optimizing energy consumption, - using HVAC ventilation and air conditioning systems, - using energy-efficient lighting options and intelligent lighting controls, - maintenance of ventilation systems, - using low-carbon cooking equipment, - investment in energy-efficient equipment, e.g.: heat pumps, solar panels, - reducing electricity consumption by recovering energy used in heating,	- investing in renewable energy sources, such as wind and solar farms, - introduction of energy management systems, LED lighting and energy-efficient kitchen appliances

Cont. table 2.

Reducing water consumption	- using water-saving devices and fixtures, such as low-flow showers, taps and toilets,	- using water-saving devices and fixtures, - implementation of systems for collecting and using rainwater,
Reducing air emissions	- GHG emissions monitoring, - measures to reduce carbon footprint, - replacing vehicles with newer, cleaner (electric) models, - promotion of shortening delivery routes	- a commitment to reduce greenhouse gas emissions in restaurants and offices and across the supply chain by 2030, compared to 2015, - a reduction in the number of miles traveled, - use of alternative fuels
Reducing packaging waste	- using packaging made from renewable and biodegradable materials, - promoting packaging reuse and recycling systems, - promoting the use of own glass at Starbucks	- declaration of use of 100% renewable, recycled or certified packaging, - reducing the use of plastic, - introducing alternatives to plastic lids and straws, - introduction of a recycling system for coffee cups, - promoting and using a closed loop system, - working with franchisees and nonprofit organisations to support local initiatives against littering, such as awareness campaigns and community cleanup days
Reducing food waste	- implementation of the Harvest program, under which surplus food from restaurants is donated to institutions and organisations that support people in need, - cooperation with the Too Good To Go app, which allows unsold food to be sold at a reduced price, - monitoring and managing food consumption, - promoting portion reduction on menus, - cleaning up used cooking oil	- donating surplus food and ingredients to charity, - recycling used cooking oil and coffee grounds
Reducing transport routes by using local sources of supply	-	- production and sourcing of local ingredients (beef and chicken suppliers, dairy and cheese, potatoes)
Other		
Control of compliance with national environmental regulations	- setting up a team responsible for complying with environmental laws, standards and guidelines in the countries in which it operates	-
Exploiting the potential of plant-based food	- Burger King's plans to introduce more plant-based products to the brand's menu	-

Source: Own elaboration based on (AmRest, 2024; AmRest, n.d.; McDonald's, 2024; McDonald's, n.d.).

Based on the data in Table 2, it can be seen that both networks are actively engaged in environmental activities. They initiate similar ventures to reduce energy intensity, water consumption, waste production and counter food waste. The least evidence was noted in the aspect of locality of action, which is due to the global nature of both chains' operations. Nevertheless, McDonald's is taking steps to engage with local suppliers and communities. An analysis of the operations of these chains suggests that the scope of some criteria should be expanded to include not only the operations of the company itself, but also those of its suppliers. This is particularly important in the context of energy intensity and air emissions. In these cases, both networks emphasise the importance of monitoring and preventing adverse impacts not only at their facilities, but also throughout the supply chain. In addition, it was noted that the AnRest chain emphasises ongoing monitoring of environmental regulations in each country and seeks to increase the share of plant-based food in its offerings.

The next dimension of the proposed model, is the economic dimension. The proposals, for action in this area, are shown in Table 3.

**Table 3.**  
*Economic dimension*

<b>Criterion</b>	<b>AmRest</b>	<b>McDonald's</b>
	Model	
Supporting local agriculture and fisheries	- supporting local supply through commitments to responsible sourcing	- supporting local agriculture through programs such as Flagship Farmers Program and the implementation of regenerative farming practices on a larger scale, - working with suppliers to promote animal health and responsible use of antibiotics during animal husbandry, - implementing sustainable sourcing practices for beef, fish, palm oil, soy and coffee
Supporting local service providers (e.g. transport)	- working with local suppliers of transportation and logistics services, - signing by suppliers a Code of Conduct that includes social and environmental responsibility	- working with local transportation and logistics providers to reduce emissions and use more sustainable fuels
Supporting the development of local tourism	-	-
Job creation	- creating jobs in 21 countries, - providing stable employment and professional development, - employing young people in particular	- creating jobs: employing more than 2 million people worldwide, - reducing barriers to youth employment
Supporting the local economy (public levies)	- paying taxes and other fees to local economies in countries where it operates	- paying taxes and other fees to local economies in the countries where it operates

Cont. table 3.

Contributing to the development of sustainable gastronomic innovation	- introducing innovative equipment, e.g. low-carbon cooking equipment	- introducing energy-efficient kitchen appliances, - measures to provide healthier and more sustainable options (e.g. the preparation of new product formulations to remove artificial ingredients, the introduction of new menu items that meet specific nutritional criteria), - developing new menu items that focus on sustainability and healthier options, such as advancing Happy Meal nutrition goals
Promoting practices for low-income earners	-	- operating community programs that support low-income individuals, such as Ronald McDonald House Charities, which provide overnight accommodations and support to families of hospitalized children, - offering programs and meal options that are affordable and nutritious
Other		
Financial programs to support the adaptation of local producers to the requirements of the enterprise	- working with local suppliers, providing support and developing their capabilities through programs such as Responsible Sourcing	- working with local suppliers, providing support and capacity building through programs such as Responsible Sourcing.

Source: Own elaboration based on (AmRest, 2024; AmRest, n.d.; McDonald's, 2024; McDonald's, n.d.).

Analysis of the sustainability reports of the two fast food chains showed that, with the exception of one, basically all the factors (activities) proposed in the author's model in economic terms are within the area of activities undertaken by the analysed chains. An activity that was not identified for both entities in the analysed reports was one related to the development of local tourism. Both analysed entities support local agriculture and transportation providers, working with them to reduce emissions and use more sustainable fuels. AmRest and McDonald's are creating jobs and offering professional development through training programs and international career opportunities. Both of the compared entities are innovating in food service and investing in sustainable infrastructure. McDonald's additionally runs social programs to support low-income people, such as the Ronald McDonald House Charities. However, it is possible to identify an additional (to the proposed model) activity that occurs in both entities: the creation of financial programs for small local suppliers.

Another dimension of sustainability is the social dimension. The results of the analysis of the activities of the two restaurant chains under study and how they relate to the model under review are shown in Table 4.

**Table 4.**  
*Social dimension*

Criterion	AmRest	McDonald's
Ensuring decent and safe working conditions	<p style="text-align: center;">Model</p> <ul style="list-style-type: none"> <li>- declaring respect for human rights, including throughout the supply chain,</li> <li>- compliance with local labour laws,</li> <li>- integration of occupational safety into the risk management system,</li> <li>- the requirement for mandatory occupational safety and certification required in the country,</li> <li>- campaigns to promote safety at work,</li> <li>- equality measures, including the establishment of a position, responsible for coordinating and monitoring them,</li> <li>- conducting research (by an external entity) on equal treatment in restaurants in various countries,</li> <li>- creation of conditions that allow employees freedom of association and collective bargaining</li> </ul>	<ul style="list-style-type: none"> <li>- inclusion of many labor issues in human rights protection policies,</li> <li>- emphasising the importance of employees,</li> <li>- a general declaration of a number of measures to create friendly and safe working conditions, as well as inclusiveness and equal treatment (also supporting such measures with franchisees and suppliers)</li> </ul>
Fair remuneration of employees	<ul style="list-style-type: none"> <li>- compliance with local labor laws (including salaries),</li> <li>- compensation strategy for employees,</li> <li>- monitoring the issue of equal pay, regardless of the gender of the employee</li> </ul>	<ul style="list-style-type: none"> <li>- some activities, mainly in the U.S., dedicated to raising the attractiveness of wages</li> </ul>
Creating opportunities to develop employees' competences in the field of sustainable gastronomy	<ul style="list-style-type: none"> <li>- competence development opportunities created by the network (internal and external training; opportunities to work in other countries),</li> <li>- no explicit reference to developing skills in sustainable gastronomy</li> </ul>	<ul style="list-style-type: none"> <li>- creation of conditions for improving competence and development for employees, including those employed by franchisees (e.g. Hamburger University or Archways is Opportunity),</li> <li>- lack of information on training related to sustainable gastronomy</li> </ul>
Acting for the preservation of the local tradition of culinary culture	-	-
Raising public awareness of sustainable gastronomy among the local community and tourists	<ul style="list-style-type: none"> <li>- work being carried out under the Group's Nutrition Policy on the gradual introduction of more balanced, healthier dishes in restaurants, improving consumers' well-being, nutritional needs and providing enjoyment</li> </ul>	<ul style="list-style-type: none"> <li>- indirectly, by making some pro-environmental or pro-health changes to menus or customer service processes</li> </ul>

Cont. table 4.

Ensuring food safety	<ul style="list-style-type: none"> <li>- the Group's Food Safety Policy, in place since 2022, to source raw materials only from suppliers approved by the Quality Assurance and Food Safety Department,</li> <li>- a declaration on the implementation of the HACCP standard and efforts to raise awareness of food safety among employees (including through training),</li> <li>- regular food safety audits conducted by independent auditors, at all stages of the supply chain,</li> <li>- the practice of unannounced inspections of restaurants</li> </ul>	<ul style="list-style-type: none"> <li>- adoption of a Global Food Safety Strategy, based on safety culture building and risk analysis,</li> <li>- conducting an assessment of the current level of safety culture within 24 markets,</li> <li>- introduction of standards for all stages of food production and distribution,</li> <li>- food safety audits of both suppliers and restaurants,</li> <li>- offering food safety training for suppliers,</li> <li>- organisation of Food Safety Week,</li> <li>- participation in events and initiatives, including international ones, dedicated to food safety and quality,</li> <li>- efforts to provide healthier food, especially for children's products</li> </ul>
Respecting consumer rights	<ul style="list-style-type: none"> <li>- the consumer comment system used to improve processes</li> </ul>	<ul style="list-style-type: none"> <li>- a declaration of the main emphasis placed on product quality and safety,</li> <li>- activities, related to responsible marketing practices towards children,</li> <li>- informing consumers about products, their composition, nutritional values</li> </ul>
Supporting local catering education	-	-
Supporting the local community through various forms of social involvement (e.g. sponsorship)	<ul style="list-style-type: none"> <li>- Food Sharing Day - an action in 9 countries, related to the supply of food to 150 facilities that care for children,</li> <li>- donating surplus products to food banks,</li> <li>- supporting the educational facility</li> </ul>	<ul style="list-style-type: none"> <li>- identifying good-neighborly relations with society as a key value,</li> <li>- declaration on supporting society in areas and times when it needs it,</li> <li>- numerous activities supporting various social groups and various areas of social life (also together with suppliers)</li> </ul>
Other		
-	-	-

Source: Own elaboration based on (AmRest, 2024; AmRest, n.d.; McDonald's, 2024; McDonald's, n.d.).

In general, the social impact activities proposed in the model seem sufficient - no new areas were found in the materials published by the two food service chains. Noteworthy is the fact that in both cases, initiatives to preserve local gastronomic traditions did not appear, which may be due to the global nature of both companies and their offerings. The same is true of the lack of information on supporting local gastronomic education. On the basis of the analysis carried out, however, it is possible to suggest clarifying the provisions, concerning the social sphere, in the area of labor relations. The idea is to indicate that, in the case of activities related to working conditions or wages, consideration should be given not only to their provision within

the enterprise itself, but also within the entire supply chain. A similar extension would have to be included in the case of food safety measures.

The last element, included in the verified model, is cooperation. It follows from the very essence of sustainable development that the implementation and realisation of the principles of this concept require the interaction of various actors. In the case of the transformation of enterprises, including those in the food service industry, the cooperation of actors co-creating supply chains is particularly important, although not only. The results of the analysis of this element for the AmRest and McDonald's chains, confronted with the verified model of sustainable gastronomy, are presented in Table 5.

**Table 5.**  
*Cooperation*

Criterion	AmRest	McDonald's
Model		
Cooperation	- collaboration relating to specific stakeholders	- the company as a global community of workers, farmers and suppliers, - collaboration relating to specific stakeholders
Other		
Cooperation with clients	- indicating the importance of comments from clients for improving the operation of the network	- taking into account parents' comments and expectations in the context of children's offerings, - sharing good food and food safety practices with consumer groups
Cooperation with business partners	- emphasising the importance and value of long-term cooperation with suppliers, - signing long-term contracts with most of them	- pointing to cooperation with business partners as an important element, from the point of view of food safety or implementation of ecological solutions
Cooperation with NGOs and sectoral organisations	- cooperation with food banks in reducing food waste	- listing NGOs and industry organisations as cooperation partners
Cooperation with scientific and educational establishments	- one brand's collaboration with a university - to develop a heart-healthier menu	- scientific basis of the standards being introduced, - sharing good practices with the academic world
Cooperation with political institutions and public administration	-	- cooperation with political institutions
Cooperation with investment community	-	- identifying the investment community as a group of stakeholders with whom the company interacts

Source: Own elaboration based on (AmRest, 2024; AmRest, n.d.; McDonald's, 2024; McDonald's, n.d.).

On the basis of the analysis carried out, it is possible to consider some refinement of the element defined in the general model by the keyword "cooperation," if only by indicating the entities with which such a relationship can be built. Such a procedure could provide more precise guidance to food service industry players who are interested in transforming themselves into a sustainable enterprise. But it may also result in a certain limitation of perspective, only to specifically identified groups of actors. Therefore, it is worth making some modification (detailing) in this area, while leaving some openness to potential new directions of cooperation.



## 5. Conclusions

The analysis of the activities of the two food service chains, on the one hand, showed that in some areas the original model of sustainable gastronomy goes beyond the activities carried out by the surveyed entities; on the other hand, it provided information and inspiration to supplement it with scopes of activities not identified in the original concept.

The results of the analysis confirm that sustainable gastronomy requires a multidimensional approach integrating ecological, economic, and social aspects. The model presented by the authors reflects these dimensions, as evidenced by the practices of AmRest and McDonald's.

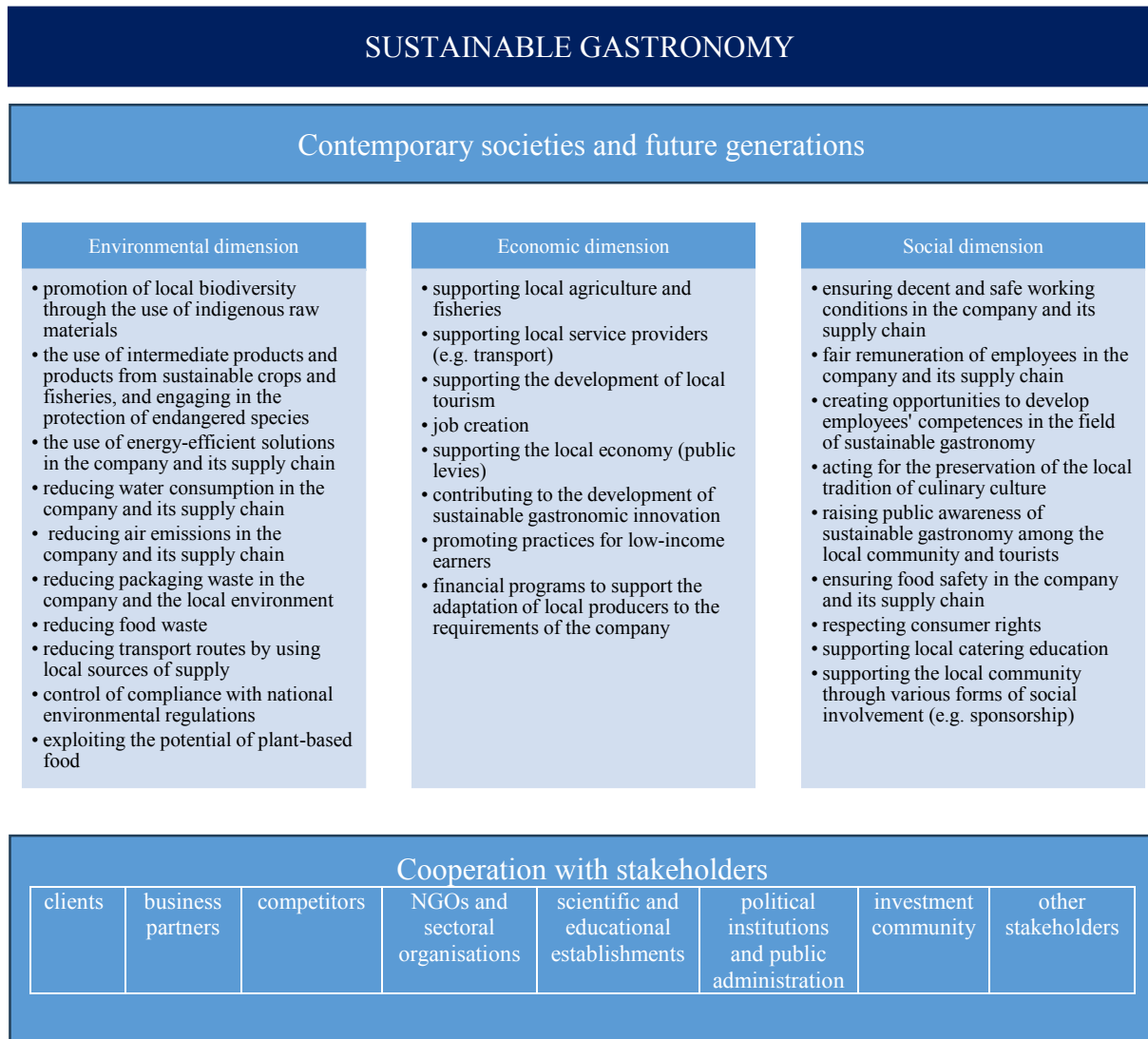
Both the original model and the conclusions of the analysis of the operations of the two food service chains point to the importance of environmental action. But sustainable gastronomy does not only include environmental measures, but also socio-economic ones, but sustainable gastronomy is not only about environmental measures, but also about socio-economic ones. These include, among others, the ethical treatment of workers in supply chains and support for the local economy, as mentioned by Paunić et al. (2024).

At the same time, the need to supplement the model with collaboration involving diverse stakeholders, including the educational sector and non-governmental organizations, has been highlighted (Östergren et al., 2023; Suna et al., 2023; Arslan et al. 2023). Sustainable development in gastronomy requires close cooperation with customers, suppliers, and social organizations. Examples from AmRest and McDonald's demonstrate that such collaboration leads to more effective implementation of pro-environmental initiatives and the building of a positive brand image for the analyzed companies (Richardson, Fernqvist, 2024; Gonçalves et al., 2023).

Education plays a critical role in the development of sustainable gastronomy, targeting both employees and consumers in responsible food management. As highlighted in the literature, such efforts can significantly reduce waste and improve operational efficiency across the enterprise (Martin-Rios et al., 2018). Technologies such as energy monitoring systems and food waste reduction applications (e.g., Too Good To Go) are crucial elements in implementing sustainable practices in gastronomy. These technologies can also serve as educational tools, increasing consumers' environmental awareness (Lévesque et al., 2024).

Sustainable gastronomy requires long-term planning that accounts for the needs of future generations and adopts an inclusive approach for various social groups. Initiatives like Ronald McDonald House Charities demonstrate that food service chains can also play a significant social role, not only in the culinary aspect but also in shaping customer awareness (McDonald's reports, 2024).

Based on the conclusions from the analysis, a modified version of the model was proposed (Figure 2).



**Figure 2.** Modified model of sustainable gastronomy.

Source: Own elaboration.

The verification of the sustainable gastronomy model has made it possible both to improve it in each of the three dimensions (environmental, economic and social) and to broaden the perspective of action planning and clarify the categories of cooperation as elements creating the conditions for the implementation of the actions and changes postulated in the model. Thus, not only was a better result achieved, in the form of a more accurately depicted concept of sustainable gastronomy, but also the validity of the verification and analysis of the model was confirmed. The conclusions of the study underline the need for a broad and long-term thinking perspective, as well as the importance of a holistic approach to the implementation of sustainability principles in catering. Similar conclusions were reached by Pasco-Dalla-Porta et al (2018), who found that a holistic understanding of sustainable gastronomy is vital. Attention is also drawn to the strong links between the areas identified in the model.

The results of the survey can serve as an inspiration and a set of basic guidelines for companies in the food service industry that aim to implement sustainability in their operations.

The verification and refinement of the developed sustainable gastronomy model was based on the analysis of secondary data published by two selected large global food service chains. The authors are aware that this research is the beginning of a process which, in subsequent steps, should include a verification of the model based on a study of the activities of other types of food service operators (e.g. small restaurants, cafés and outlets in hotel chains). This is justified insofar as the specificity of the operation of global chains certainly differs in some aspects from the specificity of the operations of small entities with strong links to the local environment. The next phases of the verification should include, in addition to the analysis of secondary data, as was the case in this article, also surveys of the opinions of various stakeholders in the food service industry - not only businesses, but also consumers.

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## FORECASTING FUTURE SKILLS AND THE INTERNAL POTENTIAL OF ENTREPRENEURS IN THE PERSPECTIVE OF MINING TRANSFORMATION IN POLAND AND THE GLOBAL LABOR MARKET MEGATREND

Ryszard MARSZOWSKI<sup>1</sup>\*, Sylwia JAROSŁAWSKA-SOBÓR<sup>2</sup>

<sup>1</sup> Central Mining Institute, National Research Institute, Katowice; rmarszowski@gig.eu, ORCID: 0000-0002-2855-7121

<sup>2</sup> Central Mining Institute, National Research Institute, Katowice; sjaroslawska@gig.eu, ORCID: 0000-0003-0920-6518

\*Correspondence author

*We can gain knowledge from others,  
but we must learn wisdom ourselves  
Adam Mickiewicz*

**Objective:** in the cognitive space of the article, it focuses on one of the key challenges for the domestic mining industry, which is the need for skillful and innovative promotion of modern attitudes and convincing that moving away from the way of thinking prevailing in the industrial era is purposeful and inevitable, because only and exclusively turning to the future - through care for one's own development - can guarantee success<sup>1</sup>.

**Methodology:** the theses presented in the article were verified using the following methods: literature review, critical analysis of literature, analysis of documents and comparisons and examples of good practices.

**Result:** the possible success of maintaining balance on the labor market in the area of internal potentials of entrepreneurs - in transformed areas - in the perspective of the megatrend global labor market will most likely be determined by an approach based on important determinants such as full and understandable information for the recipient based on the most complete knowledge of transformation processes and creativity in their implementation.

**Originality:** it seems that breaking mental barriers towards innovations in order to strengthen their acceptance may play a decisive role in creating the development of transformed labor markets. The pursuit of innovation leads directly to economic growth at the level of both the state and the commune, while at the individual level promoting social inclusion and strengthening people's sense of life to the full.

**Keywords:** transformation, job market, skills.

Category of the paper: research paper.

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## 1. Introduction

Currently, one of the key challenges, among others for the domestic mining industry, is the need for skillful and innovative promotion of modern attitudes and convincing that moving away from the way of thinking that prevailed in the industrial era is purposeful and inevitable, because only and exclusively turning to the future - through care for one's own development - can be a guarantee of success. The main determinant shaping the position outlined above is the change in the paradigm of development of the current model of the world economy as a result of its dynamic transition from the era of the industrial revolution to an economy based on knowledge, determined in its development by a new process called Revolution 4.0. In this perspective, it should be recognized that human resources - in particular qualified staff - are the most valuable resource of modern economies determining the successful course of transformation of mining areas and further.

The indicated process will have a huge impact on the quantitative and qualitative dimension of the labor market, which is also determined by changes in the structure of consumer demand or, for example, the decline or development of economies. This is related to, among others, with the emergence of increasingly severe effects of transformation processes in the globalized economy. This article is devoted to the problem outlined in this way, in which, in the context of issues related to the global labor market, the social challenges related to the transformation of mining are in the foreground.

## 2. Discussion

Transformation in Poland is an important social and economic issue. This issue is particularly related to the process of implementing the European Green Deal plan (<https://ec.europa.eu/info/strategy...>, 2024). In the perspective of the plan, the green economy, which is defined as an economy that improves people's well-being and increases social justice - while reducing environmental risk and the consumption of natural resources (Environmental Indicator Report..., 2012), is of particular importance. In another approach, the green economy is a low-emission economy, economical in the use of raw materials and socially inclusive (Measuring Progress..., 2012). The importance and significance of actions developing the green economy are emphasized by the policy of the European Union, which has some of the strictest environmental protection standards in the world. The EU and national governments have set clear objectives to shape European environmental policy towards 2050. These objectives are (A greener, more sustainable Europe..., 2022):

- protecting, preserving and enhancing the EU's natural capital,
- transforming the EU economy into a resource-efficient, green and competitive low-carbon economy,
- protecting Europeans from environmental pressures and threats to health and well-being.

EU environmental policy has always been characterized by a structured set of legal acts regulating it, the most important of which over the years have been:

- Articles 11 and 191-193 of the Treaty on the Functioning of the European Union (TFEU); in the Single European Act of 1987, a new title was introduced, "Environment", which was the first legal basis for a common EU policy in the field of the environment (OJ 2004.90.864/2 – Treaty on the Functioning..., 2004),
- under the Maastricht Treaty (1993), the environment was recognized as an official area of EU policy. The Amsterdam Treaty (1999) introduced the obligation to integrate environmental protection into all sectoral EU policies (European Union consolidated..., 2002),
- in the Treaty of Lisbon (2009), "Combating climate change", as well as sustainable development, became specific objectives (Treaty of Lisbon amending..., 2009).

A milestone in the transformation of EU countries towards a green economy – which assumes the need to decarbonize energy – is the Horizon Europe program (Horizon Europe – new program..., 2024). Horizon Europe promotes excellence and provides valuable support to the best researchers and innovators, thus driving the systemic transformation needed to ensure a green, healthy and resilient Europe. It stimulates scientific excellence through the European Research Council (ERC) to enable excellent researchers to push the frontiers of science and knowledge to help address the economic and societal challenges Europe faces. Horizon Europe also supports collaborative research on the societal challenges Europe faces and strengthens technological and industrial capacity through thematic policy groups addressing the full range of global challenges. For example, the clusters "Climate, Energy and Mobility" and "Digital, Industry and Space" will scale up climate-related research and innovation, and provide European companies with access to the technologies and data they need. Horizon Europe will also introduce new initiatives such as the European Innovation Council (EIC) and EU missions. The European Innovation Council, which operates, has received a budget of over €10 billion to support emerging and breakthrough innovations in start-ups, small and medium-sized enterprises and mid-cap companies. This activity will complement the work of the European Institute of Innovation and Technology (EIT). Furthermore, by establishing contacts with regional and national innovators, European innovation ecosystems will be strengthened. In turn, EU missions focus on issues that affect our daily lives – from fighting cancer to adapting to climate change, living in greener cities, protecting water and oceans, or ensuring healthy soils for healthy food, human health, nature and climate.

In turn, the aforementioned European Green Deal plan is the path to the first climate-neutral continent. The European Green Deal is:

- a plan to build a sustainable economy,
- resource efficiency and a clean economy,
- covering all sectors of the economy,
- the need for additional investments and a fair transition mechanism,
- citizens' voice and international cooperation,
- transition to a clean, circular economy,
- stopping climate change,
- combating the loss of biodiversity and reducing the level of pollutants emitted.

Climate change and environmental degradation pose a threat to Europe and the rest of the world. To meet these challenges, the European Green Deal action plan was created. It is to help transform the EU into a modern, resource-efficient and competitive economy that will:

- achieve zero net greenhouse gas emissions by 2050,
- decouple economic growth from resource consumption,
- shape social order so that no person or region is left out of the transformation process.

The European Green Deal is financed with funds representing one third of the €1.8 trillion earmarked for investments under the Next Generation EU recovery plan and from funds from the seven-year EU budget.

In addition to the above-mentioned literature sources relating to the transformation, the article refers to national documents outlining medium- and long-term goals and tasks in the field of energy transformation and the Just Transition Plan. The first of the documents discussed in the expert opinion is the National Recovery and Resilience Plan (National Recovery Plan..., 2021), in which the key objective in the part devoted to green energy and reducing energy intensity is clean air. This objective should be achieved, among others, by: thanks to (<https://www.funduszeuropejskie.gov...>, 2024):

- faster replacement of old coal furnaces with more ecological ones,
- purchase of photovoltaic panels and solar collectors,
- wind farms in the Baltic Sea,
- smart power grids,
- hydrogen technology,
- green cities.

In turn, in the Strategy for Responsible Development we read that the assumed transformation of the economy towards a low-emission economy will require a complete revaluation and new market models allowing for such features as power, availability, location of the producer, location of the recipient, demand characteristics, etc. However, due to the nature of energy services, changes must be evolutionary and it is necessary to reconcile a sufficiently strong base of conventional, large-scale production forces in professional energy

with distributed sources functioning as a supplement for medium-sized agglomerations and clusters, energy cooperatives, etc. with a significant level of autonomy (Strategy for Responsible Development..., 2017).

Another important document in the space of transformation processes is the Energy Policy of Poland. In this document, one of the primary goals is to ensure that for social, economic and environmental reasons, the implemented restructuring of coal regions will ensure that a just energy transformation will lead to economic strengthening, leaving no one behind and will serve future generations. Financial instruments under the EU mechanism for a just transformation, mobilizing support funds in the amount of PLN 60 billion, are to support this process. Detailed solutions in this area will be included primarily in the national and territorial plans for a just transformation (Energy Policy of Poland..., 2021). At the regional level, the key document of a strategic nature in the space of transformation processes is the Development Strategy of the Silesian Voivodeship "Śląskie 2030". This document clearly states that from the perspective of the Silesian Voivodeship, the implementation of the Silesia Program will be important, the aim of which is to change the economic profile of the region, gradually replacing traditional sectors of the economy, such as mining and metallurgy, with new ventures in more productive, innovative and technologically advanced sectors. It was assumed that after 2020, the Silesia Program will be fully implemented, correlated with government restructuring programs, expansion and modernization of transport infrastructure, implementation of a new, territorially sensitive, integrated urban, industrial, innovation and human resources policy. It is planned to introduce additional instruments related to the adaptation of national operational programs to the objectives of the Silesia Program, primarily in the area of investment promotion and innovation (Voivodeship Development Strategy..., 2020). New directions and challenges are outlined in the Regional Innovation Strategy of the Silesian Voivodeship 2030. The strategy clearly indicates that in the coming years, entities from the Silesian Voivodeship will be beneficiaries of a special European Union instrument supporting green transformation, which is the Just Transition Fund. This support will enable: production investments in SMEs, leading to economic diversification and economic restructuring; investments in the creation of new enterprises; investments in research and innovation activities and supporting the transfer of advanced technologies; investments in the implementation of technologies and infrastructures providing affordable clean energy, in the reduction of greenhouse gas emissions, energy efficiency and energy from renewable sources; investments in digitization and digital connectivity; investments in the regeneration, decontamination and renaturalization of areas and projects changing their purpose; investments in strengthening the circular economy; improving and changing employee qualifications. However, the allocation of funds will be carried out within the framework of a separate Territorial Just Transition Plan, which will be created for seven subregions of the voivodeship: Katowice, Bytom, Sosnowiec, Gliwice, Tychy, Rybnik and Bielsko (Regional Innovation Strategy..., 2021).

The key operational programmes in the transformation process space are the Regional Just Transformation Plan of the Silesian Voivodeship 2030 (Territorial Just Transformation Plan, 2021) and the Just Transformation Fund (Just Transformation Fund, 2020).

In the Regional Plan, expert attention was focused primarily on the transformation process. In this perspective, it is stated that the transformation of the voivodeship will require a change in the production structure and the development of the energy sector in the region. One of the implemented actions will be the phasing out of obsolete power units (built in the 1970s and 1980s) and replacing them with modern infrastructure, friendly to the environment and the inhabitants of the region. (...) Renewable energy sources will play a key role in the energy system of the region. The Territorial Just Transformation Plan provides support for this type of investment as an important element of the diversification of generation sources in the regional energy mix. The implementation of the indicated activities will contribute to achieving the national target of 21-23% share of renewable energy sources in gross final energy consumption.

The second of the cited documents, the Fund for Just Transition in the Silesian Voivodeship, will serve to achieve the main goal, i.e. mitigating the social, economic and environmental effects of the transition to a climate-neutral economy. In conjunction with other sources of financing, in particular the funds of the Cohesion Policy 2021-2027, funds from the remaining pillars of the Just Transition Mechanism and other public and private funds dedicated to complementary activities and projects, this Fund will give new impetus to the region's economy and open up better development prospects for its inhabitants, especially those most affected by the negative consequences of the inevitable transformation process.

Documents, plans, strategies and theses, corresponding to the goal of achieving a green economy in the EU, determine at the same time – especially at the level of local communities – the need to recognize the social reception of the just transformation process, which may be of great importance for the state and development prospects of the transformed areas and are a fundamental recommendation for the creation of programs aimed at strengthening the country's energy policy based on clean technologies. Remembering the effects that have occurred over the many years of transformation of hard coal mining in Poland, one should not ignore the fact that further transformation of this important sector of the national economy may cause states of its social acceptance or rejection. This is of particular importance for the sector and its environment, which are systematically subjected to pressure resulting from its adaptation to changing political, economic and social conditions. In this perspective, thematic areas that are clearly part of transformation processes – especially the transformation of hard coal mining – are key challenges for EU policies shaped by the European Green Deal plan, which is gaining particular importance in both the cognitive and utilitarian areas. The above-mentioned processes and phenomena trigger transformations within economic organizations and other institutions. They are directly or indirectly related to the spheres of employment and human resources management. As noted in numerous works, six key global challenges, which are: digital future, global market, health care, raw materials and natural resources, urbanization and

growth of entrepreneurship, result in the process of adaptation of enterprises in the areas of principles of operation, information methods and organizational models in order to build sensitive solutions based on innovations that shape modern (smart) enterprises of the future (Rosário, Dias, 2023). Given the directions of change outlined above, the biggest challenge for intelligent and innovative organizations is the need to predict the future, improve in the face of the changing environment, build solutions that respond to changes that may occur in the future and increase their competitiveness (Leea, Trimib, 2018, pp. 1-8).

In the area described above, special importance is attributed to the management of human resources. This is even more so if management generally means the ability to work through other people. In practical terms, this ability is difficult and complex. Effective management of people requires, apart from substantive knowledge, orientation in the scope of their needs and the system of values they possess. Only on the basis of such knowledge can one take up challenges related to developing a system of motivation, assessment, promotions, etc. Based on the definition of human resources management, it can be stated that it is the ability to determine the principles and methods that condition the pursuit of organizational goals through the employees employed in it, i.e. qualified staff that are specified and respond to the given needs (Sajkiewicz, 2004, p. 33). In the perspective of the indicated definition, the goal of strategic human resources management is to strive for a state in which everything (i.e. tradition, work style and organizational structures, as well as quality, commitment and motivation of employees) brings the enterprise closer to the desired success (Dudzińska-Głaz, 2012, pp. 83-83). In this context, strategic thinking is an essential, and perhaps even the most important component of human resources management in the transformation process. It outlines the framework within which specific solutions to problems arising in the employee team are developed and adopted (Arokiasamy, Fujikawa, Piaralal, 2024).

Moving on from the level of considerations, the subject of which is the individual, it should be noted that the changes taking place in the modern world pose new challenges for the education system and enterprises, which in turn are reflected inside them, leading to changes in processes and structures. Both education systems and enterprises that intend to survive and develop must skillfully forecast the reality surrounding them and permanently adapt to the changes taking place, among others, through appropriate strategies and permanent shaping of processes occurring inside them. In addition to this challenge, new problems in the field of human resources management are currently emerging, which are a consequence of changes in the global economy, of which domestic enterprises are participants. One of such challenges is the constant need to adapt education to the processes taking place on the labor market, which often does not correspond to the directions of economic development and the needs of the enterprise. Hence, it is so important to skillfully recognize the staffing needs expected in the economy (Matei, Abrudan, Abrudan, 2024). As Juchnowicz notes, the economy and its changing structure shape both the quantitative and qualitative staffing needs, qualifications and competencies of labor resources. A 21st century employee must be a comprehensively educated

expert. In modern economies, where knowledge is the key capital, there is a characteristic regularity. Namely, obtaining a job is determined by 70% of the professional knowledge resources and 30% by soft skills, also known as social skills. However, a job can be lost 70% due to a lack of soft skills and 30% due to a lack of professional knowledge (Juchnowicz, 2007, pp. 40-46). At the labor market level, the indicated transformations are determined primarily by the quantitatively and qualitatively changing flows of labor supply and demand for labor. In particular, changes are revealed as a result of the aging process of labor resources and the changing market, which in a given situation is dominated by high unemployment or a high employment rate (Betcherman, Olivas, 2024). The situation of change on the labor market as a result of convergence or divergence of the flows of labor supply and demand for labor in the context of qualified personnel causes an increase in demand for them or their surplus. In a given situation, appropriate solutions should be sought, in accordance with the available possibilities, to consolidate or improve the situation on the labor market. As indicated by the authors of the work entitled *Foresight of the staff of the modern economy* (hereinafter FKNG), currently numerous analytical works inform about the deficit of qualified personnel (Gryzik, 2009, p. 44). This state may significantly threaten economic development on a global scale. In view of this change, the situation on labor markets is subject to constant change. As a result of the changes taking place, regularities characteristic of labor markets can be distinguished. The population of people with unlimited access to gaining education, especially higher education, is clearly increasing. The service sector is dynamically growing. Along with this process, staffing needs are developing, which will increase in the long-term perspective (World Employment and Social..., 2024). These processes in countries with the highest level of economic development are inevitably accompanied by the progressive process of ageing of societies and the phenomenon of a decrease in the population of people entering the labor market for the first time. At the same time, there is a clear decline in births, which in the economies already mentioned do not guarantee a simple population replacement, and the average life expectancy is significantly increasing, which is the result of a significant improvement in the area of health care and living conditions. As a result of these changes, it is increasingly difficult for working people to secure the area of economic deprivation for non-working people (World employment social outlook..., 2018). The effect of the described demographic and social changes is a systematic decrease in labor resources in OECD countries, where it is forecasted that in the years 2025-2030, they will decrease by 12 million per year (Commission Staff Working Document..., 2023).

Another significant – currently very new – challenge for labor markets in transformation processes is digital disruption. As the authors of the work note: *Competencies of the future in times of disruption*, we are witnessing rapid changes in the previously linearly organized world. Thanks to digital technologies, our lives and work are changing so radically that we can even talk about sudden civilizational changes. In the perspective of 2030, we will have to free ourselves from the current cognitive dualism - seeing two separate worlds called real and virtual



- and accept the integrity of the 21st century world as a space in which reality gains a new, digital dimension. This is a sine qua non condition for the country's development, posing a huge challenge to the education system. The last decade, as never before in the history of the Internet, has shown that civilization competences have a dominant impact on the comfort of life and professional position. Today, having them is a guarantee of good remuneration and a strong position (Głąb, 2019, p. 8). In this light, transformation processes can lead to growing and perpetuating social divisions – the syndrome of “inherited poverty” – economic, civilizational and cultural territorial divisions (Bowen, Kymlicka, Muhammed, Duyvendak, 2018). As Piątkowski notes, transformation processes, on the one hand, stabilize areas of economic growth, low unemployment and increasingly better infrastructure, while on the other hand they create regions with poor economic prospects (low development dynamics and no prospects for overcoming civilizational regression). In the latter, people are accompanied by a sense of pessimism, hopelessness, apathy and discouragement. Increasingly numerous and increasingly alarming social diagnoses and expert opinions gradually began to reveal the image of permanent exclusion and isolation that grew among numerous categories of people dependent on the care of others or the support of an inefficient social welfare system. It was pointed out that this group has ceased to be a "social margin", as its numbers are gradually growing, and poverty and passivity are increasingly becoming petrified and inherited. These phenomena are particularly drastic and painful when they concern children and young people, both those from big cities and those from rural and small-town environments (Piątkowski, 2011, pp. 76-84). The phenomenon of employment diversity also includes many features defining the characteristics of qualified personnel and their position on the labor market. Diversity in employment and the benefits resulting from it have two key references (Saxen. 2014, pp. 76-85). The first emphasises the need to keep people of pre-retirement age on the labor market as long as possible. Considering Poland's development prospects, in particular the improvement of the professional and social situation of people aged 50 and over, changes in the labor market are important - and in the area of professional activation - which can be illustrated by the employment rate in the population between 20 and 64 years of age, which in 2022 approached 75.7% in Poland (Employment rate in EU countries..., 2024). In the same period, the employment rate for the 28 European Union countries was 73.5% (In Sweden, the employment rate..., 2024). In view of the above data, it is worth noting - taking into account the transformation processes - that retirement is the main cause of professional inactivity of Poles aged 45-69 (Employed, unemployed and professionally inactive..., 2024). Decisions regarding retirement are conditioned by various systemic and institutional factors, but individual reasons related to the socio-economic, health and family situation prevail. Some of the barriers to extending the period of professional activity can be removed through appropriately implemented social policy. This includes providing institutional care for minor children and seniors, as such caregiving responsibilities, especially towards grandchildren and

parents, burden many people from the 45+ generation, increasing the tendency to professional deactivation.

Based on the above regularities, it should be stated that human resources - including qualified staff - characterized by a certain level of knowledge, qualitatively unique skills and highly developed qualifications constitute the basic resource of labor supply and every organization (Mizrak, 2023). Good, qualified staff in the economic reality surrounding them can minimize structural stratification on the labor market, eliminate the mismatch between professional qualifications and employment needs, limit the growth of unemployment and ultimately determine the success of the enterprise's mission. As it is noted in research on the labor market, especially in the field of organization and management, in the recent past, competitive advantages on the market were demonstrated by enterprises with relatively simple capital resources, which were most often technologies, raw materials, means of work, etc. Currently - as indicated by research on management - the dominant ones on the market are enterprises with modern, intelligent and change-sensitive staff, which efficiently and effectively use their potential to achieve the assumed economic goals and implement the mission of the enterprise. Dominant in these activities is - as already noted earlier - the ability to work appropriately through people and manage personnel (David, 2011, 2009, 2007).

The spaces introduced in the transformation process are important for identifying knowledge that becomes a unique achievement developing in the cognitive and practical canon of implementation and development of the organization and the possibility of managing it in a possible changing socio-economic system. This position is confirmed, among others, in the monumental study on "Management, organizations and organizing - a review of theoretical perspectives". The cited work notes the importance of interpenetration of theory with practice and practices with theory - as a determinant of the development of the management science discipline. In this part, attention is drawn to the influence that concerns the classical perspective, which concerns the already established and unquestionable position in the achievements of management science, and concepts that are relatively new and that include the subject of scientific considerations. As a consequence, they spread with inevitable devices that are provided from theoretical and empirical research results - which open up a new space for the management science discipline - as part of achieving transformational goals (Latusek, 2016, p. 13). In this light, it can be assumed that empirical works, examining transformational changes in the applied goals of organizational research and the cognitive spaces encompassing them, not only spread to the encountered problems, but also bring new, external elements resulting from the facts that progress in knowledge and scientific activity is possible if we consciously and deliberately closed the research procedure (Apanowicz, 2020, pp. 19-20). Drawing conclusions from the conclusions on the content, it seems that the contribution to transformational allegations based on research based on changes in the environments transformed within the framework of economic and humanistic sciences, applying itself in the form of compensating practical knowledge. The validity provided by your Sudol achievements,

who notes, science is increasingly expanded, management practice, as it is increasingly expanded, more advanced solutions should be applied in conditions expanded from the reach of technology and increasingly advanced prediction of the future in terms of the development of technology, and social life (Horizons of Contemporary Management, 2016, pp. 38-39). Against this background, it was noted that the current action is possible for employees, which can be available for the world economic growth and development. The labor market is turbulent and constantly changing. The processes and actions occurring in the labor market can be identified its characteristic determinants. As the authors of the work entitled Using the labor market note, every day people, companies and institutions in the labor market make choices. What education should be the property of my child? Is there a skilled force available in the system, which can come from our company, available in a new business? Can a better educated workforce be used to attract foreign investment? Is there a need to revise some educational programs? Is the application required to attract students to study in the extension? Are people making decisions based on the information provided earlier; or inevitably a description in a situation of imperfect information. In this category, people, institutions and companies have not been preparing for these challenges for many years. You can never be sure what will happen will appear in the future, it is important to use the information that is available in the future (Rihova, 2016). Expand the forecasts and notifications are the aforementioned growing population and its aging. As signaled by the authors of the Leadership 2030 report, especially as a result of the effects of demographic changes that come from the traditional industrial model (Building a New Leader, 2014). These countries may be primarily the result of an attack with social systems and growing migrations. A serious challenge for these countries will be the "brain drain". It is worth supporting here that the controller was sent by the Royal Society in London (British Royal Society). It took place in the first half of the 1960s and described the emigration of a young controller living in the British Isles (Podemski 2010; Aráuz, Wittchen, 2010, p. 91; Kaczmarczyk. Tyrowicz, 2008, p. 4).

Over time, the term brain drain was adapted in other European countries, including Poland. An example of the phenomenon described is, among others, the migration of Poles from 1981-1988. It is estimated that around 700,000 people emigrated from Poland during those years, of whom nearly 15% had education higher than secondary. It is worth noting that the indicated percentage of migrants constituted a serious loss considering the fact that during that period people with higher education constituted only 7% of the entire Polish population. It is estimated that as a result of the described migration of highly qualified and specialist staff, national labour resources decreased by a factor corresponding to one quarter of the total number of graduates of national universities (Kaczmarczyk, 2006, p. 11). As a result of the changes outlined above, industrial countries may experience numerous shortages, which may result in numerous problems and social conflicts. This may be particularly evident in the phase of the return of migrants, who may undoubtedly accelerate local development at the expense of increasing competition on the labour market as a result of the increasing supply of highly developed

professional qualifications. The authors of the Leadership 2030 report call this phenomenon directly the "talent war" (<https://www.leadersinstitute...>, 2024).

Along with the indicated trends, it is necessary to note the growing problem related to migration. This is particularly noticeable in countries with moderately developed economies, which are struggling with the outflow of qualified personnel to highly developed markets. When assessing the indicated phenomenon, it is emphasized that in the migration processes of human resources characterized by highly developed and innovative qualifications, not only the brain drains counts, but also their degradation (brain waste). The global regression on labor markets that occurred in the years 2001-2004 significantly limited the professional development of young people. The indicated phenomenon particularly strongly depreciated the position on the labor market of young people with lower and less developed qualifications. These people most often decided to migrate as a result of lower self-esteem in the context of their own development opportunities on the domestic labor market, lack of abilities enabling planning of personal development and critical knowledge on the subject of migration conditions and the resulting effects. When deciding to leave the country, they did so many times as a result of pressure from the environment (critical attitude towards the position on the labour market burdened with the risk of unemployment) and the lack of other solutions. As a result of decisions made, which were not determined by justified premises, there was a depreciation of the qualifications and skills held as a result of taking up work unrelated to the education and qualifications held. This was also indirectly related to the phenomenon of social alienation in the place of origin and difficulties related to socio-professional adaptation in the place of destination of migration. In conclusion, economic migration of young people resulted in very unfavorable further behaviors, which were associated with the lack of continuation of education, stagnation in the development of personal life and lowering self-esteem as a result of assigning the status of a second- or third-rate employee (Kaczmarczyk, Tyrowicz, 2008, p. 4).

In light of the considerations undertaken above and the indicated regularities, it is clear that the situation in the structure of human resources, including qualified personnel in the labour market and enterprise dimension, is currently determined by numerous challenges. Failure to address them may significantly determine a bad relationship between labour demand and labour supply. In this situation, it seems justified to accept the following thesis: since it is impossible to stop changes in the market, one must learn to benefit from it (Chesbrough, 2002). The view expressed above regarding changes in the market implies several significant changes, among which the following deserve special attention:

- the growing importance of local participation in making global decisions in more culturally diverse conditions of cooperation,
- the need to implement projects based on international mobility and adaptability as well as cultural sensitivity,

- the need to increase social awareness related to responsibility for the natural environment,
- the disappearance of state policy in the implementation of social functions and their takeover by an increasingly organized local society.

An indispensable element of the ongoing changes that determine the situation on labor markets, including in enterprises, is the previously indicated high positive balance of external migration (Kałuża-Kopias, 2014) and the reversal of the age pyramid and the related demographic depression and ageing of society (Marszowski, 2017, pp. 229-244). These processes will force the need to develop innovative solutions that can integrate and develop international policies towards the phenomenon of migration of older people, especially in relation to women. In response to the indicated changes, it seems that the primary actions should be focused on building innovative solutions that respond to the need for intergenerational integration programs related to maintaining the professional activity of older people for as long as possible. At the same time, reducing the growing intergenerational information gap. The potential success in this area will most likely be determined by the ability to prepare innovative solutions that ensure a balance between professional work and life - based on the flexibility and multifunctionality of work - while guaranteeing freedom and autonomy to the individual. It is worth noting in the context of the threats indicated that in highly developed economies, the changes taking place have been focused on selected economic and social areas. They are currently taking shape on the level of the convergence process between nano-, biological and information technologies and cognitive sciences (hereinafter referred to as NBIC technologies) (Cognitive Sciences and Philosophy of Law, 2014, pp. 175-186). NBIC technologies are developing extremely dynamically, creating progress in the sphere of health care, energy, environmental protection and production, leading to the transformation of other areas, even non-technical ones – from outside their area of impact. It seems that in this light, the future of local communities will be determined by two trends. In the first of them, the local community will be on the margin of the changes taking place as a result of its exclusion from the process of co-participation in the convergence mentioned above. In a successful scenario, it will join the process indicated above based on its development potential – and will benefit from it on equal terms with other participants.

In view of the above-outlined patterns and challenges, the transformation of mining, especially in the context of global trends related to decarbonization, automation and sustainable development, has a huge impact on human resources in this sector. Changing technologies, regulations and socio-economic expectations force not only the adaptation of enterprises, but also far-reaching transformations in competences, work organization and employment structures. First of all, automation and the introduction of modern technologies, such as robotics, artificial intelligence or the Internet of Things (IoT), reduce the demand for traditional, physical work in mines. Tasks previously performed by people are increasingly being taken over by machines, which leads to a reduction in jobs in the mining sector. Therefore, the need

to retrain employees is becoming a key challenge for human resources. Skills related to the use of advanced technologies and data management are becoming increasingly desirable, which requires intensive training programs and investments in the development of human capital. Secondly, the transformation of mining forces a change in the approach to human resources management. Mining companies need to develop flexible employment strategies that allow them to adapt to new technological challenges and the changing structure of the industry. Instead of long-term employment based on manual work, there is a need to create more dynamic work models that value innovation, analytical skills and an interdisciplinary approach to problems. HR managers must therefore take into account new competences and promote continuous professional development of employees. Finally, the transformation of mining also brings with it social transformations. In regions dependent on traditional forms of extraction, the reduction in the number of jobs can lead to social tensions, requiring intervention in the form of programs supporting local communities. Therefore, the development of strategies that support restructuring processes by creating new jobs becomes a key aspect, especially in sectors related to renewable energy and other sustainable branches of the economy. The transformation of mining significantly affects human resources, requiring new competences, adaptation to advanced technologies and flexible employment models. At the same time, it poses challenges related to retraining employees and support for mining regions, which is necessary for sustainable social development. In view of the above findings, it seems that breaking down mental barriers towards innovations in order to strengthen their acceptance may play a decisive role in creating the development of transformed labour markets. Striving to develop innovations leads directly to economic growth in both the state and the commune, supporting social inclusion in the individual dimension, strengthening people's sense of life to the full (Wronka-Pośpiech, 2015, p. 133).

### **3. Summary**

Analysis of the overall analysis in the spatial space of the transformation noticeable, characteristic of the occurrence, which can limit or determine their successful course. spreading to the risk that occurs in the last decades of the labor market. In view of this, the solution that will follow with the development, can be detected on the regularities, the detection and launch of which can ensure their successful solution. Continuing the supply, it should be taken into account that they are particularly exposed to the effects of transformation changes in countries and regions whose economies are on the traditional industrial model. the threat that may occur above all is the threat to the efficiency of social systems and growing migrations. In this light, transformation processes can lead to growing and perpetuating social divisions - the syndrome of "inherited poverty and deprivation" - economic, civilizational and cultural territorial

divisions. On the one hand, transformation processes can stabilize economic growth, lead it and increasingly threaten infrastructure, on the other hand, create regions with poor economic prognosis (low development dynamics and no prospects for breaking the civilizational regression). In these last speeches there is usually a sense of pessimism, hopelessness, apathy and disruption. In order to apply the effects above, the effects resulting from the full definition of the community that is transformed, justified that the departure from the way of thinking in the industrial era is purposeful and inevitable, caused only and exclusively with access to the future - through the application of one's own development - can constitute a success. In the system dominated by the Industrial Revolution 4.0 and shaped meaning, attention should be paid to the inevitability of technological developments that will shape a new dimension of life and work. Transformational processes in extensions available worldwide, combined with cognitive functional functions, two independent worlds and virtual, in favor of the original reality perceived in one digital sensor. The above elements concern one of the goals, that is, to perform a reconnaissance of the social reception of the transformation, which may be significant for the state and development perspective of the transformed areas and be a fundamental recommendation for the creation of restrictions that may affect these elements in the labor market space.

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## INVESTIGATION OF MATERIAL PROPERTIES UNDER CRYOGENIC CONDITIONS: A REVIEW

Abdisa Sisay MEKONNIN<sup>1\*</sup>, Krzysztof WACLAWIAK<sup>2</sup>

<sup>1</sup> Department of Material Technology, Faculty of Materials Engineering, Silesian University of Technology;  
abdisa.sisay.mekonnin@polsl.pl, ORCID: 0000-0003-2121-0106

<sup>2</sup> Department of Material Technology, Faculty of Materials Engineering, Silesian University of Technology;  
krzysztof.waclawiak@polsl.pl, ORCID: 0000-0003-2175-1906

\* Correspondence author

**Purpose:** The purpose of this work is to analyse the behavior and mechanical properties of metals, alloys, polymers, concrete, and composites of various materials at low and cryogenic temperatures below 123 K (-150.15°C). This review paper highlights the influence of cryogenic conditions upon material selection and design for applications where critical service conditions require exposure to extreme cold, including energy storage, aerospace, offshore structures, superconducting technologies, shipbuilding, and LNG carriers.

**Design/methodology/approach:** This review attempts to synthesize results from experimental studies, computational modeling, and theoretical analyses that have examined changes in material mechanical properties at cryogenic conditions. This review is focused on the fracture toughness, tensile strength, brittleness, and associated properties of the various classes of materials. In so doing, the approach is aimed at understanding how those properties evolve at low temperatures and their implications on materials selection and design for harsh environment applications.

**Findings:** Results show that even though cryogenic temperatures can be applied to enhance the tensile strength, modulus, ultimate strength, and fatigue resistance of materials, they simultaneously cause a significant reduction in ductility, therefore making the material more brittle with enhanced susceptibility to micro-cracking. The paper underlines the fact that material development should proceed to develop those possessing increased strength, resistance to wear and corrosion with less compromise of ductility.

**Limitations/implications of the research:** The complexity in testing materials at cryogenic conditions and the difficulty in directly correlating the experimental results with real applications are the limitations of the research. Further research is needed before such challenges are met and before materials with optimum performance at low temperatures, without sacrificing key properties, are developed.

**Originality/value:** This review gives important insight into the mechanical behavior of materials at cryogenic temperatures and points out the need for advanced material development with specific emphasis on additive manufacturing for tailoring material properties in view of superior performance and reliability in extreme cryogenic environments. The results will be an important guideline for future research and material selection of various industries, specifically aerospace and energy storage.

**Keywords:** Cryogenic temperatures, mechanical properties, advanced materials.

**Category of the paper:** Literature review.

## 1. Introduction

The demand for materials that can withstand very low temperatures and cryogenic conditions is increasing across a wide range of industries, including shipbuilding, energy storage sectors, food processing and preservation, offshore structures, LNG (liquefied natural gas) pipelines, and hydrogen energy storage tanks (Luo et al., 2022; Sohn et al., 2015; Zhang et al., 2023; Xie, 2017). However, a major challenge for the engineering applications mentioned above is prolonged exposure to extreme low-temperature environments (Naser, 2019). Materials safely works under very low temperature is crucial for hydrogen turbo pumps in rocket engines (Sa'pi, Butler, 2020), superconducting magnets (Crescenzi et al., 2011), battery technology, aerospace cryogenic engines, nuclear energy, and more. While cryogenic applications are numerous, one particularly promising area that warrants further research and optimization is illustrated in Figure 1.

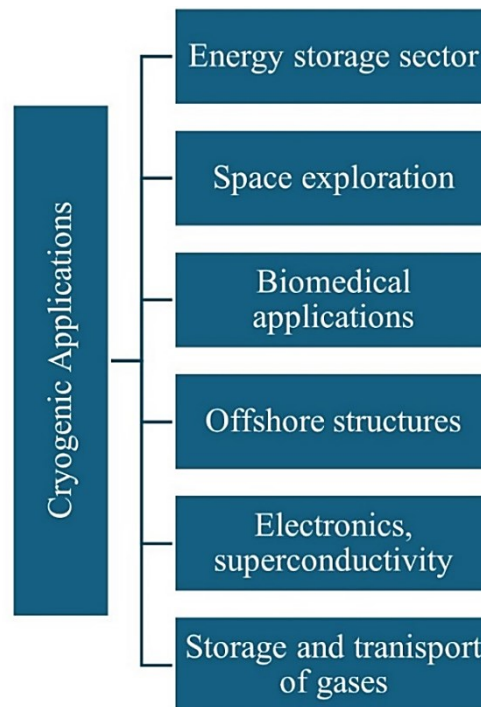
This literature review aims to synthesize the current state of knowledge on materials suited for cryogenic applications, such as those used in LNG carriers (operating at  $-163^{\circ}\text{C}$ ) and liquefied hydrogen storage tanks (operating at  $-253^{\circ}\text{C}$ ). By evaluating advancements in cryogenic materials, including metals, composites, concrete, and polymers, this review seeks to highlight trends, challenges, and future directions for material optimization.

A significant focus of this review is the performance of materials under cryogenic conditions, where properties such as high strength, thermal stability, corrosion resistance, and ductility are paramount. Materials that safely work at very low temperatures are mandatory in cryogenic application areas to give the desired function. This holds particular significance for liquefied natural gas (LNG) carriers, which operate at temperatures around  $-163^{\circ}\text{C}$  (Kogbara et al., 2013; Krstulovic, Opara, 2007), and liquefied hydrogen storage systems, where hydrogen is stored at  $-253^{\circ}\text{C}$ . At such low temperatures, the materials used for constructing LNG storage tanks, and liquefied hydrogen storage must demonstrate exceptional cryogenic properties. Several characteristics like high strength, thermal stability, corrosion resistance, and ductility, are needed for materials utilized in such circumstances. The efficient design and functioning of systems in extremely low temperatures depend on these characteristics. For example, at cryogenic temperatures, thermoplastic polymers like polytetrafluoroethylene (PTFE) and polyether ketone (PEEK) show high tensile strength. This makes them perfect for sealing applications in cryogenic fuel systems like those used in LNG carriers and liquefied hydrogen storage (Wang et al., 2024). Similarly, much research work conducted on glass fiber-reinforced epoxy shows good cryogenic properties, and it is a cornerstone in cryogenic pressure vessels for sealing purposes due to its high fatigue and corrosion resistance (Morino et al., 2001).

From another perspective, materials suited for cryogenic environments are becoming essential and transformative for industries, including hydrogen energy storage applications like cryo-compressed, liquid hydrogen storage (Barth'el'emy, Weber, Barbier, 2017), as well as for space exploration technologies. In addition, the advancement of carbon-neutral strategies has led to a rapid increase in the use of clean hydrogen as an energy vector for more efficient energy supply utilization (Guo et al., 2023; Jin et al., 2023). The novelty of this review lies in its comprehensive assessment of different materials performance across a broad spectrum of cryogenic applications and the basic mechanical properties of materials under such very low temperatures. It provides a critical analysis of the literature to identify gaps and opportunities for future research, particularly in optimizing materials for hydrogen energy storage, a key component of carbon-neutral strategies. By drawing on both foundational studies and recent advancements, this review establishes a cohesive understanding of material behavior under extreme low-temperature conditions. Hydrogen is a promising clean energy carrier particularly the liquefied hydrogen which stored at very low temperature (cryogenic temperature). Therefore the demand for containers that can securely handle, transport, and store hydrogen in cryogenic settings such as cryo-compressed and liquid hydrogen storage, which necessitates temperatures as low as (-253°C) is high. Hydrogen energy holds promise as a fossil fuel alternative due to its abundant supply, non-toxicity, and near-zero carbon emissions (Said, 2022; Bionaz et al., 2022; Singh, Altaee, Gautam, 2020).

The storage and transportation of hydrogen as a liquefied gas impose greater demands on the design and construction of storage tanks (Gu et al., 2020; Kumar et al., 2011) because of its great storage density and efficiency of delivery, liquid hydrogen (LH<sub>2</sub>) is especially preferred. Comparing liquefied hydrogen storage to compressed gaseous hydrogen storage improves safety and addresses low energy density caused by space limitations in compressed hydrogen storage techniques. But storage of liquid hydrogen is a challenge due to its very low temperature needs Sarangi, 1987. Containers for LH<sub>2</sub> storage must endure temperatures down to 20 K (Zu'ttel, 2004). These containers' materials must be carefully chosen to guarantee that they are compatible with such low temperature of liquid hydrogen, resistant to hydrogen embrittlement, and have the best possible mechanical and thermophysical qualities. While LH<sub>2</sub> storage tanks are commonly made of stainless steel (Yatsenko et al., 2022), hydrogen embrittlement is a concern (Qiu et al., 2021). Various grades of stainless steel have been tested for resistance to this issue.

Aluminum, with its high strength and reduced susceptibility to embrittlement, is another option for LH<sub>2</sub> storage tanks. Additionally, titanium and composite materials are being explored as alternative materials to store in such a very low temperature (Aziz, 2021; Qiu et al., 2021).



**Figure 1.** Applications area of cryogenic temperature.

A deep understanding of how materials behave in cryogenic conditions is crucial to building safe and effective systems for storage and transportation purposes, like liquid hydrogen storage tanks. The choice of materials for these extremely low temperatures remains a significant challenge. At low temperatures, materials must maintain their desired properties without breaking down. Because of their advantageous strength-to-weight ratios, metals, composites, and alloys like aluminum alloys are particularly interesting and could be used in cryogenic applications (Xu, Roven, Jia, 2017; Dong et al., 2020).

The materials used in cryogenic environments must ensure both safety and reliability. Although no precise temperature strictly defines cryogenics, it is generally considered to be temperature below (-150°C). Below this threshold, gases such as oxygen, nitrogen, hydrogen, and helium begin to reach their boiling points (Sa'pi, Butler, 2020). The cryogenic temperature enhances the physical and mechanical properties of materials such as tensile strength, yield strength, and fatigue.

According to the literature source, cryogenic temperature improves resistance to corrosion, erosion, wear, and abrasion while also increasing durability and stabilizing strength characteristics. This process refines and stabilizes the crystal lattice structure and ensures a more uniform distribution of carbon particles throughout the material, resulting in stronger and more durable materials (Kalia 2010). Refrigeration and cryogenics have a shared common history, with the main distinction between them being the temperature range they operate within. The various application areas of temperature ranges connected to low temperatures (LT) and cryogenic temperatures (CT) are shown in Table 1. For example, due to aircraft operating in diverse temperature ranges, particularly in low-temperature conditions, components must be

engineered to endure extremely low temperatures. At high altitudes, aircraft can frequently experience temperatures below (-50°C). To ensure reliability and safety, electronic components, hydraulic systems, and fuel systems must be specifically designed to withstand these harsh conditions.

The methodology employed for this literature review involves a systematic approach to identifying, evaluating, and synthesizing peer-reviewed studies and industry reports. Key publications were selected based on their relevance, scientific rigor, and contribution to the field. The review is structured to provide an overview of cryogenic applications, material performance, and emerging trends, followed by an analysis of challenges and future research directions. By consolidating knowledge from a wide range of studies, this literature review aims to support researchers and engineers in selecting and developing materials for cryogenic applications. It underscores the critical role of material science in enabling advancements in energy storage, transportation, and other cryogenic technologies, paving the way for more sustainable and efficient systems.

**Table 1.**  
*Temperature Ranges and Categories for Different Substances*

Explanation	[K]	[°C]	Category
Room temperature	296	23	RT
Design for aircraft components temperature	216	-57	LT
Lowest temperature measured on Earth	184	-89	LT
Liquid methane (LCH <sub>4</sub> ) or natural gas (LNG)	111	-162	CT
Liquid nitrogen (LN <sub>2</sub> )	77	-196	CT
Liquid hydrogen (LH <sub>2</sub> )	20	-253	CT
Liquid helium (LHe)	4.2	-269.95	CT
Absolute Zero	0	-273.15	CT

Source: (Sapi, Butler, 2020).

Low temperatures are usually defined as those in the range from 0 C (273 K) to about -150°C (123 K), and are usually in application in such fields as aerospace engineering, refrigeration, and atmospheric studies. Cryogenic temperatures, on the other hand, define any state below -150°C (123 K) in which materials such as nitrogen, oxygen, hydrogen get in liquid form and their cryogenic handling and storage is what a study discipline named as cryogenics constitute. Materials exposed to cryogenic conditions exhibit special properties, such as superconductivity a very important issue in different scientific research and technological applications. Known differences and characteristics of materials in both temperature ranges are a must for the development of technology in areas depending on low and cryogenic temperatures.

## 2. Literature Review: Effect of Cryogenic Temperature on Material Properties

Cryogenics is the scientific study of materials at very low temperatures, typically below  $-150^{\circ}\text{C}$ , where significant alterations in their physical and mechanical properties occur due to temperature-dependent phenomena and material composition. At cryogenic temperatures, a material's microstructure can change, enhancing properties such as tensile strength, hardness, and durability. For instance, many metals experience increased yield and tensile strength as atomic vibrations decrease, which suppresses dislocation movement, while ductility may decline, leading to a transition from ductile to brittle behavior. Similarly, certain polymers retain flexibility and toughness at low temperatures, making them suitable for cryogenic applications. The performance of materials is also influenced by their composition; for example, the addition of elements like nickel in alloys can improve toughness and reduce brittleness in cryogenic conditions. Understanding these intricate relationships is essential for advancing technology in fields such as aerospace, energy storage, and superconducting technologies, where material performance under extreme conditions is crucial. In addition, cryogenic treatment like deep cryogenic treatment is a technique used to process materials at ultra-low temperatures to enhance their performance characteristics of traditional alloys (Gu et al., 2018; Yang et al., 2006). This review work highlights how various materials such as metals, composites, ceramics, and polymers, behave under cryogenic conditions and explores their mechanical characteristics.

### 2.1. Effect of Cryogenic Temperature on Metals and Alloys

In recent years, the study of the properties of metals at low temperatures has emerged as a key focus in materials science. Traditional metals and alloys, especially stainless steels, show outstanding tensile qualities, such as resistance to oxidation, corrosion, and wear in the cryogenic environments (Cao et al., 2023; Zhu et al., 2017). Notably, face-centered cubic (FCC) metals exhibit an enhanced hardening rate at cryogenic temperatures due to several factors, including the inhibition of dynamic recovery, microstructural changes, and an increase in defect density. These characteristics make them ideal for cryogenic applications.

Austenitic stainless steels, especially the 300 series (AISI 304L, 316L, 321, and 347), are highly suitable for use in very low-temperature application areas like liquid natural gas (LNG) storage and nuclear facilities. Their effectiveness is particularly notable in applications such as LNG cargo barriers, as illustrated in Figure 2, austenitic stainless steel. However, it is important to note that cryogenic temperatures significantly affect their mechanical properties. Numerous studies show that at cryogenic temperatures, the tensile strength, and ultimate strength of various metals increase. For instance, AA6061-T6, an aluminum alloy, showed improved mechanical characteristics at cryogenic temperature (Jin et al., 2024). This improvement is attributed to increased resistance to dislocation movement resulting from reduced thermal energy.





**Figure 2.** LNG applications of austenitic stainless steel, image of an LNG carrier.

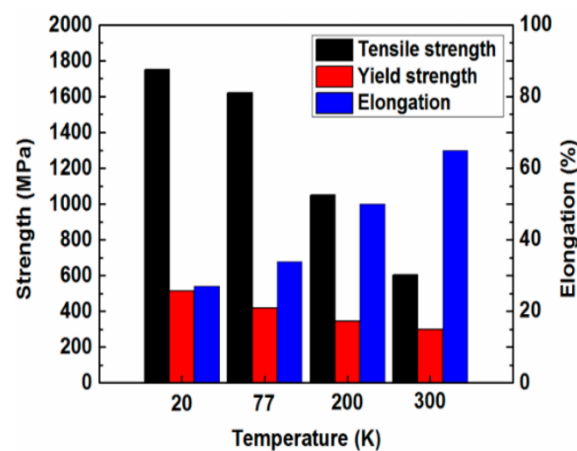
Source: (Park et al., 2010).

The mechanical properties of high-strength and high-toughness (HSHT) steels have shown significant improvement at cryogenic temperatures, according to recent studies. (Xia et al., 2023), reported that when tested at  $-196^{\circ}\text{C}$ , HSHT steel exhibits a yield strength of 1200 MPa and a tensile strength of 1620 MPa. These steels maintain both strength and ductility in harsh environments, as evidenced by the marked improvement in strength accompanying enhanced uniform elongation. Such characteristics are crucial for applications that require high-performance materials. In the context of bulk metallic glasses, a study by (Li et al., 2013), demonstrates that reducing the temperature from 293 K to 77 K increases the compressive yield stress from 1791 MPa to 2217 MPa, illustrating a substantial enhancement in strength. Additionally, cryogenic treatment of metals, such as Cr8-type cold work die steel, enhances hardness by reducing retained austenite and improving wear resistance through the precipitation of specialized carbides (Chi et al., 2010).

Research on stainless steels reveals that while they maintain corrosion resistance, their toughness decreases markedly at temperatures approaching liquid nitrogen levels (77 K). Conversely, titanium alloys have been shown to retain good strength and toughness as well as excellent corrosion resistance at cryogenic temperatures (Zhao et al., 2021), making them suitable for specific aerospace and cryogenic storage applications. Most metals become inherently brittle at low temperatures. Nevertheless, conventional titanium exhibits a consistent trade-off between strength and ductility at cryogenic temperatures (Huang et al., 2022; Zang et al., 2022; Zherebtsov et al., 2013). Leskovšek, Kalin, and Vičintin (2006) investigated the influence of cryogenics on the wear resistance of steel and demonstrated that cryogenically treated samples exhibit improved wear resistance. Additionally, research on copper proves that it exhibits greater strength and ductility at cryogenic temperatures (77 K) than at room temperature during uniaxial tensile tests. This implies that cryogenic conditions noticeably improve the mechanical properties of copper (Zhang et al., 2021).

At cryogenic temperatures, the microstructure of materials can be enhanced, which is

important for improving their overall performance. Also, stress relaxation can be significantly slowed, resulting in increased material strength and stability (Feng et al., 2014; He et al., 2018; Li et al., 2016). Therefore, cryogenics is a crucial science to improve the mechanical properties of metals. In general, as the temperature decreases, a material's elastic modulus, tensile strength, and yield strength tend to increase, along with improvements in its fatigue strength and endurance limit (Duthil, 2015; Qiu et al., 2021), but its plasticity diminishes. The substantial reduction in plasticity at low temperatures can lead to the initiation of brittle cracks and increase the risk of fracture. Anjaria et al. (2024) reported that, at cryogenic temperatures, materials experience a typical localized plastic deformation resulting from the concurrent activation of multiple deformation mechanisms.



**Figure 3.** Cryogenic behavior of 18Cr–8Ni stainless steel across various temperatures.

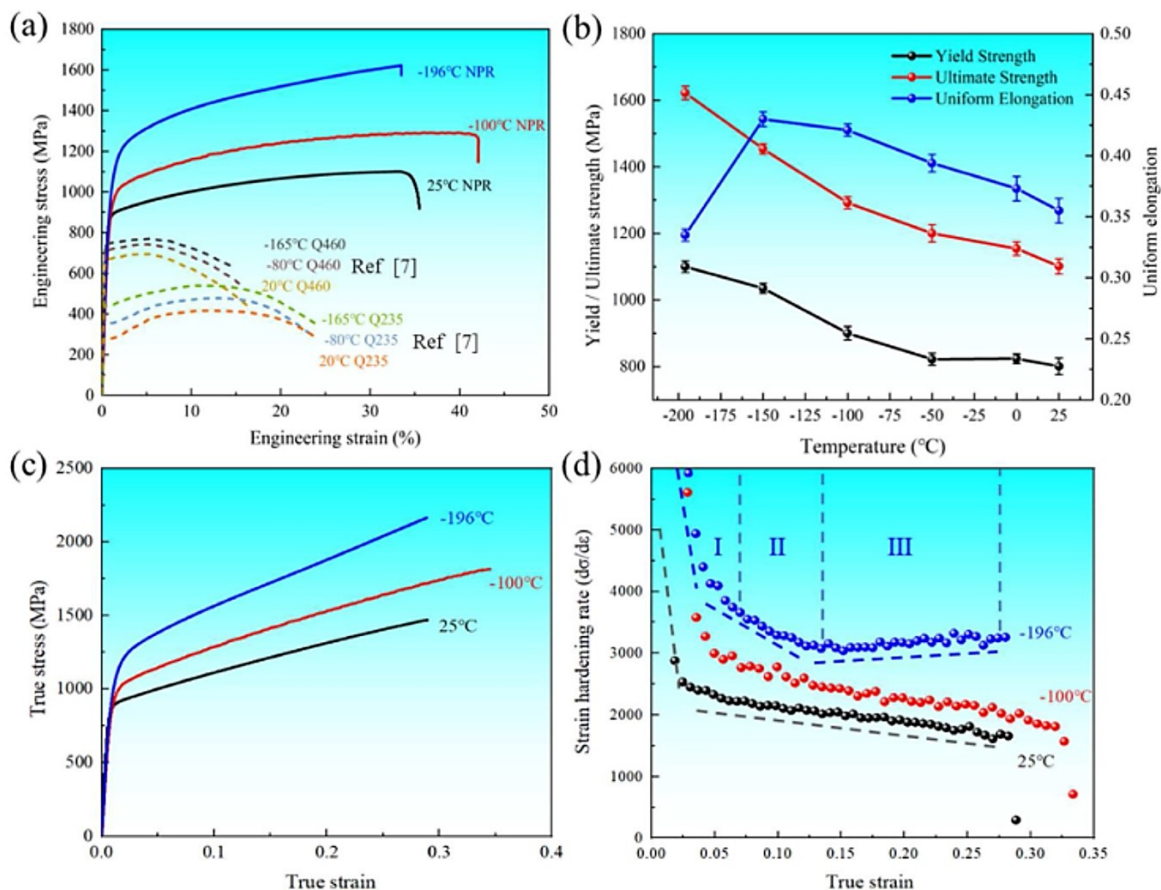
Source: (Qiu et al., 2021).

Many studies have confirmed the dependency of material mechanical properties on cryogenic temperatures, with most metals exhibiting an increase in tensile strength as temperature decreases. This phenomenon is supported by the findings of (Xia et al., 2023), as illustrated in Figure 4. Microstructural analysis reveals that deformation at cryogenic temperatures leads to a high dislocation density and the formation of mechanical twins, suggesting the presence of complex deformation mechanisms critical to understanding material performance.

The influence of cryogenic temperatures on the mechanical properties of metals is well-documented, with a general trend of increasing tensile strength at lower temperatures. This behaviour can be largely attributed to reduced thermal agitation, which minimizes atomic vibrations and restricts dislocation movement. In addition (Xia et al., 2023; Umezawa, 2021) corroborate this trend. Ghosh et al. (2023) conducted experiments on various alloys under cryogenic conditions and observed significant increases in tensile strength accompanied by a reduction in ductility. Their study highlighted the roles of deformation twinning and high dislocation density as critical factors influencing the mechanical response of metals in such environments.

Microstructural analysis across these studies consistently demonstrates that deformation mechanisms at cryogenic temperatures are complex, involving the simultaneous occurrence of twinning and dislocation activity. According to (Umezawa, 2021), these mechanisms enhance material strength by creating barriers to further dislocation motion, thereby increasing the stress required for continued deformation. This phenomenon is essential for understanding the behaviour of metals in cryogenic environments, such as aerospace applications or cryogenic storage systems, where materials are subjected to extreme conditions.

Furthermore Ma et al. (2023) employed axial tensile testing and scanning electron microscopy to investigate the strength and fracture mechanisms of aluminium plate-fin structures at cryogenic temperatures. Their analysis revealed a quasi-cleavage fracture mode characterized by distinct morphological features, including dimples, tear ridges, and microscopic cleavage zones. Similarly, Zheng et al. (2022) found that pure magnesium specimens demonstrated enhanced strain-hardening tendencies and increased tensile strength under cryogenic conditions. However, these specimens also exhibited reduced elongation to failure, along with the suppression of grain boundary sliding.



**Figure 4.** The graph presents the mechanical responses of HSHD steel at various temperatures: (a) engineering stress-strain curves of HSHD, Q235, and Q460 steels, (b) temperature- dependent trends in HSHD steel's mechanical properties, (c) true stress-strain curves for HSHD steel, and (d) strain hardening rate curves for HSHD steel at different temperatures.

Source: (Xia et al., 2023).

Together, these studies (Xia et al., 2023; Umezawa, 2021; Ghosh et al., 2023; Ma et al., 2023; Zheng et al., 2022) provide consistent evidence that cryogenic temperatures significantly enhance the mechanical properties of metals. These enhancements are driven by microstructural phenomena such as twinning and dislocation interactions, which are pivotal for optimizing materials for high-performance applications in cold environments.

## **2.2. Effect of Cryogenic Temperature on Composite Materials**

Understanding the cryogenic behavior of composites is essential for their effective use in real world applications at cryogenic temperatures, ensuring they meet the specific performance requirements for cryogenic conditions. Advanced composites, including fiber reinforced polymers and metal matrix composites, are increasingly explored for cryogenic applications such as space applications (especially for pressure vessel or tanks), superconducting devices, and the storage of propellant gases in liquid form, all of which are pertinent to the energy sector, especially for green transition, due to their customizable properties. Composite materials, with higher strength and lower density, offer the potential to reduce tank weight by up to 25% compared to aluminum alloy tanks (Verstraete et al., 2010; Schutz, 1998). The composites encompass thermo- plastic and thermosetting polymers reinforced with fibers and particles. The literature suggests that composites can be engineered to maintain structural integrity at low temperatures while minimizing weight. Designing composite components for working under cryogenic conditions presents a substantial challenge because of the complex stress fields that develop within the materials. Chen et al. (2021), Hohe et al. (2021), S'api, Butler (2020) commenced from rheological changes the material experiences during curing and cooling to cryogenic temperatures (Baran et al., 2017), and due to the dissimilar nature of the constituents and dissimilar properties.

Cryogenic temperatures pose a significant challenge to the mechanical performance of composites, as extreme conditions can induce microstructural changes that affect mechanical properties and may lead to fracture. While most research has focused on room temperature behavior, some researchers have specifically studied the cryogenic characteristics of composite materials (Kliauga, Sordi, 2021; Cheng et al., 2020). According to reported by Sa'pi and Butler (2020) as temperature decreases, the Young's modulus and tensile strength of the matrix increase due to reduced polymer chain mobility, which enhances the binding forces between molecules and strengthens the material. The mechanical properties of composites at low temperatures are influenced by the resin, fiber, and interface. Hence, as the temperature decreases, the bonding strength of the polymer molecular chains increases, leading to higher Young's modulus and tensile strength in the resin matrix. However, this decrease in temperature also results in reduced toughness of the resin matrix (Hohe et al., 2021). Additionally, based on the time temperature superposition principle, lower temperatures slow stress relaxation over time. For instance, carbon fiber reinforced polymers have shown promise in maintaining their strength and stiffness even at cryogenic temperatures, although they may still suffer from matrix

cracking. Metal matrix composites, particularly those reinforced with ceramics, offer a balance of strength and toughness, making them suitable for use in cryogenic fuel tanks and structural components in space vehicles. Also, SiC/Al composites have gained increasing attention due to their well-rounded properties, including a high specific modulus, impressive hardness, and strong corrosion resistance (Wang et al., 2014; Chen et al., 2014). Numerous studies have identified SiC/Al as a promising material for use in cryogenic applications (Liu et al., 2019; Feng, Liang, Jianfu Zhang, 2014; Zulfia, Hand, 2002; Yan, Lifeng, Jianyue, 2008; Guoju Li et al., 2014; Shen et al., 2015). SiC/Al composites are used in spacecraft for long-duration remote sensing satellites, but their mechanical properties in cryogenic conditions remain largely unexplored.

In general, a review of composite materials at cryogenic temperatures shows that cold conditions generally enhance strength, modulus, fatigue, and thermal properties. However, they also reduce ductility, leading to lower failure strain, fracture toughness, and impact resistance.

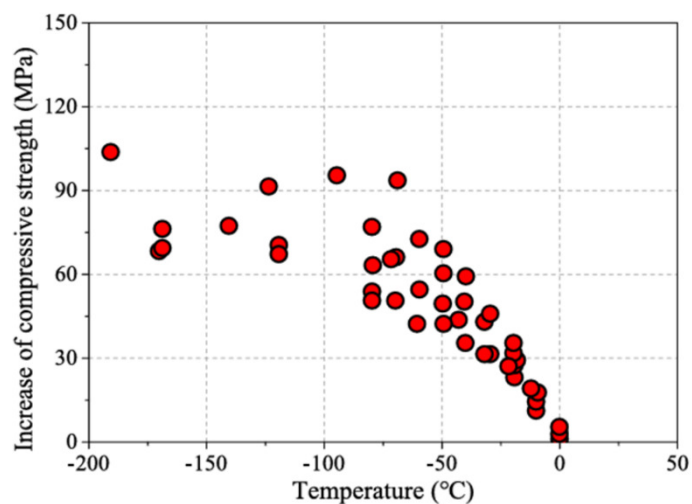
### **2.3. Effects Cryogenic temperature on Concrete Properties**

Nowadays, the application of concrete materials at cryogenic temperatures is on the rise due to their strong mechanical properties, good design flexibility, relatively low cost, and durability (Lin et al., 2022; Mottaghi, Benaroya, 2015), particularly at extremely cold temperatures in space and energy sector. However, a challenge with concrete is that it has traditionally been used in normal temperature and pressure applications, and its performance in harsh environments has not been extensively investigated by researchers and engineers. Concrete properties can be severely compromised when exposed to cryogenic temperatures, which can, in turn, reduce the lifespan of structures. A growing number of containment tanks or vessels for the storage and transportation of liquefied natural gas (LNG) have been built worldwide as a result of the LNG market's expansion.

Concrete has been used as the primary structural material in the majority of LNG tanks (Cheng et al., 2022; Kogbara et al., 2013). These tanks are made up of an inner tank of 9% nickel (Ni) steel and an outside tank made of prestressed concrete (Ludescher, Næss, Bjerkeli, 2011). It is evident that very low temperatures can affect the mechanical properties of concrete. Therefore, it is of great importance to have a good understanding of the properties of concrete at cryogenic temperatures. Every study in the literature to date shows that concrete exhibits significantly higher compressive strength at cryogenic temperatures as a result of ice formation within the pores of the concrete (Zhengwu et al., 2018; Liu et al., 2016), even double of that of room temperature (Dahmani et al., 2007). Some studies, such as those by Wang et al. (2021) and Zhang (2018), have attempted to quantify the aforementioned strengthening effects using micro, and mesoscale models of ice formation in concrete pores and cracks. The compressive strength of concrete at low temperatures is heavily influenced by its water content (Xie, Yan, 2018; Zhengwu et al., 2018. Xiong et al., 2022) demonstrated that the compressive strength of geopolymer paste increased from 50.0 MPa to 80.0 MPa at -30°C.

Moreover, Unlike metals, alloys, and some composites, concrete's compressive strength does not continuously increase as temperature decreases. Literature source indicate that as temperature decreases, compressive strength initially increases to a peak, but then decreases with further temperature decline as shown in Figure 5. Zhang et al. (2023) reported that the flexural properties of ultra-high-performance concrete (UHPC) significantly improved at  $-170^{\circ}\text{C}$ , however, this enhancement was accompanied by a marked reduction in ductility, a phenomenon referred to as the thermal dependent brittleness effect. Additionally, Liu et al. (2016) showed that temperature drops had no effect on the final strain.

In general, the mechanical properties of concrete have been evaluated in various studies (Zhang et al., 2023; Kogbara et al., 2013, 2015), it is widely recognized that the compressive strength of these materials significantly improves at cryogenic temperatures. Furthermore, a trend has been observed where compressive strength increases as the temperature decreases further into the cryogenic range. The moisture content and exposure to cryogenic temperatures have a major impact on the thermal characteristics of concrete. As temperatures drop, the pore water in concrete migrates and changes phases, leading to temperature induced deformation that causes initial shrinkage, followed by expansion, and then further shrinkage.



**Figure 5.** Increase in compressive strength of concrete at sub-zero temperatures.

Source: (Lin et al., 2022).

#### 2.4. Effect of Cryogenic Temperature on Ceramics

Ceramics are known for their good mechanical properties, high temperature stability and are often considered for cryogenic applications where thermal insulation and structural stability are required. Ceramics are effective insulation materials due to their exceptional vacuum sealing properties and hygroscopic nature, which result in minimal degradation over time (Xie et al., 2011). In addition ceramics possess essential functional properties, including piezoelectricity, magnetism, and high temperature superconductivity (Porz et al., 2021; Ritchie, 2011). However, at cryogenic temperatures, ceramics typically exhibit increased brittleness due

to their low fracture toughness. The literature reports that materials like alumina and zirconia, while maintaining their thermal stability, are prone to sudden failure under stress at cryogenic temperatures. Research has focused on improving the toughness of ceramics through composite materials or novel processing techniques to make them more suitable for cryogenic environments like advanced ceramics (Webber et al., 2017; Gumbsch et al., 2001). High entropy transition metal carbide (HETMC) ceramics, made from multiple primary components, usually deliver superior performance due to their high configurational entropy (Han et al., 2023). High entropy transition metal carbide (HETMC) ceramics are a class of advanced materials composed of multiple transition metals in near equimolar ratios, yielding high configurational entropy that lowers Gibbs free energy. This complex, multi component design provides exceptional benefits, including improved mechanical strength due to atomic scale lattice distortions that resist dislocation motion, superior thermal stability, and enhanced oxidation and corrosion resistance. Additionally, the diverse elemental makeup allows for the precise tailoring of properties such as thermal conductivity, hardness, and wear resistance making HETMC ceramics ideal for demanding applications in extreme environments like aerospace and power generation. By leveraging the high-entropy effect, these materials can achieve both durability and adaptability beyond the limitations of traditional ceramics.

## **2.5. Effect of Cryogenic Temperature on Polymer**

Cryogenic characteristics of polymers are increasingly important with advancements in space, superconducting, electronics, defense, and cryogenic engineering. In fiber-reinforced polymer composites, unequal thermal expansion between fibers and matrix can cause internal stresses, leading to micro-cracking in the polymer matrix at cryogenic temperatures (Nobelen, et al., 2003). Polymers generally have poor performance at cryogenic temperatures due to their tendency to become brittle (Lau et al., 2013). The literature highlights that most polymers, such as polyethylene and polytetrafluoroethylene (PTFE), suffer from significant reductions in flexibility and toughness when cooled to cryogenic levels. However, some high-performance polymers, such as polyimides, demonstrate better retention of mechanical properties, though they still experience some embrittlement. The insulating properties of polymers, particularly their low thermal conductivity, remain advantageous in cryogenic applications, such as insulation in superconducting magnets and space exploration equipment. Plastics, which are classified under polymers, are widely used in various applications due to their versatility. Understanding their behavior at cryogenic temperatures is critical for advancing low-temperature technologies. Previous studies on polymers, particularly polyimides have shown that cryogenic temperatures significantly affect their mechanical properties, with both the elastic modulus and ultimate tensile strength increasing as temperatures drop, while failure strain decreases. Additionally, fracture toughness improves moderately at lower temperatures, with no detectable sample size dependence, and detailed fracture behavior has been analyzed using optical and scanning electron microscopy.



Research on polymers like ABS, PE, and PVDF (Kim et al., 2022), battery separators in lithium ion batteries, and epoxy transposed wire in reactors highlights the impact of low temperatures on tensile strength, fracture strain, and brittleness. Studies on polyethylene variants like HDPE, LDPE, and LLDPE emphasize the importance of parameters like relative elongation at break and impact strength at subzero temperatures in assessing frost resistance properties. The data from these research papers collectively demonstrate that low temperatures generally lead to increased tensile strength but decreased ductility, impacting the overall mechanical behavior of materials used in various industries. The tensile strength and modulus of the matrix increase at cryogenic temperature due to reduction in polymer chain mobility.

## **2.6. High entropy alloys as cryogenic materials (HEAs)**

High-entropy alloys (HEAs) are extremely interesting prospects for technical applications because of their exceptional flexibility, extraordinary corrosion resistance (Pao et al., 2023), fatigue endurance (Gludovatz et al., 2014), wear resistance (Cantor et al., 2004). In high-entropy alloys (HEAs), the principal components do not vary significantly; instead, five or more metallic elements are combined in Equi atomic ratios, melted, and subsequently solidified to create a uniform solid solution structure. Recent studies underscores their potential in areas such as superconductivity and applications in extreme environments. In recent studies, high-entropy alloys (HEAs) such as Fe<sub>27</sub>Co<sub>24</sub>Ni<sub>23</sub>Cr<sub>26</sub> have demonstrated remarkable strength and ductility at cryogenic temperatures. Tai et al. (2024) reported that this alloy achieves impressive tensile strengths of up to 1211 MPa, with an elongation of 87.2% at -150°C. These properties highlight the potential of HEAs for low-temperature applications, where both strength and flexibility are critical. Jiang et al. (2023) observed that the FeNiAl<sub>0.1</sub>Ti<sub>0.05</sub> alloy achieves a yield strength of 575 MPa and a tensile strength of 1145 MPa at 77 K. This alloy demonstrates a well-balanced combination of strength and ductility, attributed to modified deformation mechanisms at cryogenic temperatures. These findings underscore the adaptability of HEAs to extreme conditions, further supporting their suitability for cryogenic applications. In addition, HEAs have been found to exhibit superconductivity, with the Ta<sub>1/6</sub>Nb<sub>2/6</sub>Hf<sub>1/6</sub>Zr<sub>1/6</sub>Ti<sub>1/6</sub> alloy achieving a critical current density exceeding 100 kA cm<sup>2</sup> at 4.2 K (Jin et al., 2024). The exploration of high-entropy superconductors has opened new avenues for applications in high-field magnets and nuclear fusion reactors. This development underscores the potential of these materials in advancing technology for demanding energy applications.



### 3. Methods

This literature review followed a systematic approach to identify, evaluate, and synthesize relevant peer-reviewed studies and industry reports. The search strategy was designed to capture a broad spectrum of knowledge related to cryogenic applications, material performance, and emerging trends in the field, with a focus on how these aspects support cryogenic application areas particularly, the improvement of energy storage and transportation systems.

The initial sources of information were established academic databases, such as Scopus, Web of Science, and Google Scholar. They were chosen for their wide coverage of peer-reviewed literature, conference proceedings, and industry reports. This search was further narrowed down to include publications between 200 and 2024 to cover recent developments and aggregate formative studies that have guided the field for the past two decades. Only English-language publications were included to ensure both consistency and accessibility to the broadest possible international audience.

The review focused on peer-reviewed journal articles, conference proceedings, and high-quality industrial reports. Such publication types were chosen for their scientific rigor, relevance to the field, and contribution to advancing material science in cryogenic technologies. Search terms were chosen to reflect the major themes of the review: cryogenic applications, material performance, cryogenic technologies, and energy storage systems. The search terms were then iteratively refined in an attempt to strike a balance between key areas. All told, both broad and specific keywords had to be used, capturing sources from foundational research in cryogenic materials to the leading edge. This is with clear definition to the inclusion/exclusion criteria so that only works focusing squarely on material properties, performance, and application under a cryogenic environment would be gathered. This work hence removes any publications on matters relating to non-cryogenic applications and further non-theses from material science and publishes instead the final study which embodies both scientifically well-designed methods and highly important conclusions of significant knowledge that aid in revealing and interpreting material phenomena. When multiple were found to deal with the same or closely related topics, priority was given to more recent and highly cited works, so that breadth of research could be presented in the review, including a look at the most highly influential studies of the field.

This review summarizes the state of knowledge in cryogenic materials and related technologies by consolidating information from this carefully selected body of literature, bringing into light not only the achievements so far but also areas that require further investigation. The methodology followed will also provide a transparent and reproducible framework for researchers and engineers involved in the selection and development of materials for cryogenic applications.

## 4. Summary and Main Conclusion

At cryogenic temperatures, materials undergo significant changes in their microstructure, influencing mechanical properties such as tensile strength, hardness, and durability. Reduced atomic vibrations in metals at these temperatures limit dislocation movement, resulting in increased yield and tensile strength. However, this improvement is often accompanied by reduced ductility, shifting materials from ductile to brittle behaviour. While this phenomenon enhances resistance to deformation under stress, it raises concerns about sudden, catastrophic failures due to brittleness. The reviewed literature reveals both benefits and challenges associated with material performance in cryogenic environments.

Research indicates that cryogenic conditions enhance properties like tensile strength, fatigue strength, hardness, and corrosion resistance. However, critical limitations exist. Metals exhibit a trade-off between strength and ductility, which poses risks in applications such as cryogenic fuel tanks and aerospace components. This balance is not fully addressed in existing studies, leaving a gap in methods to mitigate brittleness while maintaining strength. Research on concrete shows that its compressive strength initially increases at cryogenic temperatures due to ice formation in its pores, but further cooling leads to strength degradation. However, the variability in these findings, often linked to differences in moisture content and composition, highlights the need for standardized testing methodologies. Additionally, while traditional materials like stainless steel and aluminium alloys have been extensively studied, there is limited exploration of emerging materials such as advanced superalloys and hybrid composites, which show potential for improved performance.

Several important lessons emerge from the literature. Materials like composites and polymers demonstrate improved modulus and fatigue resistance at low temperatures, yet their impact resistance and fracture toughness decline. The unique influence of moisture content on concrete's cryogenic behaviour suggests opportunities to tailor its composition for optimized performance. Furthermore, the renewed focus on lightweight and high-strength materials, such as titanium alloys and composites, underscores a shift toward solutions that meet the demands of space exploration, energy storage, and delivery systems where traditional materials may fall short. These insights provide a deeper understanding of material behaviour and help identify opportunities for improvement in cryogenic applications.

The importance of this research extends to numerous critical industries. In aerospace applications, the enhanced strength-to-weight ratios of advanced alloys and composites at cryogenic temperatures improve the safety and efficiency of cryogenic fuel tanks and spacecraft components. In the energy sector, advancements in hydrogen embrittlement resistance and improved material properties facilitate the design of reliable storage systems for LNG and liquefied hydrogen, contributing to the global push toward carbon-neutral energy solutions. For infrastructure, understanding concrete's cryogenic behaviour offers valuable guidelines for the construction of storage facilities and structures operating in extreme environments.

Future research should focus on addressing current limitations and expanding the knowledge base. Developing alloys that retain ductility while enhancing strength at cryogenic temperatures will reduce the risk of brittle failures. Standardizing testing protocols for concrete performance under extreme conditions will ensure consistent and reliable results. Expanding the use of composites, given their thermal and fatigue resistance, could lead to lightweight, high-performance systems for cryogenic applications. Furthermore, exploring novel materials and coatings, particularly for hydrogen storage and aerospace technologies, could unlock new opportunities. By addressing these challenges and building on the lessons learned, the field can make meaningful advancements, supporting innovation across industries that depend on cryogenic technologies.

## **5. Future Research direction**

The study should focus on developing new materials capable of functioning in cryogenic environments, which pose particularly harsh and challenging conditions. At these extremely low temperatures, materials are prone to losing ductility, becoming brittle, and suffering from micro-cracking. To address these issues, it is essential to optimize or develop new materials that retain high strength, hardness, corrosion resistance, and wear resistance without compromising ductility or experiencing a significant shift in the ductile-brittle transition temperature. These kinds of materials ought to be impervious to the development of microcracks brought on by mechanical strains and thermal contraction, which are frequent in cryogenic applications. Moreover, it is imperative that these materials retain their stiffness and ductility under all circumstances and avoid losing volatile components. Applications where mechanical integrity must be maintained in harsh settings, such as the building of cryogenic tanks, aerospace components, and energy systems, call for this in particular. Moreover, the study should prioritize the development of new alloys and composite materials that can overcome the challenges associated with the ductile-brittle transition in cryogenic conditions.

Many conventional materials experience a drastic loss of ductility at very low temperatures, leading to a higher risk of sudden fracture. The research should focus on creating materials that can withstand this transition, retaining their ability to deform plastically rather than fracturing suddenly. This would substantially enhance the reliability and safety of systems operating in cryogenic environments, such as liquefied natural gas (LNG) storage tanks, cryogenic fuel tanks for space exploration, and superconducting technologies. Future research could explore the potential of high-entropy alloys (HEAs), amorphous metals, and nano-structured materials, which show promise for maintaining suitable mechanical properties at cryogenic temperatures. These materials may provide improved ductility, strength, and fracture resistance, creating new opportunities for cryogenic applications.

Additionally, advancements in additive manufacturing may allow for the development of highly customized materials tailored for specific cryogenic needs, further pushing the boundaries of what can be achieved in low-temperature environments.

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## THE IMPACT OF SOCIO-DEMOGRAPHIC FACTORS ON CONSUMER ATTITUDES AND BEHAVIORS TOWARDS FOOD CONSUMPTION – THE CASE OF POLAND

Szymon MICHALAK<sup>1\*</sup>, Paweł BARTKOWIAK<sup>2</sup>, Bogdan PACHOLEK<sup>3</sup>,  
Magda STACHOWIAK-KRZYŻAN<sup>4</sup>

<sup>1</sup> Poznań University of Economics and Business, Department of Product Marketing;  
szymon.michalak@ue.poznan.pl, ORCID: 0000-0003-2874-7694

<sup>2</sup> Poznań University of Economics and Business, Department of Strategic Management;  
pawel.bartkowiak@ue.poznan.pl, ORCID: 0000-0001-9330-756X

<sup>3</sup> Poznań University of Economics and Business, Department of Product Marketing;  
bogdan.pacholek@ue.poznan.pl, ORCID: 0000-0003-0576-1426

<sup>4</sup> Poznań University of Economics and Business, Department of Product Marketing;  
magda.stachowiak-krzyzan@ue.poznan.pl, ORCID: 0000-0002-4093-2238

\* Correspondence author

**Purpose:** The aim of the article was to define the attitudes and behavior of Polish consumers towards food depending on gender, age, place of residence, income and level of education of the respondents.

**Design/methodology/approach:** The study used a quantitative approach based on data from an online survey conducted in 2023 with 631 Polish respondents. The survey included 17 variables measured on a five-point scale describing consumers' attitudes and behaviors towards food. Descriptive statistics and exploratory factor analysis were used to identify the key components that define consumer attitudes and behaviors towards food.

**Findings:** The results of the study indicate that Polish consumers generally have a positive attitude towards experimenting with food; however, this openness to innovation is rather moderate. Respondents are not indifferent to the quality and origin of food and have a positive attitude towards minimally processed food. The analysis of the results based on metric criteria revealed the presence of many statistically significant differences. Polish women consume food more consciously than men and make more conscious food choices. They are more interested in the quality and origin of food. The younger generation of Poles is more open to new foods. At the same time, older consumers generally pay more attention to a healthy diet than the other generation of consumers. Poles with a higher annual income and Poles with a higher level of education are more willing to buy unprocessed food.

**Research limitations/implications:** The research was conducted with Polish consumers only. Due to cultural differences, future research could be conducted with a cross-cultural sample.

**Originality/value:** The study fills a research gap in the field of research on the determinants of Polish consumers' behavior towards food and may provide a starting point for further in-depth studies.

**Keywords:** consumer behaviour, consumer attitudes, food products.

**Category of the paper:** research paper.

## 1. Introduction

Eating habits have changed significantly in recent years. Greater variety and availability of food, higher incomes of the population, the changing and increasingly higher expectations and needs of customers - all this has led to changes in the personal food system of consumers (Sajdakowska et al., 2018). Health and environmental concerns related to the production and consumption of food have become crucial for modern society (Żelazna, Bojanowska, Buraczyńska, 2021). Consumers are increasingly mindful of what they eat and notice the impact of daily food choices on their health and the environment. Modern consumers are paying more and more attention to the ecological, healthy and safe aspects of food.

Decisions related to food choices are sometimes difficult to explain because they are frequent, multifaceted, situational, dynamic and complex (Sobal, Bisogni, 2009; Bublitz et al., 2010). In addition, consumer opinions about food and the technologies used in food production play an important role in explaining consumer decisions about food (Ares, Gámbaro, 2007; Bruhn, 2007; Vassallo et al., 2009). The decisive factors in the purchasing process for many novel foods differ depending on the type of innovation and its market acceptance (Barrena, Sánchez, 2012). On the other hand, consumers generally show a certain degree of resistance when it comes to accepting innovations in new foods that are introduced to the market (Balrcellos et al., 2009; Bäckström, Pirttilä-Backman, Tuorila, 2004).

In the contemporary food market, there are several prevailing trends and development directions for food products. The food sector is increasingly turning to sustainability issues (Vermeir et al., 2020). Environmentally Sustainable Food Consumption can be defined as the use of food “that satisfies basic needs and provides a better quality of life while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants during the life cycle so as not to compromise the needs of future generations” (Oslo Roundtable..., 1994). Reducing meat consumption and replacing it with plant-based foods and alternative proteins is a new and growing trend (Hoak et al., 2004; Lea, Crawford, Worsley, 2006; Megido et al., 2016). The organic market and locally produced food are growing because customers want to buy high-quality and safe food for themselves and their families (Bentsen, Pedersen, 2021; Jones, Comfort, Hillier, 2004). New consumption practices are gaining attention in light of increasing concerns about food sustainability, safety, nutrition and animal welfare.

The aim of the article was to defining consumer attitudes and behaviors towards food among Polish consumers depending on the respondents' gender, age, place of residence, income and level of education. Understanding which demographic factors influence polish consumer attitudes adopted when choosing food products could be of utmost importance in the coming years and is very important for the market success of this food. This research adds to the growing literature on consumer acceptance of innovative food products and demonstrates the new finding that demographic factors play an important role in the perception and acceptance of this foods.

## 2. Literature review

Studies have shown that socio-demographic factors such as age, gender and education level influence the purchasing decisions of food consumers (McCluskey, Grimsurd, Ouchi, Wahl, 2003; Ward, Tran, 2007). Consumer acceptance is one of the most important challenges for innovative food producers and is crucial for the success of new foods. Therefore, it is necessary to understand the determinants that influence consumer attitudes in the food market. The studies reveal differences between various demographic groups. We first focus on some key determinants of consumer acceptance of insects as food. According to previous studies, these were the most studied socio-demographic variables: gender, age, income and education level of respondents.

### Gender

Keifer et al. (2005) found that there are significant gender differences in dietary behavior, food consumption, and the psychological factors that influence this behavior. Women are generally more knowledgeable and conscious about their diet (Jun et al., 2016). Women are also more likely to consume fruit and vegetables, dairy products and whole grains. Lone et al. (2009) have empirically shown that women eat more consciously than men. According to research, women are more likely to buy health-promoting foods (Pearson, Henryks, Jones, 2011) and more organic foods than men (Irianto, 2015; Lockie et al., 2002; Radman, 2005). Consuming a balanced diet plays a crucial role in increasing women's motivation. Women are the clear promoters of healthy eating at home and in the family, and they prioritize healthy eating for their children (Yazar, Burucuoğlu, 2019). Therefore, female consumers have a more negative attitude towards genetically modified foods than male consumers when it comes to whether genetically modified foods are healthy or not (Chen, 2011). Men are more likely to consume red meat, alcohol, fast food and foods high in sugar (Keifer et al., 2005).

### Age

Research has shown that age is a significant factor that increases the likelihood that consumers are willing to try food products. Age determines consumer attitudes towards food. Younger consumers are more innovative than older consumers (Kowalczyk, 2011). Results of studies among Polish respondents show that young consumers are open to innovation (Barska, 2014) and that they accept novelties on the food market more easily compared to other consumer groups (Żakowska-Biemans, 2016; Kowalczyk, 2010; Gutkowska, Ozimek, 2005).

Younger consumers are generally more aware of organic food than their older counterparts (Kumar, Ali, 2011). In turn, Leclercq et al. (2009) and Wongprawmas et al. (2021) point out that older consumers tend to consume more fresh food - fruit and vegetables - and are generally more aware of a healthy diet than the younger generation of consumers. Colón-Ramos et al. (2013) reported that unhealthy foods such as fast food are favored by younger consumers.

### **Income**

Some results indicate that there is an influence on the acceptance of innovative foods. Consumers who have a high disposable income and pay more attention to a healthy and balanced diet are more likely to choose innovative food products. As Pearson, Henryks and Jones (2011) found, people with a higher annual income are more likely to buy a health-promoting food product. Studies have shown that high-income consumers have a greater awareness of organic food (Briz, Ward, 2009; Gil, Soler, 2006).

In addition, the results of the studies reviewed suggest that high price is a barrier to food acceptance and a limitation in acquiring the knowledge and skills needed to change dietary and health behaviors (Sajdakowska et al., 2018).

### **Level of education**

There is a possible correlation between the level of education and the depth of nutritional knowledge and awareness (Gil, Gracia, Sanchez, 2000; Popek, Halagarda, 2017). According to the studies examined (Pearson, Henryks, Jones, 2011), the level of education has a positive influence on the acceptance of a food product. According to studies (Evans et al., 2010; Vidigal et al., 2015), people with a higher level of education appear to be more open to new products and new technologies in the food market. High education was found to be a strong factor increasing the likelihood of trying new, innovative, healthy food products (Cattaneo et al., 2018). People with higher education had a more positive attitude towards buying organic food (Magnusson et al., 2001). The link between education and willingness to eat may be explained by the greater environmental awareness that highly educated people tend to have compared to less educated people.

## **3. Research Design**

The research was conducted in April 2023 on a population of adult Poles. Quota sampling was employed as the method for sample selection, and the structure of the sample (Table 1) corresponded to the structure of the adult population of Poland as outlined in the most recent national census. The sample size consisted of 631 respondents. The study was carried out using the nationwide research panel Ariadna. The dataset was created with IBM SPSS 27.

**Table 1.**  
*Structure of the research sample*

<b>Respondent characteristics</b>		<b>N</b>	<b>%<math>\uparrow</math></b>
<b>Sex</b>	Female	329	52.1
	Male	302	47.9
	<b>Total</b>	<b>631</b>	<b>100.0</b>
<b>Age</b>	up to 29 years old	117	18.5
	30-49 years old	246	39.0
	50+	268	42.5
	<b>Total</b>	<b>631</b>	<b>100.0</b>
<b>Place of residence</b>	Village	234	37.1
	Small towns (up to 99,000 inhabitants)	208	33.0
	Large cities (over 100,000 inhabitants)	189	30.0
	<b>Total</b>	<b>631</b>	<b>100.0</b>
<b>Material status</b>	Below average	121	19.2
	Average	223	35.3
	Above average	287	45.5
	<b>Total</b>	<b>631</b>	<b>100.0</b>
<b>Education</b>	Primary, middle school, or vocational education	77	12.2
	Secondary, post-secondary, or technical education	272	43.1
	Higher education	282	44.7
	<b>Total</b>	<b>631</b>	<b>100.0</b>

Source: own research.

The research procedure involved the analysis of 17 variables (table 2), including both original variables and those adapted from other studies (Videbæk, Grunert, 2020; Orsi, Voegelé, Stranieri, 2019; de Koning et al., 2020; Bäckström, Pirttilä-Backman, Tuorila, 2004). The variables were measured using a five-grade ordinal scale. In all calculations, it has been assumed that there are equal intervals between categories on an ordinal scale. Polish consumers generally believe that minimally processed food products are better than highly processed ones ( $\bar{x} = 3.84$ ). They also enjoy experimenting with food, such as trying new products ( $\bar{x} = 3.74$ ) or new recipes ( $\bar{x} = 3.72$ ). Interestingly, relatively low scores related to concerns about what they eat ( $\bar{x} = 2.33$ ) and the statement that they do not care how the food they consume is produced ( $\bar{x} = 2.33$ ) suggest that Poles tend to be conscious consumers who pay attention to both the food products themselves and the methods of their production. It is also worth noting that environmental issues were not relatively important for respondents in the context of purchasing and consuming food ( $\bar{x}$  ranging from 3.12 to 3.59). Importantly, even at the declarative level, they do not show a clear willingness to purchase more environmentally friendly products if they were to cost more than non-ecological food products ( $\bar{x} = 3.29$ ).

**Table 2.***The mean values of variables describing consumer attitudes and behaviors toward food*

Variable	$\bar{x}$	$\sigma$
1. I look for ways to prepare unusual meals.	3.28	.967
2. Recipes and articles on food from other culinary traditions encourage me to experiment in the kitchen.	3.45	.976
3. I like to try new foods that I have never tasted before.	3.74	.951
4. I like to try out new recipes.	3.72	.913
5. When I buy food, I consider how its purchase and consumption will impact the environment.	3.12	.960
6. It is important to me that the food was produced in an environmentally friendly way.	3.59	.935
7. It is important to me that the food has been packaged in an environmentally friendly way.	3.56	.941
8. If given a choice, I choose the more environmentally friendly product, even at higher costs.	3.29	.988
9. I am very particular about the healthiness of food.	3.61	.905
10. I eat what I like, and I do not worry much about the healthiness of food.	2.95	1.086
11. A healthy and balanced diet plays an important role in my life.	3.54	.996
12. I don't care what I eat, as long as hunger stays away.	2.33	1.038
13. I don't care how my food is produced.	2.33	1.021
14. I don't need much information on new foods.	2.84	.962
15. I trust minimally processed food.	3.49	.863
16. In my opinion, minimally processed food products are better than highly processed ones.	3.84	.884
17. I trust that minimally processed products are of high quality.	3.60	.794

Legend:  $\bar{x}$  – mean;  $\sigma$  – standard deviation

Source: own research.

The comparison of the average significance of variables determining consumer attitudes and behaviors towards food, based on selected respondent characteristics (age, place of residence, material status, and education level), was conducted using analysis of variance (ANOVA). The results obtained are presented in table 3.

**Table 3.***The mean significance of variables determining consumer attitudes and behaviors towards food based on respondent characteristics*

Variable	$\bar{x}$ overall	Age			ANOVA
		$\leq 29$	30-49	$\geq 50$	
1. I look for ways to prepare unusual meals.	3.28	3.40 <sup>2</sup>	$\approx 3.35^2$	$> 3.17^1$	3.315*
2. Recipes and articles on food from other culinary traditions encourage me to experiment in the kitchen.	3.45	3.56 <sup>2</sup>	$\approx 3.58^2$	$> 3.28^1$	6.976***
4. I like to try out new recipes.	3.72	3.79 <sup>2</sup>	$\approx 3.81^2$	$> 3.61^1$	3.600*
6. It is important to me that the food was produced in an environmentally friendly way.	3.59	3.45 <sup>1</sup>	$\approx 3.54^1$	$< 3.70^2$	3.593*
9. I am very particular about the healthiness of food.	3.61	3.43 <sup>1</sup>	$< 3.60^2$	$\approx 3.69^2$	3.468*
10. I eat what I like, and I do not worry much about the healthiness of food.	2.95	3.12 <sup>2</sup>	$\approx 2.99^2$	$> 2.84^1$	2.984*
12. I don't care what I eat, as long as hunger stays away.	2.33	2.66 <sup>3</sup>	$> 2.38^2$	$> 2.13^1$	11.220***
13. I don't care how my food is produced.	2.33	2.58 <sup>2</sup>	$\approx 2.43^2$	$> 2.12^1$	10.865***
16. In my opinion, minimally processed food products are better than highly processed ones.	3.84	3.63 <sup>1</sup>	$< 3.84^2$	$\approx 3.92^2$	4.411*
17. I trust that minimally processed products are of high quality.	3.60	3.44 <sup>1</sup>	$< 3.61^2$	$\approx 3.66^2$	3.417*



Cont. table 3.

Variable	$\bar{x}$ overall	Place of residence V   T<100   C≥100	ANOVA
No statistically significant differences were identified based on the respondents' place of residence.			
Variable	$\bar{x}$ overall	Material status ↙   ↔   ↗	ANOVA
3. I like to try new foods that I have never tasted before.	3.74	3.59 <sup>1</sup> ≈ 3.66 <sup>1</sup> < 3.86	4.877**
12. I don't care what I eat, as long as hunger stays away.	2.33	2.55 <sup>2</sup> > 2.27 <sup>1</sup> ≈ 2.28 <sup>1</sup>	3.620*
15. I trust minimally processed food.	3.49	3.45 <sup>1</sup> ≈ 3.36 <sup>1</sup> < 3.60 <sup>2</sup>	4.711**
17. I trust that minimally processed products are of high quality.	3.60	3.49 <sup>1</sup> ≈ 3.54 <sup>1</sup> < 3.70 <sup>2</sup>	4.062*
Variable	$\bar{x}$ overall	Education P   S   H	ANOVA
9. I am very particular about the healthiness of food.	3.61	3.38 <sup>1</sup> < 3.55 <sup>2</sup> ≈ 3.72 <sup>2</sup>	5.409**
10. I eat what I like, and I do not worry much about the healthiness of food.	2.95	3.29 <sup>2</sup> > 2.99 <sup>1</sup> ≈ 2.82 <sup>1</sup>	5.854**
11. A healthy and balanced diet plays an important role in my life.	3.54	3.30 <sup>1</sup> ≈ 3.42 <sup>1</sup> < 3.73 <sup>2</sup>	9.354***
12. I don't care what I eat, as long as hunger stays away.	2.33	2.70 <sup>2</sup> > 2.36 <sup>1</sup> ≈ 2.19 <sup>1</sup>	7.878***
13. I don't care how my food is produced.	2.33	2.47 <sup>1</sup> ≈ 2.42 <sup>1</sup> ≈ 2.20 <sup>1</sup>	4.197*
15. I trust minimally processed food.	3.49	3.18 <sup>1</sup> < 3.41 <sup>2</sup> < 3.64 <sup>3</sup>	10.697***
16. In my opinion, minimally processed food products are better than highly processed ones.	3.84	3.40 <sup>1</sup> < 3.72 <sup>2</sup> < 4.07 <sup>3</sup>	22.700***
17. I trust that minimally processed products are of high quality.	3.60	3.22 <sup>1</sup> < 3.53 <sup>2</sup> < 3.77 <sup>3</sup>	16.987***

Legend:

Statistical significance (p-value): \*\*\*p≤0.001, \*\*p≤0.01, \*p≤0.05

Age: ≤29 – up to 29 years old; 30-49 – from 30 to 49 years old; ≥50 – 50 years old or older

Place of residence: V – village; T&lt;100 – town with less than 100,000 inhabitants; C≥100 – city with 100,000 inhabitants or more

Material status: ↙ – below average; ↔ – average; ↗ – above average

Education: P – primary/vocational; S – secondary/post-secondary; H – higher education

 $\bar{x}$  – mean<sup>1,2,3</sup> – group membership – the higher the value, the higher the mean in the group

Source: own research.

The presentation of results in the table 3, was limited to statistically significant findings. In terms of age, respondents in the 30-49 and 50+ age groups place greater emphasis on the healthiness of the food they consume (see variable 9: "I am very particular about the healthiness of food"). The lower engagement of the youngest age group in health and ecological matters is further confirmed by variables such as 12: "I don't care what I eat, as long as hunger stays away" and 13: "I don't care how my food is produced"—though in the case of the latter variable, a similar attitude is also observed among the middle-aged group. The obtained results indicate lower demands, especially among the youngest respondents, concerning the healthiness and quality of the food they consume. As for the place of residence, the analysis did not reveal statistically significant differences, suggesting that the attitudes and behaviors of respondents towards food are similar regardless of where they live. In terms of material status, the ANOVA showed significant differences in several key variables—respondents with higher material status are more inclined to try new dishes (they experiment with food more often—variable 3) and show greater trust in minimally processed food (variables 15 and 17). When it comes to education, individuals with higher education ("university graduates") pay more attention to the

healthiness of the food they consume (clearly noticeable compared to individuals with basic education) and demonstrate greater trust in minimally processed products. This may reflect a higher awareness within this group regarding the quality of the food they consume. In summary, older consumers, as well as those with higher material status and higher education, are more engaged in health and environmental concerns related to food. In contrast, younger individuals and those with lower education or material status tend to be less concerned with these aspects.

The next step in the research procedure was the analysis of the dataset using the exploratory factor analysis (EFA) method. Factor analysis is commonly used to reduce a dataset containing many original variables and replace it with a smaller set of factors. The newly extracted factors are independent of each other while retaining some of the information contained in the original variables. This allows for the identification of potential hidden relationships within the entire dataset (Walesiak, Bąk, 1997; Czyż, 1971; Malarska, 2005; Watkins, 2018).

The analysis of the correlation matrix between variables revealed the presence of many statistically significant correlations, thus providing a basis for conducting Exploratory Factor Analysis (EFA). As part of data inspection, Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were conducted. The KMO measure ranges from 0 to 1, with higher values indicating greater justification for performing factor analysis on a given data set. The KMO value (table 4) was 0.893, which, according to Kaiser's classification, is "meritorious" (Watkins, 2018). The result of Bartlett's test of sphericity showed that the variable correlation matrix is not an identity matrix ( $p < 0.001$ ), thus the results of both tests justify the use of exploratory factor analysis for analyzing the data set.

**Table 4.**

*Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity results*

<b>Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy</b>		,893
<b>Bartlett's Test of Sphericity</b>	Approximate Chi-Square:	5078,289
	df	136
	Significance	< ,001

Source: own research.

Subsequently, using the principal component method, factors (components) were extracted. Uncorrelated primary variables were transformed into new components and ranked according to the explained variance (Table 5). Applying the so-called Kaiser criterion, four factors (components) were identified in subsequent stages of data analysis, which had eigenvalues greater than 1 (Braeken, van Assen, 2017).

**Table 5.**  
*Total Explained Variance of Factors*

Total Explained Variance of Factors									
Variable	Initial eigenvalues			Sum of squared loadings after extraction			Sum of squared loadings after rotation		
	Overall	% of variance	% cumulative	Overall	% of variance	% cumulative	Overall	% of variance	% cumulative
1	6.358	37.402	37.402	6.358	37.402	37.402	3.358	19.751	19.751
2	2.073	12.195	49.597	2.073	12.195	49.597	2.977	17.509	37.261
3	1.565	9.203	58.801	1.565	9.203	58.801	2.887	16.985	54.245
4	1.319	7.761	66.562	1.319	7.761	66.562	2.094	12.317	66.562
5	.785	4.615	71.177						
6	.613	3.607	74.784						
7	.568	3.341	78.125						
8	.510	2.997	81.122						
9	.492	2.897	84.019						
10	.452	2.658	86.677						
11	.398	2.342	89.018						
12	.369	2.170	91.188						
13	.347	2.040	93.228						
14	.317	1.867	95.095						
15	.306	1.799	96.894						
16	.270	1.591	98.485						
17	.258	1.515	100.000						

Factor extraction method – principal components.

Source: own research.

The calculations of factor loadings were performed using orthogonal Varimax rotation. There is no consensus in the literature regarding the minimum value of such a loading to be considered in further analysis. Some authors classify variables with factor loadings of at least 0.4 for further analysis (Yong and Pearce, 2013), while others use thresholds of at least 0.5 (Czyż, 1971) or 0.65 (Walesiak, 1996). The threshold for considering factor loadings as significant was arbitrarily set at 0.6. The factor loadings of two variables did not meet this criterion, thus the variable "9. I pay a lot of attention to the healthiness of the food I eat" (0.525) and "11. A healthy and balanced diet plays an important role in my life" (0.530) were removed from further analysis. The remaining variables along with their components are included in Table 6. The first component relates to openness regarding food and meal preparation (seeking new ways of preparation, making unconventional meals, trying new dishes and recipes). The second component concerns the ecological aspects of food consumption—considering the environmental impact of purchases, environmentally friendly production, eco-friendly packaging, and declarations about purchasing more ecological alternatives at higher costs. The third component reflects consumers' potential indifference toward the quality and origin of food. The final component pertains to attitudes toward unprocessed products—trust in them, their quality, and their superiority over processed products. Based on the analysis of the results presented in Table 6, it can be concluded that Polish consumers are indeed open to experimentation in the context of food consumption, but to a relatively limited extent ( $\bar{x} = 3.55$ ). Interestingly, ecological issues were rated even lower by respondents ( $\bar{x} = 3.39$ ). Despite observed changes in consumer behaviors and an increasing awareness (at least at the declarative level) regarding environmental issues, the results of our study suggest that Polish consumers exhibit pro-ecological attitudes towards food consumption, but these are relatively limited.

The results of the conducted analysis showed that respondents are not indifferent to what they eat. Rather (though not to a significant extent), they pay attention to the quality and origin of food products ( $\bar{x} = 2.61$ ). Notably, the component concerning attitudes toward unprocessed food received the highest rating (which does not mean it was rated highly overall) ( $\bar{x} = 3.64$ ).

**Table 6.**

*Results of the EFA in the set of variables defining consumer attitudes and behaviors towards food*

Component	$\bar{x}$ overall	Factor loading	Variables
1. openness to culinary experiments	3.55	.739	1. I look for ways to prepare unusual meals.
		.826	2. Recipes and articles on food from other culinary traditions encourage me to experiment in the kitchen.
		.805	3. I like to try new foods that I have never tasted before.
		.836	4. I like to try out new recipes.
2. environmental awareness in food choices	3.39	.839	5. When I buy food, I consider how its purchase and consumption will impact the environment.
		.738	6. It is important to me that the food was produced in an environmentally friendly way.
		.748	7. It is important to me that the food has been packaged in an environmentally friendly way.
		.775	8. If given a choice, I choose the more environmentally friendly product, even at higher costs.
3. indifference to the quality and origin of food	2.61	.743	10. I eat what I like, and I do not worry much about the healthiness of food.
		.829	12. I don't care what I eat, as long as hunger stays away.
		.739	13. I don't care how my food is produced.
		.655	14. I don't need much information on new foods.
4. attitudes toward minimally processed food	3.64	.819	15. I trust minimally processed food.
		.747	16. In my opinion, minimally processed food products are better than highly processed ones.
		.768	17. I trust that minimally processed products are of high quality.

Factor extraction method – Principal components.

Rotation method – Varimax with Kaiser normalization.

The rotation converged in 5 iterations.

Source: own research.

It is noteworthy that the analysis of the significance of the components defining the attitudes and behaviors of Polish consumers regarding food consumption, based on gender (Table 7), revealed statistically significant differences between women and men in relation to all factors. Women are more inclined than men to experiment with food consumption and make more environmentally conscious food choices, as well as exhibit more positive attitudes toward minimally processed food. Furthermore, they also show greater interest in the quality and origin of the food they consume.

**Table 7.**

*Mean significance of the components defining consumer attitudes and behaviors towards food based on gender*

Variable	$\bar{x}$ overall	Sex	test-t
		F   M	
1. openness to culinary experiments	3.55	3.64 > 3.44	3.144***
2. environmental awareness in food choices	3.39	3.51 > 3.26	4.065***
3. indifference to the quality and origin of food	2.61	2.46 < 2.78	-5.103***
4. attitudes toward minimally processed food	3.64	3.72 > 3.55	3.178***

Legend:

Statistical significance (p-value): \*\*\* $p \leq 0.001$ , \*\* $p \leq 0.01$ , \* $p \leq 0.05$

Sex: F – Female; M – Male

$\bar{x}$  - mean

Source: own research.

Analyzing the results through the lens of respondents' age, it can be stated that regarding issues related to experimenting with food preparation and consumption, as well as paying attention to its quality and origin, individuals aged below 29 and those aged 30-49 exhibit similar attitudes (table 8). Interestingly, while younger individuals are more open to culinary innovations than those over 49, the oldest group is less indifferent to the quality and origin of the food they purchase and consume. Individuals in the youngest age group exhibit a significantly less positive attitude toward unprocessed food compared to other age segments. Notably, no statistically significant differences were recorded concerning pro-ecological issues in the context of food consumption.

**Table 8.**

*Mean significance of the components defining consumer attitudes and behaviors towards food based on age*

Variable	$\bar{x}$ overall	Age	ANOVA
		$\leq 29$   30-49   $\geq 50$	
1. openness to culinary experiments	3.55	3.64 <sup>2</sup> $\approx$ 3.64 <sup>2</sup> > 3.42 <sup>1</sup>	5.697**
2. environmental awareness in food choices	3.39	3.36 <sup>1</sup> $\approx$ 3.34 <sup>1</sup> $\approx$ 3.45 <sup>1</sup>	1.483
3. indifference to the quality and origin of food	2.61	2.78 <sup>2</sup> $\approx$ 2.69 <sup>2</sup> > 2.47 <sup>1</sup>	7.998***
4. attitudes toward minimally processed food	3.64	3.52 <sup>1</sup> < 3.63 <sup>2</sup> $\approx$ 3.70 <sup>2</sup>	2.790*

Legend:

Statistical significance (p-value): \*\*\* $p \leq 0.001$ , \*\* $p \leq 0.01$ , \* $p \leq 0.05$

Age:  $\leq 29$  – up to 29 years old; 30-49 – from 30 to 49 years old;  $\geq 50$  – 50 years old or older

$\bar{x}$  - mean

<sup>1,2,3</sup> – group membership – the higher the value, the higher the mean in the group

Source: own research.

The results of the discussed analysis based on the respondents' place of residence are particularly interesting (Table 9). No statistically significant differences were recorded in this regard in the respondents' declarations.

**Table 9.**

*Mean significance of the components defining consumer attitudes and behaviors towards food based on place of residence*

Variable	$\bar{x}$ overall	Place of residence		ANOVA
		V	T<100   C≥100	
1. openness to culinary experiments	3.55	3.55 <sup>1</sup>	3.59 <sup>1</sup> ≈ 3.49 <sup>1</sup>	0.928
2. environmental awareness in food choices	3.39	3.40 <sup>1</sup>	3.36 <sup>1</sup> ≈ 3.40 <sup>1</sup>	0.159
3. indifference to the quality and origin of food	2.61	2.64 <sup>1</sup>	2.59 <sup>1</sup> ≈ 2.60 <sup>1</sup>	0.298
4. attitudes toward minimally processed food	3.64	3.64 <sup>1</sup>	3.62 <sup>1</sup> ≈ 3.67 <sup>1</sup>	0.257

Legend:

Statistical significance (p-value): \*\*\*p≤0.001, \*\*p≤0.01, \*p≤0.05

Place of residence: V – village; T<100 – town with less than 100,000 inhabitants; C≥100 – city with 100,000 inhabitants or more

$\bar{x}$  - mean

<sup>1,2,3</sup> – group membership – the higher the value, the higher the mean in the group

Source: own research.

Individuals reporting a relatively higher material status are more inclined to experiment with dishes and exhibit relatively more positive attitudes toward minimally processed food than those with medium or lower status (Table 10). Interestingly, no statistically significant differences were noted between groups regarding responses related to ecological awareness and indifference in food consumption.

**Table 10.**

*Mean significance of the components defining consumer attitudes and behaviors towards food based on material status*

Variable	$\bar{x}$ overall	Material status			ANOVA
		↙	↔	↗	
1. openness to culinary experiments	3.55	3.48 <sup>1</sup>	3.47 <sup>1</sup>	< 3.64 <sup>2</sup>	3.554*
2. environmental awareness in food choices	3.39	3.36 <sup>1</sup>	3.39 <sup>1</sup>	≈ 3.40 <sup>1</sup>	0.130
3. indifference to the quality and origin of food	2.61	2.70 <sup>1</sup>	2.57 <sup>1</sup>	≈ 2.61 <sup>1</sup>	1.140
4. attitudes toward minimally processed food	3.64	3.58 <sup>1</sup>	3.55 <sup>1</sup>	< 3.74 <sup>2</sup>	5.372**

Legend:

Statistical significance (p-value): \*\*\*p≤0.001, \*\*p≤0.01, \*p≤0.05

Material status: ↙ – below average; ↔ – average; ↗ – above average

$\bar{x}$  - mean

<sup>1,2,3</sup> – group membership – the higher the value, the higher the mean in the group

Source: own research.

The analysis of the results based on the respondents' education level revealed that Polish food consumers assess the significance of openness to culinary innovations and ecological issues in the context of their market behaviors (Table 11). Clear differences between groups were noted regarding attitudes toward minimally processed food. The higher the level of education, the more positive these attitudes become. Similar statistically significant differences were observed in relation to paying attention to the quality and origin of food.

**Table 11.**

*Mean significance of the components defining consumer attitudes and behaviors towards food based on the level of education*

Variable	$\bar{x}$ overall	Education P   S   H	ANOVA
1. openness to culinary experiments	3.55	3.45 <sup>1</sup> $\approx$ 3.54 <sup>1</sup> $\approx$ 3.57 <sup>1</sup>	0.691
2. environmental awareness in food choices	3.39	3.33 <sup>1</sup> $\approx$ 3.45 <sup>1</sup> $\approx$ 3.45 <sup>1</sup>	1.289
3. indifference to the quality and origin of food	2.61	2.86 <sup>2</sup> > 2.66 <sup>1</sup> $\approx$ 2.49 <sup>1</sup>	7.404***
4. attitudes toward minimally processed food	3.64	3.27 <sup>1</sup> < 3.55 <sup>2</sup> < 3.83 <sup>3</sup>	25.258***

Legend:

Statistical significance (p-value): \*\*\* $p \leq 0.001$ , \*\* $p \leq 0.01$ , \* $p \leq 0.05$

Education: P – primary/vocational; S – secondary/post-secondary; H – higher education

$\bar{x}$  - mean

<sup>1,2,3</sup> – group membership – the higher the value, the higher the mean in the group

Source: own research.

#### 4. Discussion and future research directions

The results of the study suggest that, in general, Polish consumers exhibit a positive attitude toward experimenting with food; however, this openness to innovations is rather moderate. Similar conclusions can be drawn regarding the importance of ecological issues for consumers when purchasing and consuming food. Respondents are not indifferent to the quality and origin of food products and tend to have a positive attitude toward minimally processed food.

The analysis of the results based on metric criteria revealed the presence of many statistically significant differences in the assessment of the specified components. These differences were observed in relation to all components when evaluating based on gender. The analysis through the lens of age showed that certain age groups exhibit similar attitudes toward food products. Older individuals displayed significantly different attitudes regarding openness to innovations and ecological considerations in the context of food choices, quality, and origin compared to the other two age groups, which, in turn, exhibited similar attitudes in these aspects. Wealthier respondents were more open to innovations and exhibited a more positive attitude toward minimally processed food than less affluent individuals. The findings indicated that the higher the education level of consumers, the more positive their attitudes toward minimally processed food. The only metric criterion for which no statistically significant differences were found among Polish consumers regarding their attitudes toward food was place of residence.

Poles, like many other Europeans, are conscious consumers who pay attention to their diet, food and the way it is produced. The results of research among Polish consumers are consistent with the findings of other researchers - price is the biggest obstacle to buying organic products (Sajdakowska et al., 2018; Bryła, 2016). Despite the awareness that organic food is of better quality, subject to stricter controls and produced in a more traditional way, Polish consumers

do not show a clear willingness to buy it. The analysis of Polish consumers' attitudes and behaviors towards food consumption based on geographical variables is consistent with the research results presented in the literature on this topic. In line with other studies (Jun et al., 2016; Lone et al., 2009), Polish women consume food more consciously than men and make more conscious food choices. They are more interested in the quality and origin of food. The younger generation of Poles is more open to new foods. At the same time, older consumers generally pay more attention to a healthy diet than the other generation of consumers, which is consistent with the studies by Leclercq et al. (2009) and Wongprawmas et al. (2021). Poles with a higher annual income and Poles with a higher level of education are more willing to buy unprocessed food.

Although this study provides several empirical contributions, it still has some limitations that can be addressed by future researchers. First, this study is limited to Polish consumers; future research could conduct a cross-cultural sample. Secondly, further research can be conducted qualitatively by conducting focus groups or in-depth interviews with consumers to explore other reasons that may drive customer purchase intentions for healthy, innovative foods.

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## OFFICE WORK AUTOMATION: IMPLEMENTATION, COSTS, AND BENEFITS. A CASE STUDY

Dariusz NOWAK<sup>\*1</sup>, Marzena REMLEIN<sup>2</sup>

<sup>1</sup> Poznań University of Economics and Business, Institute of Management, [dariusz.nowak@ue.poznan.pl](mailto:dariusz.nowak@ue.poznan.pl),  
ORCID: 0000-0001-7448-6101,

<sup>2</sup> Poznań University of Economics and Business, Institute of Accounting and Financial Management,  
[marzena.remlein@ue.poznan.pl](mailto:marzena.remlein@ue.poznan.pl), ORCID: 0000-0001-7865-0319

\* Correspondence author

**Purpose:** This paper explores the role of office automation in enhancing operational efficiency and competitive advantage for enterprises, particularly in the supply and material sector. The research seeks to analyze the cost-benefit balance of automation, examine its impact on employee tasks, and provide actionable guidelines for managers considering automation.

**Design/methodology/approach:** Using a qualitative, case-study approach, the authors conducted unstructured interviews with key personnel, including the CEO and IT department members, at a Polish supply company. This was supplemented by participant observations and document analysis to gain insights into automation processes, its applications in various office functions, and implementation challenges.

**Findings:** The study revealed that automation significantly enhances efficiency, reduces operational costs, and improves internal and external communications. However, it also highlighted challenges, such as resistance from employees and the high costs of system integration and customization, which impact the adoption rate across diverse functions.

**Research limitations/implications:** The study is qualitative nature limits its generalizability, suggesting the need for further quantitative research across varied industries. Future studies might explore the long-term economic impact of automation and the effectiveness of training programs in overcoming employee resistance.

**Practical implications:** The findings underscore the importance of tailored automation strategies to streamline routine tasks and improve employee productivity. Practical benefits include better resource allocation, faster response times, and improved customer satisfaction, providing businesses a strategic advantage in dynamic markets.

**Social implications:** The paper indicates potential social impacts, such as shifts in workforce skill requirements and the need for continuous employee retraining. Automation could influence job roles, thus impacting employee morale and necessitating adjustments in corporate social responsibility practices.

**Originality/value:** This study provides original insights into the practical challenges and benefits of office automation in a specific business sector, making it valuable for business managers and decision-makers seeking to implement or expand automation in their organizations.

**Keywords:** Office automation, operational efficiency, cost-benefit analysis, employee resistance, competitive advantage.

**Category of the paper:** case study.

## 1. Introduction

Office automation is becoming an increasingly crucial component of the development strategies of modern enterprises, aimed at streamlining and simplifying various operational processes. In today's dynamic business environment, where competition is intensifying and customer demands are growing, companies must continually seek ways to enhance efficiency and reduce costs. In practice, automation involves the implementation of modern technologies such as robotics, artificial intelligence, and other advanced systems that replace routine, repetitive tasks previously performed by humans. Automation contributes to increased productivity, error reduction, and improved quality, which in turn impacts the overall operational efficiency of the enterprise.

Automation of office processes, particularly in the context of human resource management, finance, customer service, and logistics, is a significant step toward increasing the competitiveness and innovation of contemporary firms. Through automation, enterprises can shorten process execution times, improve task quality, and minimize the risk of human error. It also enables better management of company resources, both human and material, by optimizing work schedules, monitoring efficiency, and automatically generating reports.

The introduction of automation also enhances internal and external communication, facilitating collaboration between departments and with business partners. In the context of customer service, automation allows for better management of customer relationships by collecting and analyzing data on customer preferences and behaviours, which in turn enables the personalization of offers and improvement of customer satisfaction. Automated service systems can also address frequently asked questions, reducing the burden on customer service departments and allowing employees to focus on more complex issues.

Automation is also reflected in the accounting and financial sectors, impacting areas such as invoice processing, payment management, and financial reporting, thereby increasing the precision and speed of these operations. In the procurement department, automated systems can monitor inventory levels in real-time, generate replenishment orders, and analyze supplier data, leading to more efficient supply chain management.

Therefore, office automation is a key element in the development strategies of modern enterprises, leading to significant improvements in operational processes, increased efficiency, cost reduction, and enhanced customer service quality. The implementation of modern automation technologies is essential for companies that aim to remain competitive in the market and effectively respond to changing business conditions.

This paper presents the theoretical justification and practical implications of implementing automation in the operational and office activities of a company operating in the supply and material market. It adopts three goals, including:

1. Theoretical: to explain the concept of office automation from the perspective of various theories.
2. Empirical: to discuss the problems and benefits, as well as the use of office process automation in a company operating in the supply and material market.
3. Applicational: to formulate recommendations and guidelines for implementing automation in enterprises.

The paper also aims to provide practical guidelines that can be used by managers and decision-makers in the process of planning, implementing, and optimizing office process automation.

## **2. Office Automation: theoretical implications and implementation practices**

The implementation of automation in the operational and office activities of enterprises is justified by several theories, including the Resource-Based View (RBV), the Theory of Resistance to Innovation, and the Unified Theory of Acceptance and Use of Technology (UTAUT).

From the perspective of the Resource-Based View (RBV), the focus is on utilizing and optimizing the internal resources of an organization to achieve a sustainable competitive advantage. RBV posits that a firm's resources, which are valuable, rare, inimitable, and well-organized (VRIO), can form the basis for long-term success. Automation fits within this context by enabling firms to better manage their resources and increase operational efficiency. As a key element of a strategy based on RBV, automation allows firms not only to improve operational performance and reduce costs but also to enhance innovation and flexibility, which are essential for maintaining competitiveness in a dynamically changing market (Moderno, Nascimento, Gomes, 2021).

The implementation of business process automation often encounters resistance, as explained by the Theory of Resistance to Innovation. This theory suggests that employees may resist new technologies for various reasons, such as fear of job loss, lack of trust in new systems, or adherence to traditional work methods (Talvar, 2020; Frank, Chrysochou, Mitkidis, 2021; Chu, 2023). In the context of automation, employees may fear that automated systems will replace their roles, leading to uncertainty and stress. Additionally, the lack of appropriate training and support can exacerbate these concerns, as employees may feel incompetent in handling new technologies. To effectively implement automation, organizations must consider these factors and undertake actions such as transparent communication, education, training, and support to reduce resistance and ensure a smooth transition to new systems. It is also crucial

to involve employees in the implementation process, what can increase their sense of control and acceptance of changes.

From the perspective of the Unified Theory of Acceptance and Use of Technology (UTAUT), the automation of business processes helps to understand the factors influencing the acceptance and use of new technologies in organizations. Key considerations include the impact of expected performance, where benefits such as increased operational speed and error reduction motivate employees to accept technology. The expected ease of use of the technology is also significant, especially considering that the intuitiveness and user-friendliness of automated systems affect their acceptance (Marikyan, Papagiannidis, 2023). Furthermore, support from colleagues plays an important role, as recommendations, opinions, and positive feedback from coworkers can encourage technology adoption. The experience and freedom of use are also important. Users with more technological experience are generally more inclined to use new technologies. It is also important to minimize concerns related to the loss of control over processes or data security through appropriate communication and training strategies.

In the simplest terms, automation refers to the process of using modern technologies to perform various tasks that were previously carried out by humans (Pawlak, 2007). This encompasses the implementation of robots, artificial intelligence, and other advanced technologies to execute routine, repetitive tasks, thereby improving efficiency and reducing the need for human intervention (Josten, Lordan, 2022), as well as mitigating the psychological and physical engagement of individuals. Siderska (2020) suggests that the essence of automation should be considered from the perspective of the context to which it applies. This approach allows for viewing business process automation from the perspective of modern technology, which introduces innovations and improvements in companies, a set of programmable tools that perform and mimic human actions, and a methodological approach that reduces the scope of simple, repetitive, and routine tasks.

Automation, as a modern technology, introduces innovations and improvements in enterprises by utilizing advanced systems and tools to perform tasks traditionally done by humans. This transformation is evident in various aspects of business operations, from error reduction and quality improvement to cost savings, error reduction, safety enhancement, scalability, and overall efficiency and productivity (Dubey, Singh, B., Singh, D., 2023). Savona et al. (2022) highlight that digital automation is particularly crucial in the process of enhancing business operations, serving as a cornerstone of contemporary technological progress. According to the authors, its significant advantage is the ability to work continuously without fatigue, ensuring a constant pace of production or work, while maintaining high-quality outcomes. Consistent efficiency directly influences productivity growth and ensures that companies can meet the high demands of the market. Despite the undeniable advantages of technological automation, reliance on advanced solutions may lead to dependency on specialized technical skills (Llale et al., 2020). The authors argue that this necessitates ongoing training in the operation and maintenance of automated systems. In some cases, this can



contribute to a mismatch between the skills required for specific job positions and the actual competencies possessed by the workforce. This may lead to labour market mismatches, where there are vacancies related to advanced technologies but a lack of qualified candidates to fill them. Moreover, the rapid pace of technological change necessitates continuous learning and adaptation, which can be burdensome for both employees and employers (Murphy, 2023). Automated systems are typically designed to perform specific tasks, which can limit their flexibility. When business processes change or need to adapt, automated systems may not be able to adjust as quickly as humans. This lack of flexibility can lead to operational challenges, particularly in dynamic environments where adaptability and quick response times are critical. Additionally, integrating automation with existing processes can be complex and time-consuming, requiring significant changes in workflows and potentially causing disruptions during the transition period.

Automation can also be viewed from the perspective of programmable tools related to transformations in modern manufacturing or services. The programmable technologies encompass a range of tools and systems designed to enhance the efficiency, precision, and flexibility of various processes. These tools integrate computer science with manufacturing engineering, enabling machines to perform tasks that traditionally required human intervention (Kandray, 2010). Programmability offers numerous benefits to enterprises, including increased efficiency and productivity, greater precision and quality, flexibility and adaptability, cost savings, and enhanced safety (Radke, Dang, Tan, 2020; Breton, Bosse, 2002; Lahtinen, Mahlamäki, Myllärniemi, 2023).

Siderska (2020) points out that a critical aspect of the methodological approach is the identification of appropriate business processes for automation. According to the author, ideal processes are highly repetitive, rule-based, and involve structured data. Selecting the right processes for automation is crucial to avoid inefficiencies and ensure proper implementation. As highlighted, office process automation is defined as the application of programmable tools to automate repetitive, rule-based tasks that were previously performed by humans. In practice, this involves the use of tools such as robotics (Zieliński, 2022), business process management systems (BPM) (Kwiecień, 2017), robotic process automation (RPA) software (Doguc, 2020), as well as artificial intelligence (AI) (Ślusarczyk, 2021) and machine learning (ML) (Sajja, 2022). These tools find wide application in various areas of business operations, from office work, customer service, human resources, accounting, through financial management and liquidity, to production, warehousing, and quality control processes.

Automation in finance and accounting significantly enhances operational efficiency by eliminating manual, time-consuming tasks, thereby reducing costs and minimizing the risk of errors. In the area of accounts receivable and payable, automated systems can perform accurate and rapid postings, speeding up the cash conversion cycle. Invoices can be automatically generated and sent, and ERP systems can flawlessly reconcile accounts and match invoices with purchase orders, reducing the risk of discrepancies and streamlining the month-end closing

process (Kroll et al., 2016; ABSL, 2020; Borowiec, 2022; Remlein et al., 2022). In finance and financial resource management, automation enables efficient liquidity management, investment optimization, and effective financial risk management (Gotthardt et al., 2019; Kaya et al., 2019).

In planning and budgeting, automation allows for more precise financial forecasting and better cost control, enabling companies to respond more quickly to market changes (Kaya et al., 2019). In auditing, automated tools can process large volumes of data in a short time, identifying potential irregularities and supporting auditors in risk analysis (Huang et al., 2019; Moffitt et al., 2018; Rozario, Vasarhelyi, 2018). Automation of tax processes and their settlements not only ensures compliance with regulations but also enables continuous monitoring and reporting of tax liabilities, which is crucial for avoiding penalties and optimizing taxation (Mezzio, Stein, R., Stein, S., 2019; Łada, Mierzejewska, 2021; Remlein, Jastrzębowski, Obrzeżgiewicz, 2022b).

Automation in procurement, production, and warehousing significantly improves the efficiency and precision of operations in these areas. In procurement, automated management systems can monitor inventory levels in real-time, generate replenishment orders, and analyze supplier data to optimize costs and delivery times (Otundo, 2021; Chopra, 2018). In production, automation allows for precise planning and execution of production processes, reducing downtime and minimizing waste. Automated production lines can operate continuously, ensuring consistent product quality and increasing production efficiency (Hermaniuk, 2021; Beigi, 1997; Syreyschikova et al., 2020).

In warehousing, automated warehouse management systems (WMS) can control the receipt, storage, and dispatch of goods, optimizing warehouse space and reducing the time needed to fulfil orders. Warehouse robots can move products, complete orders, and prepare them for shipment, increasing the speed and accuracy of logistics operations (de Koster, 2015; Nilsson, Merkle, 2015). Through automation, companies can not only increase the efficiency of their processes but also better respond to changing market conditions and customer needs.

### **3. Research methodology and characterization of the studied entity**

The issue addressed in this article has an exploratory-explanatory nature, which requires the use of qualitative research methods. These methods involve examining the nature of the analyzed phenomena, their manifestations, symptoms, and contexts, while omitting strict frameworks, frequency, systematicity, and place within a clearly defined chain of cause and effect (Ugwu, Chinyera, Eze, 2023). The essence of qualitative research lies in its ability to provide complex, multifaceted textual descriptions that explain experiences, feelings, and beliefs concerning a specific research problem.

The study on office process automation was conducted using qualitative method triangulation, in the form of a case study involving interviews: unstructured, in-depth, and focused, with the chief executive officer (CEO) of a company operating in the material and technical supply market in Poland, as well as with IT department employees responsible for planning, implementing, and controlling processes related to work improvement. The study was enriched with an analysis of company documentation, including reports and statements, as well as participant observation involving the testing of some implemented solutions. Participant observation entailed active participation and monitoring of daily operations within the company, with an emphasis on automation processes. At an individual level, the authors integrated with operational and technical teams to directly experience and analyze the implementation and functioning of automation systems.

It should be noted that the form of the focused, open interview allowed respondents to freely express their views beyond standard questions, resulting in numerous opinions and positions from the business representative regarding the automation of office processes and their impact on the company's operational activities. The conducted interview primarily focused on:

- diagnosing and assessing the current state of the company concerning office process automation,
- characterizing activities related to the implementation of work improvement processes,
- evaluating the costs, benefits, and risks of office work automation,
- identifying future actions and development perspectives in the context of office work automation.

The results of the conducted interviews were recorded, transcribed, and subjected to content analysis.

The development perspective of office work automation was illustrated through a company engaged in material and technical supply, headquartered in Poznan. The company was founded in the early 1990s and is considered a modern and dynamically operating entity in both the domestic and international markets. During the interview, the CEO emphasized that the company is highly innovative and flexible in introducing new products, services, organizational changes, and technical advancements, while seeking new markets and supply sources.

The primary domain of activity is related to the wholesale supply of spare parts to the industry. The core offering includes bearings, both rolling and linear, drive belts and wheels, conveyor belts, hydraulic hoses, chains and sprockets, tools, seals, and gaskets. The company also produces specialized components and tools and provides a wide range of professional production services in comprehensive industrial and technical supply, maintenance, storage, including strategic inventory, service, warranty and post-warranty service, training and workshops, transport, maintenance, diagnostics, assembly and disassembly, and consultancy.

The company operates in both the original equipment manufacturer (OEM) market and the maintenance, repair, and overhaul (MRO) market, with the latter accounting for about 75% of the revenue. The MRO market is considered highly specialized, requiring extensive knowledge of machine and device construction, as well as the characteristics, properties, and parameters of the offered parts. To ensure the highest level of delivered supplies and services, the company holds authorized representation of leading domestic and international spare parts manufacturers.

Deliveries and services are executed through an extensive sales network, with 18 branches located mainly in major industrial centres across Poland. Alongside the sales network development, the company places great emphasis on its employment structure, currently employing 138 highly qualified individuals whose qualifications are continually enhanced through various studies, trainings, workshops, and courses both domestically and internationally.

The company actively collaborates with around 10,000 clients (including retail customers) from various industries and areas of activity, characterized by different sizes and scales of purchases. Notably, no single contractor dominates the sales structure of the company.

The highly specialized nature of the company's activities necessitated the adoption of an appropriate organizational structure, which has a dual character. On one hand, it is based on a traditional functional approach, with the president overseeing the entirety and department heads managing individual units. On the other hand, it features a flat structure, where each regional manager supervises several operational employees. This direct coordination of operational work by experienced and skilled managers is seen as a significant advantage.

In addition to traditional organizational units such as accounting, human resources, legal, IT, and marketing, the company features two dominant areas. The first deals with material and technical supply, organizing deliveries of both standard, widely known parts and highly specialized, rare items typically produced in small or single batches. The second group, dominant in nature, consists of sales employees, primarily sales engineers with excellent industry knowledge, experience, and competencies gained through training and courses organized by the company and foreign partners. Their work involves direct client contact, often at the client's site, and documenting devices for repair or overhaul.

The specificity of the company's operations, requiring high mobility, skills, and industry knowledge, has led to the implementation of many new solutions, methods, and tools based on automation, digitization, and new technologies. The need for office work automation, according to the CEO, stems from the necessity to streamline and simplify various processes and procedures, including:

- human resource management, work time, calendar, and scheduling,
- document circulation, analysis, and processing, including report generation,
- communication both within the company and with contractors,
- financial matters, including salaries, liquidity management, trade credit, etc.,

- monitoring, reporting, and overseeing customer service,
- organization of supply, control, storage, and warehousing of products.

Automation in these areas significantly enhances the operational efficiency of the company by reducing the time required for routine tasks and minimizing the risk of errors. Implementing modern technological solutions also allows better resource utilization and a focus on strategic activities, contributing to the overall development of the enterprise.

## **4. Areas of process automation in the organization**

### **4.1. Human Resource Management**

The first area fully automated in the analyzed enterprise was the human resource management process. In the examined entity, this process is based on an external application for HR called e-employee, which was implemented in the year 2015. The application is used in direct contact with employees, both those working at the headquarters and in various branches. The program simplifies all HR, personnel, and administrative procedures. Each employee, depending on their position and role, is granted specific permissions, allowing them to access selected options, information, and data. Among the many modules available in the application, the company uses the options for managing leave, planning, and controlling work time, and handling business trips. According to the interviewee, the application is particularly useful in the process of planning leave and managing absences, especially in the context of ensuring continuity of work at the headquarters and the branches. The clarity and readability of the program practically eliminate the possibility of approving leave for all employees at the same time. The work time control module is equally useful. The nature of the business, primarily the need to ensure a high level of customer service, requires the company to be open from early morning until late evening. The main area of the company's activity is the maintenance market, including repairs, maintenance, and inspections, characterized by a high degree of failure, malfunction, and damage. Thus, the availability of spare parts, which the company provides directly from its warehouse, and the delivery time, are crucial. These factors result in employees starting and ending work at different times, working on Saturdays, and, in some cases, even on Sundays and holidays. The requirement to log in to the system upon arrival at work and log out at the end of the workday serves as an essential tool for controlling work time, eliminating the need for employer involvement in the supervision process. The module concerning business trips is used to a lesser extent, mainly indicating the date and destination of the planned trip and, in some cases, the need to reserve a company car. This limitation primarily results from the dynamic nature of the indicated area, as many business trips are sudden and related to unforeseen situations at the client's site.

The company does not use modules for training, employee evaluation, or recruitment. Activities related to these areas are conducted traditionally or using other solutions. For example, recruitment is currently carried out through the external platform "pracuj.pl", which has significantly simplified the procedure, saving time, employee involvement, and office costs. It should be noted that in the past, the company had its relatively extensive recruitment system based on many criteria and requirements. However, this process was inefficient, often hiring individuals who did not possess the declared competencies or quickly changing employers. Analyzing the recruitment issue, the interviewee emphasized that currently, new employees are not subject to high requirements, especially compared to previous experiences. The main problem the company faces is the lack of willing candidates, and in the case of hiring an employee, their low engagement, minimal initiative, high expectations, and generally negative attitude towards performing job duties. The interviewee emphasized that each new employee undergoes an individual instruction and training system, tailored to their skills, experience, competencies, position, etc. This process cannot be automated as it requires consideration of the candidate's personal traits, including their engagement, ability to assimilate new knowledge, creativity, entrepreneurship, initiative, or willingness to experiment. Therefore, the recruitment and training process relies on both automation and a traditional approach, utilizing a personal touch. Employee evaluation in the studied company is also not automated; it is individual, complex, comprehensive, and conducted by the direct supervisor and management. This process mainly concerns employees involved in supply, customer service, and sales. Each of them (or branch) has a set sales target, usually quarterly, less frequently monthly, which is analyzed in terms of its achievement, including the value and obtained margin. Additionally, the increase in sales value (and margin) over successive periods is considered. These elements form the basis for calculating additional gratifications.

In summary, it should be emphasized that a significant benefit of implementing the e-employee application was the reduction in number of HR employees from three to two. However, it should be noted that these employees also perform other tasks.

#### **4.2. Procurement**

Another external application utilized in office work at the discussed enterprise is the EDI (Electronic Data Interchange) system, which is currently in the implementation phase. It is primarily used for communication and relationship development with suppliers, who were also the initiators of the application's implementation. Currently, it is used with four strategic partners, including SMC, NTN, Timken, and Optibelt (global manufacturers of spare parts and original equipment). This application serves as a specific form of communication and information exchange between business partners, replacing traditional email. The system facilitates the electronic exchange of standard business documents such as inquiries, offers, estimates, orders, confirmations, shipping lists, invoices, etc., significantly enhancing the speed and accuracy of data processing.

From the perspective of the company's operational activities, this is extremely important due to the need for quick responses to inquiries and demands from customers in case of failures or sudden needs for specific parts, components, semifinished products, and details. In the past, the response time to a standard inquiry was about 24 hours; currently, thanks to the implementation of these systems, the information transfer is almost instantaneous.

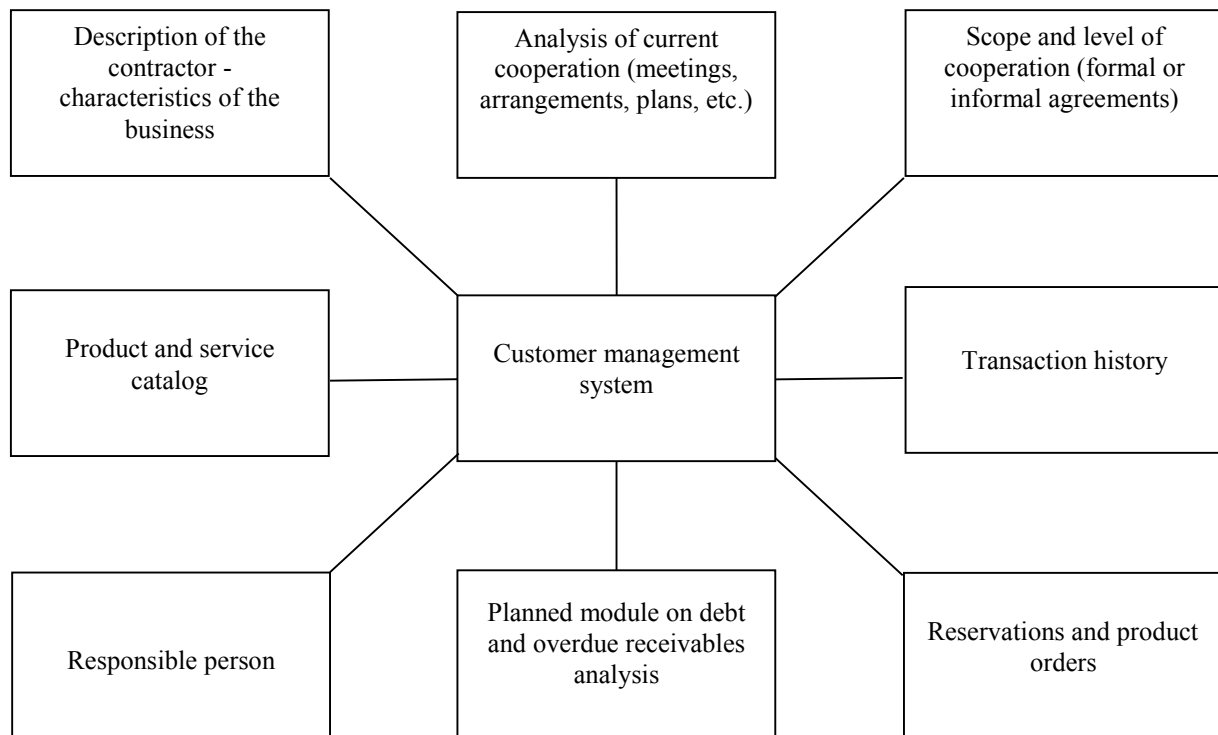
An additional benefit of implementing the EDI application is the ability to directly, in real-time, view partners' inventory levels, prices, production plans, and other information related to orders and deliveries. The company can connect to suppliers' systems, providing easy access to many pieces of information and data that were previously obtained traditionally (via email inquiries or fax). The company plans to fully implement the EDI system with the mentioned partners by the end of October, 2024 and, depending on possibilities and interest, expand it to the relationships with other contractors. To this end, a special team has been established to adapt the company's programs and procedures to the partners' software, enabling full compatibility between the companies.

It should be noted that in the analyzed enterprise, the operational activities, including inventory records, receipts, issues, reservations, sales, etc., are conducted using proprietary software, which is continuously adapted to the company's needs by specialized IT department employees.

### **4.3. Customer Service**

In addition to utilizing external applications, the company develops and implements its own systems to support office work. A typical example is the customer relationship management software, developed by the IT department (Figure 1). The application is open-source, allowing for updates and modifications based on changes in the environment. During the interview, it was emphasized that external applications do not possess these features, and their adaptation to current needs generates relatively high costs. It was also noted that with external products, it is not always possible to modify the application according to the company's expectations.

The application used in operational activities consists of several modules that provide a comprehensive view of the customer. The first module includes a detailed description of the client, containing information such as the company's name, legal form, business profile, production program, type of production equipment, etc. This section also includes information about contact persons and descriptions of events, curiosities, and other information that can be used in the business relationships (e.g., information about customer needs that the company cannot currently meet).



**Figure 1.** Customer Management System Modules.

Source: Own elaboration.

The second module contains information about meetings, both past and planned ones, mutual agreements, plans, needs, anticipated changes in processes and production equipment, negotiation results, and other aspects useful in the company's current operations. A significant element of this module is the ability to block or limit sales, for example, when a client significantly delays payment for delivered products or services. The next module contains information about the most frequently used assortment along with its detailed characteristics (type, kind, purpose, estimated demand, required quality, manufacturer, possibility of using substitutes, etc.). This section is very helpful in the direct customer service process, even if the person responsible for contact with the customer changes. From the company's perspective, the most important part of the application is the transaction history with individual partners. It includes information about the type of purchased assortment, sales volume, price, financing period with trade credit, preferred delivery type, etc. It should be emphasized that the transaction history is primarily used to analyze inventory liquidity, which is done manually by trained procurement department employees. This department in the analyzed entity is very extensive due to the nature of the business, which involves the need to maintain operations or production in cooperating enterprises. A lack of specific assortment or a delivery delay can result in the termination of the agreement and the client switching to the competitors. Therefore, the company strives to maintain a high level of part availability, which for standard products ranges from 90-95%. Another module contains information about successive orders and deliveries that will be made in the future. These deliveries are based on annual orders delivered to clients according to an agreed schedule. Each subsequent deadline for meeting the client's



demand is signalled well in advance, practically eliminating delivery delays. An essential module of the customer relationship management system is also the option to reserve parts for future pickup. This option is particularly used in situations of completing a comprehensive order for a client planning, for example, production increase, changes, scheduled maintenance, modernization, or repairs.

## 5. Results

### 5.1. Motives for automating office processes

One of the most critical issues discussed during the interview was the overall perception of the office work automation. According to the CEO, automation, including office work in a modern enterprise, is an objective necessity that impacts the competitive position, revenue and profit levels, costs, employee attitudes toward work, internal and external relationships, inventory optimization, production, distribution, and many other aspects. It fundamentally contributes to simplifying the work of individual employees, particularly in terms of routine and conventional tasks. It also facilitates the development of relationships with contractors, simplifying both the company's procurement process and the planning of sales and deliveries to customers. The interviewee emphasized that *the solutions implemented in the company are continuous and permanent over time, requiring updates, modernization, and modifications.*

He particularly highlighted the changes occurring in the business environment, notably the dynamic technological progress and the necessity to adapt to new requirements and conditions related to accounting, human resource management, customer service, and relationships with contractors. Specific demands from some partners, who condition cooperation on meeting particular criteria, including IT system compatibility, are also significant. The interviewee noted that the company is fundamentally familiar with, analyzes, and implements automation in its operational activities as much as possible and needed.

In his view, *a major drawback of implementing new solutions is the high cost of automation on one hand, and the limitations associated with the complex and multifaceted nature of the company's operations, which require a tailored approach on the other.* Furthermore, he mentioned, *implementing automation without a detailed calculation of benefits and costs can have the opposite effect, and instead of expected profits, the company might incur tangible losses.* Particular attention should be paid to actions, behaviours, procedures, and processes that constitute core competencies for the entity, i.e., assets indicating competitive advantage. Trying to frame these into specific structures will streamline the process but will also enable competitors to easily replicate, copy, or utilize them.

For this reason, not all areas of activity are equally subject to process automation. However, it should be emphasized that the company both seeks new solutions in the market and develops, designs, and implements its own methods of improvement. It is also noteworthy that most of the implemented office work improvements stem from grassroots initiatives by employees who, based on their observations, insights, and analyses, submit various remarks and needs.

## **5.2. Perceived benefits and costs of office process automation**

There are numerous benefits and advantages associated with the implemented application. During the interview, the CEO highlighted *the ability to respond quickly to customer enquiries, reduce costs, eliminate errors, improve operational work, increase productivity, as well as the ability to better manage business processes and reporting*. An added value is also *the reduced involvement of employees in the discussed process, allowing them to be reassigned to other tasks, as well as significant improvements in information flow and communication*. The interviewee noted that in the past, there were instances where notifications, inquiries, or offers did not reach the recipient, were sent to unauthorized employees, contained errors, were delayed, or even went unanswered.

A significant drawback of external applications used for office work automation is the high cost of acquisition, as well as the limited usefulness of basic versions, mainly due to the specificity of the company's operational activities. The prices of applications range from several thousand to tens of thousands of PLN, and their valuation is usually individual. Additionally, each application requires customization to the company's profile, software, industry specifics, types of customers, suppliers, and other aspects, generating further costs. Furthermore, any change, modification, or need to improve the application requires engaging external service providers, leading to additional cost increases, time consumption, operational difficulties, and not always yielding the expected results.

For example, in the analyzed entity, it is practically impossible to fully automate the sales process. In the company this system is multi-criteria based, relying on various price levels determined by the type of customer (retail, wholesale, industrial, service, OEM – Original Equipment Manufacturers, MRO – Maintenance Repair and Overhaul), turnover volume, formal or informal agreements, barter, negotiations, consignment agreements, successive deliveries, etc. Additionally, the company offers products from different manufacturers and various substitutes with different quality, utility, value, and usability, contributing to further difficulties in attempting to automate the process. Therefore, the sales process must be conducted with significant employee involvement, as they possess the necessary knowledge, understand the buyer and their needs, and can advise and select appropriate products that meet the customer's expectations.

### **5.3. Barriers to implementing external applications for office work automation**

Despite the numerous benefits arising from the implementation of the application, it is only used in some business relationships because a significant portion of contractors is not interested in the process of electronic document exchange. The primary concern is the potential leakage of sensitive data, such as purchase prices, production costs, sales prices, type of contractor, scope of cooperation, technical documentation, cost estimates, etc. Consequently, the company prefers traditional communication methods in many business relationships, primarily using email and, less frequently, direct telephone conversations. The primary advantages of these methods include speed, ease of use, clarity, readability, cost savings, and easy access to information and files. Email allows for quick and mass communication with company employees and branches, which is crucial when it is necessary to send important information, such as issues related to the financial liquidity of contractors who might attempt to make purchases knowing they cannot settle the payment within the agreed period. Furthermore, a particularly significant advantage of phone and email communication, from the perspective of managing the company's distribution network, is the ability to easily and securely store data, even over long periods, as well as classify and categorize it. According to the CEO, the EDI application does not have these functions.

During the interview, it was emphasized that the customer relationship management application lacks a module that presents and analyzes the contractor's debt levels and overdue receivables. These elements are included in a different application related to accounting, requiring additional employee involvement in directly servicing a specific customer. Currently, efforts are underway to add a module that includes the contractor's current financial and payment situation, with a particular focus on transaction history. However, it should be noted that attempts to create applications that monitor debt and integrate them with the company's operational activities have not yielded the expected results, leading to the establishment of a dedicated unit solely responsible for monitoring and collecting receivables. This issue is extremely significant from the company's perspective because the analyzed enterprise operates in the industrial market, characterized by a very high transaction volume. The failure of even one contractor to settle their dues can cause severe financial disruptions, potentially leading to a temporary loss of financial liquidity.

It was noted that the company employs 138 people and has a sales network comprising the headquarters and 17 branches. Such an extensive structure requires an appropriate communication system, which in the examined entity is based on the 3CX virtual telephone exchange. This system was implemented in 2016-2017 and, according to the interviewee, is a fully useful tool that improves relationships with both employees and contractors. The practical use of the exchange allows to contact with multiple employees or contractors simultaneously, conducting videoconferences, chats, screen sharing, whiteboards, documents, and even running panels, surveys, and other activities. The ability to record conversations and

analyze them later is also useful, enabling the review of details, nuances of conversations, or comments that might be helpful in subsequent analyses. The interviewee noted that the application is fully flexible, and calls or conferences can be conducted from various locations, with the only requirement being internet access. From the company's perspective, a highly useful feature is the ability to anonymously join the negotiation process between a client and a company employee, during which advantageous solutions can be suggested to the employee. Another function utilized by the company is the automatic connection of incoming calls to the employee who is not currently assisting a customer. This approach greatly facilitates and simplifies work (traditionally performed by a secretary) and significantly impacts the speed and mobility of customer service, given that customers are inherently impatient.

As mentioned, not all areas of the company's operations are subject to automation. One such area is the analysis of the liquidity of the assortment offered by the company. During the interview, it was emphasized that the breadth and depth of the product range is a unique asset of the enterprise, a key competence that has been built over several decades. Currently, there are over 35,000 items in the sales catalogue, with their volume continually increasing. The company offers its customers products from various domestic and foreign manufacturers, with differing qualities, applications, purposes, and purchase prices. These products are sold to about 10,000 buyers, none of whom are dominant. The daily sales volume and value necessitate precise daily analyses regarding the types of products sold, their manufacturers, purchase and sale prices, availability from suppliers or competitors, delivery times, production cycles, expected demand (monthly, quarterly, annually), product life cycles, and similar parameters.

According to the CEO, due to the dynamically changing demand, characterized by discontinuity and inconsistency, automation cannot be utilized in the analysis of inventory liquidity. This is particularly true for items with specific, unique, and relatively rare or dynamic applications, used by specific groups of enterprises, and often at irregular intervals. These items also have relatively high purchase prices, making it impossible to create above-standard inventory stocks. The availability of these items from the manufacturer, determined by production schedules, policies, and irregular production cycles (related to batch size), also prevents automation. Attempts to automate the process could thus result in significant losses, as it is challenging for computer programs to simultaneously account for several criteria.

This issue does not affect so-called successive orders or popular products with broad and common applications, whose deliveries are made within strictly defined time frames. Ensuring a high level of availability of the offered products therefore requires an individual approach to procurement and warehousing organization. This process involves the liquidity analysis of individual items and is performed manually by designated employees. This analysis demands above-average concentration, focus, and the ability to combine various events, and it also takes a considerable amount of time. Proper execution of this process ensures a comprehensive product range, making it one of the most critical areas of the company's operations, according to the CEO. The interviewee emphasized that the skills of the employees conducting this

analysis, their experience, and their approach to work are key competencies of the company and fundamentally impact its competitive position, image, and reputation.

## 6. Conclusions

In the face of dynamically changing business conditions, work automation is becoming not just a benefit but a necessity, especially for enterprises aiming to maintain competitiveness. The conducted case study analysis revealed the crucial role that automation plays in various aspects of a company's operations, from simplifying and streamlining office work to optimizing operational processes and strengthening relationships with contractors. The implementation of systems like e-employee and EDI in the discussed unit has significantly improved efficiency, reduced costs, and increased transparency and speed of information flow. It is emphasized that in practice, automation can be applied in all areas of a company's operations, particularly those involving repetition, rhythm, or cyclicity. It is especially useful in accounting and financial processes, internal and external communication, sales and customer base management, recruitment, work supervision, report creation, etc.

Analyzing the dynamic changes in the business environment, it can be noted that the role of office work automation will rapidly gain importance, especially in the context of labour market changes related to the lack of generational replacement. Demographic issues mean that many companies already face significant challenges in finding competent and engaged employees. Over the next few years, this negative trend will intensify, with more people leaving the workforce and fewer willing to take on new challenges, particularly those associated with monotony and repetition, which are ideal for automation.

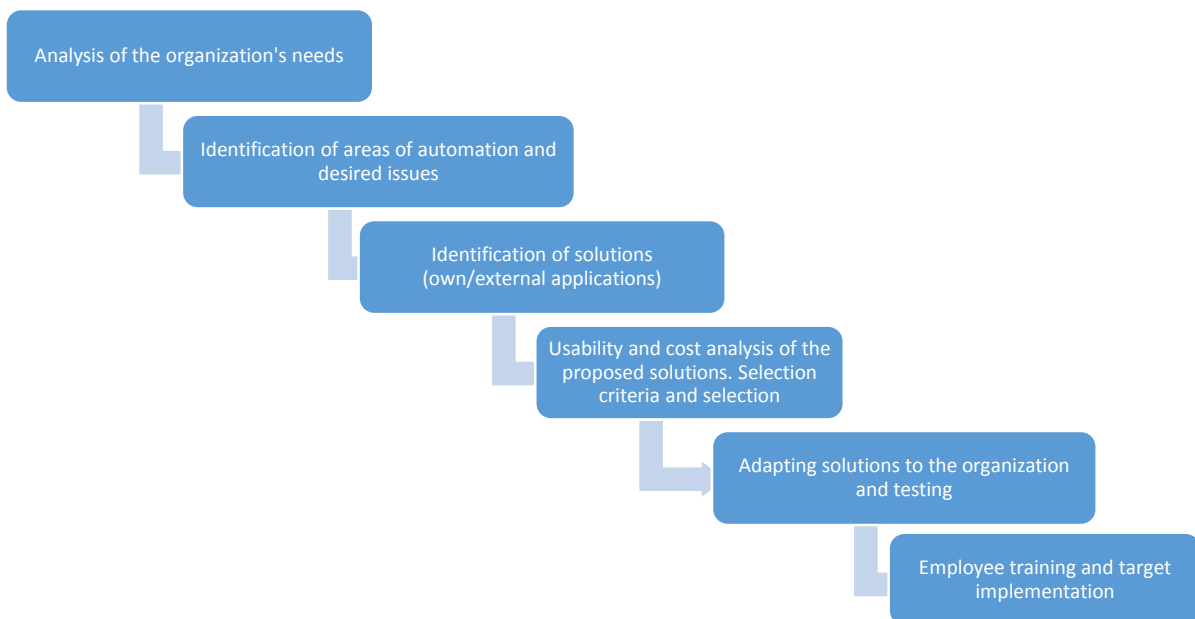
It should be also emphasized that implementing new technologies comes with many challenges, including the need for continuous adaptation of systems to a changing environment, regulations, and contractor requirements. The high costs associated with implementation and modification of solutions are also a significant drawback. In the context of incurred costs, it is worth noting the grassroots initiatives of employees, which are often sources of innovation and improvements, with the caveat that key competencies and unique procedures of the company must be protected from easy replication and should not be subjected to automation processes. According to the interviewees, the process of office work automation requires a balanced approach that considers the specificity of the given activity and the individual needs and preferences of the enterprise.

The case study showed that there are specific, unique, and unrepeatable solutions that cannot be systematized. In the discussed entity, one such area is employee evaluation, where due to the dynamic, discontinuous, and variable nature of operational activities, measurable

criteria cannot be applied. A personalized analysis, conducted by the competent individuals with extensive experience and practice, is required. Automation does not apply to areas that are exceptional and fundamentally constitute the core competence of the enterprise. In the analyzed company, an example of such an asset is the ability to shape the assortment-quality-price offer, which ensures the full availability of spare parts and is directed at both enterprises focusing on branded elements with certificates of origin and those for whom quality is of secondary importance.

In light of the above considerations, conducting the process of office work automation requires a phased approach (Figure 2).

In summary, it can be emphasized that office work automation in the discussed enterprise is both a strategy for improving efficiency and reducing costs and a way to increase flexibility and adaptability in a rapidly changing business environment. In the process of ongoing changes, it is essential to remember the need to balance technology with the personalization of work, characterized by an individualized approach to customers, employees, and other stakeholders, which will be crucial today and in the future for building, maintaining, and developing lasting business relationships and maintaining an appropriate market position.



**Figure 2.** Phased Approach to Office Work Automation in the Analyzed Enterprise.

Source: Own elaboration.

The conducted case study has also allowed for the formulation of several recommendations to assist entrepreneurs in implementing automation within their own companies. First, the introduction of automation should be carried out gradually, starting with the most repetitive and time-consuming tasks. Simultaneously, the automation process should involve employees at various levels, who can help identify areas requiring automation and minimize resistance to change.

It is also crucial to invest in training and technical support, which should help to develop competencies and reduce resistance to changes. Before implementing automation, companies should conduct a detailed cost-benefit analysis. Understanding potential savings and the investments required to implement new systems allows for more informed business decisions. Entrepreneurs should also remember that not all areas of operations should be subject to automation. A company should protect its core competencies and unique procedures, which constitute its competitive advantage, from full automation to avoid the risk of them being copied by competitors.

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## ECONOMIC AND MARKET ASPECTS OF COOPERATIVE MODEL OF HOUSING STOCK MANAGEMENT

Sławomir PALICKI

Poznań University of Economics and Business; slawomir.palicki@ue.poznan.pl, ORCID: 0000-0003-3410-8039

**Purpose:** Quite dynamic housing cooperative movement in Poland is a specific phenomenon in the area of housing resources management in Central-Eastern Europe. The main objective of the article is to assess the functioning of Polish housing cooperatives in terms of maintaining the proper condition and market potential of large panel housing estates.

**Design/methodology/approach:** The desk research method, comparative analysis, and own calculations based on statistical data published by the Statistics Poland and the NBP were used. The article presents non-obvious arguments indicating the successes of Polish housing cooperatives.

**Findings:** Polish housing cooperatives, despite significant limitations in their functioning caused by legislative decisions after 1990, have successfully evolved towards effective resource management. The structure of operating costs as a property manager is similar to housing communities, and at the same time clearly more advantageous than in the case of resources managed by the public sector or social housing associations.

**Research limitations/implications:** The commonness of housing cooperatives in Poland makes it difficult to compare it with the rest of Central-Eastern Europe, because this formula for managing housing resources in other countries is generally rarely used. Therefore, there is a lack of non-Polish publications in this area.

**Practical implications:** The management methods in the cooperative model provide similar cost-effectiveness to specialist property managers. Housing cooperatives implement broad repair programs, contributing to maintaining the good condition of large panel housing estates.

**Social implications:** Members of the cooperative co-decide on their activities in a democratic way, which allows for maintaining interpersonal ties and building grassroots civic engagement. The housing cooperative strongly rooted in Poland could play the role of an institutional investor, competitive with developers on the residential real estate market. This might change housing policy, seeking new solutions that are helpful for people economically excluded from the real estate market.

**Originality/value:** The article draws attention to the substantial potential, professionalism and know-how of housing cooperatives in Poland. This is an exceptional situation compared to European solutions. The paper is addressed to scientists and public life entities, authorities, political decision-makers showing the idea of engaging housing cooperatives in the development of affordable housing.

**Keywords:** housing cooperative, large panel housing estate, affordable housing, housing management.

**Category of the paper:** Research paper.

## 1. Introduction

The models for meeting the housing needs of the population in individual countries on the continent depend on many variables (Lis, 2015, 2017). Of course, one can focus on economic factors, such as the wealth of societies, the rate of capital accumulation or the affordability of apartments in the market offer of individual countries and regions, but omitting the issue of lifestyle, the worldview of residents in the area of building modern vs. traditionalist household and family structures, the specificity of national social policies, construction of law (Zakrzewski, 2022) as well as more local historical conditions (including contemporary history, after the end of World War II) would be a huge mistake. In the group of circumstances that are not directly related to the market, it is worth mentioning here, among others, the shaping of social policy that favors the construction of so-called affordable housing. Generally speaking, three forms of affordable housing are used: social (institutional – with the involvement of the state and/or local entities, i.e. the city/commune), cooperative and social assistance model (e.g. stock dedicated to homeless people). These are sometimes formulas of direct investment in the construction of public, social or municipal housing resources. The great differentiation in the impact of market mechanisms in individual countries over time is also invaluable. Countries covered by the impact of the idea of real socialism for almost half a century are trying to make up for the shortcomings in this area, often doing so at a much faster pace. Hence, the basic, economic determinant of housing relations, which is the division of society into owners of their own flats and tenants, according to the latest data for 2022, remains strongly differentiated in the countries of our continent (House or flat – owning or renting, 2024). The average share of tenants for the entire European Union is 30.9% of the total population. Thus, 69.1% of the EU population lives in resources that are their own property. However, these relations are most strongly shaken towards the dominance of the ownership formula in the former "People's Democracies" - in Romania it is even 94.8%, and in Poland 87.2%. At the other extreme are Germany and Austria (respectively: only 46.7 and 51.4% of ownership), where the development of models of stable, long-term rental housing has become most widespread in Europe. The Polish structure of the analyzed indicator is closest to Bulgaria, Lithuania, Latvia and Hungary. Interestingly, among the neighbors with a post-socialist background, the Czech Republic is changing the most dynamically in this respect, already reaching almost 23% of the tenants share. However, this is not entirely a recipe for housing success, as in recent years, in the entire EU, the lowest economic availability of apartments relative to the earnings of residents has been characteristic of the Czech Republic and Slovakia (Raport o sytuacji..., 2024; Overview of European Residential Markets. August 2023). For comparison - in Poland, the economic availability of apartments is 65-75% higher than in the aforementioned neighbors.

It is also good to look at the intensity of various, socialized forms of institutional and management activity in the area of housing in Europe. An interesting source of knowledge in this area is the report of the Housing Europe organization (The State of Housing in Europe, 2024). The most developed housing resources within the framework of affordable, non-profit construction (this concept should be treated broadly, it includes all forms of non-market support, i.e. "socialized" activities in various models and scope of housing - including mutual community-cooperative, state, municipal, intervention-social assistance) operate in the Netherlands, Austria, Sweden, Denmark and France, constituting 29, 24, 24, 20 and 17% of the total national housing resources, respectively. Among these countries, the activity of housing cooperatives was established in Sweden and Denmark, where it concerns 24% and 7% of all apartments, respectively. Interestingly, these entities are involved in the management of existing, but also in the construction of new resources (Anund Vogel, Lind, Lundqvist, 2016; Larsen, 2024). In the other above-mentioned countries, the formula of social and welfare construction is mainly used. In a similar way, 11% of apartments were built in Finland, 9% in Ireland, 6% in Belgium, 4% in Germany, 3.5% in Italy. In Greece, there are no resources of a social/communal nature at all. On the other hand, housing cooperatives commonly own apartments in Norway (14% of the resources) and - marginally - in the Czech Republic (3.1%) and Italy (2%). The case of the Czech Republic is intriguing. Only about 300 housing cooperatives have survived there to this day, while at their peak in the late 1960s there were almost 3,000. In 1991, 21% of the total Czech housing resources were owned by cooperatives (About Czech Republic, 2024). Although as much as 14% of all apartments are still managed by cooperatives, more than  $\frac{3}{4}$  of them are fully owned by individuals, not by cooperatives themselves. The dynamics of transforming the cooperative right to apartments into full ownership in free market conditions turned out to be much higher in the Czech Republic than in Poland, where in 2022 12.5% of the total stock was still cooperative. To sum up, currently, housing cooperatives in Europe are a common phenomenon only in Poland and some Scandinavian countries.

## 2. Scope and sources of data

The main source of data on the market position of large panel housing estates were NBP reports on unit prices of apartments. In terms of the structure of maintenance costs of buildings managed by housing cooperatives, data was taken from Statistics Poland. This data should be assessed as reliable and credible, as well as sufficiently numerous to draw convincing conclusions from it. Analysis of this data in a comparative approach allowed to indicate the direction of changes that occurred in housing cooperatives against the background of the basic, full formula of ownership of multi-family housing in Poland. To shed the right light on the

economic, management and market aspects of the functioning of housing estates in Poland, it was necessary to take into account the following partial threads:

- changes in the legal framework concerning housing cooperatives, determining investment and management activities, as well as changes in the ownership structure of housing resources after 1990,
- financial aspects of managing the resources of housing cooperatives,
- activity of residents of cooperative resources as participants of the real estate market,
- prices on the market of cooperative housing and those built using prefabricated technology (mainly the so-called "large panel" or concrete) in comparison with other housing resources.

### 3. Results

It should be emphasized that housing cooperatives implement the assumptions of a somewhat separate, exclusive community, whose members want to achieve common goals in the field of housing "for themselves" (Zakrzewski, 2010). This is of fundamental importance in the area of resource management and the decision-making model. These should be actions developed jointly, and even if indirectly, i.e. through the cooperative's board, then at least as consistent with the will of the majority of the cooperative's members.

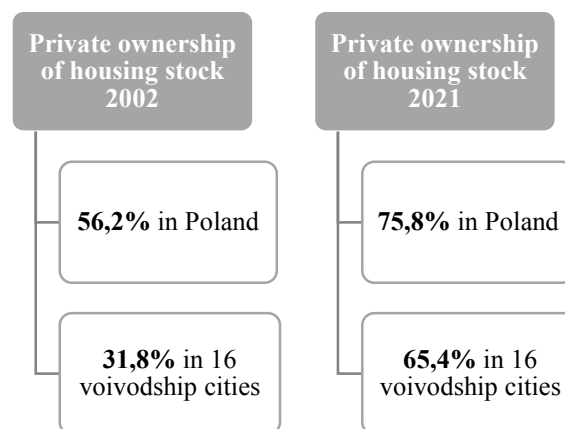
The attendance of housing cooperative members at general meetings was examined by Skotarczak (2015). It turned out that it depends on the size of the cooperatives themselves – in the largest ones, the attendance reached only 3% (mainly members of management and supervisory boards and their friends participated in the meetings), in the smallest even 55%, and in the remaining ones an average of 30% (Skotarczak, 2015). It is worth adding, however, that the largest housing cooperatives in the biggest Polish cities manage resources exceeding even 30,000 apartments, which are often inhabited by over 50,000 people. The problem of scale often prevents achieving high attendance of members at general meetings.

#### 3.1. Consequences of legislative changes for housing cooperatives in Poland after 1990

Until 2001, the provisions of the Cooperative Law did not regulate in detail the issues of property management by housing cooperatives. It was implicitly assumed that these organizations deal with their own resources, and it was only added superficially that the internal statute of the cooperative may provide for the management of multi-unit facilities even after their full ownership has been transferred to cooperative members (this last provision was later repealed). A major change in the functioning of housing cooperatives was caused by the Act on Ownership of Premises (1994) and the Act on Housing Cooperatives (2000), which – to put it briefly – became the basis for transforming so-called cooperative ownership right to

a residential premises into separate “full” flat ownership (Sikorska-Lewandowska, 2022; Skotarczak, Blaszkę, 2016a). This was one of the elements of the broader process of enfranchising (commodification) the Polish population on the real estate market after 1990. The universality and mass interest in such transformations among cooperative members will be illustrated by a handful of data.

In 2022, cooperative housing in Poland constituted approximately 12.5% of the total housing stock, while in 2002 this indicator was still 27.9%, and in 2007 - 24.7%. In the spatial structure of housing stock, a high share of cooperatives in 2022 was recorded in the following voivodships: Podkarpackie (43.3%), Podlaskie (43.0%) and Świętokrzyskie (42.3%) (Gospodarka mieszkaniowa..., 2023).



**Figure 1.** Share of housing stock in private ownership in Poland in 2002 and 2021.

Source: own study based on data of Statistics Poland.

This rapid outflow of residential premises from the cooperative stock has led to the need to seek solutions for the uninterrupted and reasonable management of common parts of multi-family buildings (so-called common property), from which it is impossible to physically "extract" apartments legally transformed into separate flat ownership. The owners of most of the newly separated premises had nothing against the cooperatives continuing the management processes on the common property, and this state of affairs was additionally supported by the relevant legal interpretation of the Supreme Court in 2012 (Skotarczak, Blaszkę, 2016a). It is also worth mentioning that according to data for 2022, in large Polish urban centers as much as 76.3% of the population lives in multi-family buildings, and only 23.7% in houses. Housing estates, alongside city center quarter development in the form of tenement houses, constitute one of the cores of multi-family buildings. At the same time, according to data from the National Census in 2021, over 11.5 million apartments in Poland belonged to individuals, which constituted 75.8% of the total stock, compared to 56.2% in 2002. In the case of 16 voivodship cities, their percentage increased during this time from 31.8% to 65.4% (Figure 1). In the years 2002-2021, the number of apartments belonging to housing cooperatives decreased in the country by over 1/3 (Raport o sytuacji..., 2024).

However, cooperatives have not ceased to be a strong, institutional player in the real estate ownership and management market. Among the 6.6 million apartments covered by the Statistics Poland in 2022 in the study of housing resources located in buildings managed/administered by various entities, more than half were apartments of individuals in buildings managed by housing communities, 29.6% were apartments of housing cooperatives, and 11.9% were municipal. There is therefore a clear tendency to abandon cooperative ownership in favor of full ownership in the formula of residential real estate (flat ownership), and at the same time the accompanying collective agreement to leave these resources under the management of cooperatives.

There were and are various motivations and premises among Poles that explain transformation decisions in the area of the right to premises – subjectively understood market and emotional factors were considered to be the leading ones (full ownership as the best product on the real estate market; higher market value of ownership flats; easier sale; herd effect – others do it, so it is right; freedom to dispose of the premises in the technical and organizational sense; independence from the cooperative; expectations of reduction of the premises maintenance costs; fear of making such a transformation impossible in the future) (Skotarczak, Blaszkę, 2016a). However, the conviction about the high effectiveness of cooperatives as property managers is stable, based on experiences from the free market era. Of course, there were also situations of separating entire blocks of flats from the cooperative resources and establishing so-called housing communities. But such events were usually characteristic of small towns, where the fragmentation of resources led to the liquidation of the entire housing cooperative. However, such phenomena did not have a fundamental significance for the cooperative movement, as illustrated by Skotarczak and Blaszkę (2016a) research covering 342 cooperatives from the West Pomeranian Voivodship - in the years 2010-2015, the percentage of bankruptcy among these entities was recorded at a very low level of 0.88%.

In Poland, the cooperative movement in the housing sector is still large. In 1989, at the end of the centrally controlled economy, there were 4,021 housing cooperatives operating in the entire country (About Poland, 2024), and as of October 19, 2022, according to the REGON database, there were 3499 of them (Milewska-Wilk, 2023). This means a net decrease of only 13% in the total number of these institutions over 33 years, while in a comparable period the decrease in housing resources under their control reached about 55%. This is a key argument not only for the cooperative's successful fight for survival, but also a direct illustration of the excellent skills of functioning in a competitive market environment. Cooperatives learned how to manage not only their own resources but also new housing stock entrusted to their order from other entities.

Outlining legal changes and their consequences for the activities of cooperatives requires mentioning the effects of the amendment to the Act on Housing Cooperatives, dated 14 June 2007. At that time, cooperatives were deprived of the legal possibilities of further separating new tenancy and ownership rights to residential premises. As a result of such circumstances, cooperatives limited their investment activity, understood in terms of the construction of new



facilities, almost to none. In 2007, they put 8240 new apartments into use, in 2022 - only 1513. For comparison - in 1992 alone, this number exceeded 80,000 premises. In the years 2007-2024, cooperatives carried out partial investments, conducting them in a manner almost identical to developers, selling the apartments produced as separate residential properties. The role of cooperatives in the mix of housing production on a national scale has undergone a radical transformation, or even a reversal, over the 35 years of development of the market economy in Poland. The share of cooperative investments in the total number of newly delivered apartments has fallen from around 60% in 1990-1992 to a marginal level of less than 1% in 2019-2022 (with developer companies currently taking on the role of the main market creator, accounting for around 60% of the new gross housing supply and more than 90% in the biggest cities). And although the amendment to the Housing Cooperatives Act of 20 July 2017 restored the possibility of establishing tenant rights to residential premises (but not ownership rights to residential premises), and additionally in the case of such constructions, the National Economy Bank made preferential formulas and credit terms available to cooperatives under the Social Rental Housing program (so-called institutional rental), the investment effects are poor: in total, in the years 2019-2022, they put into use 905 tenant apartments in this formula throughout Poland (Milewska-Wilk, 2023).

**Table 1.**

*State and changes in the ownership structure of the housing stock in Poland in 2007 and 2022*

Types of housing stock ownership	2007	2022	Change 2022/2007 [%]
Total, including:	12 875 298	15 562 867	20,9
Cooperatives	3 173 203	1 936 978	-39,0
Municipal	1 174 705	778 752	-33,7
Private	8 155 227	12 648 544	55,1
State	-	29 192	-
Social Housing Associations	71 297	110 312	54,7
Companies	300 866	59 089	-80,4

Source: own study based on data of Statistics Poland.

Real estate market regulations in terms of ownership and changes in the legal framework for the functioning of housing cooperatives in Poland after the introduction of market economy rules led to a 39% reduction in the stock of apartments owned by cooperatives in the years 2007-2022 (Table 1). However, this is still close to 2 million apartments, and there is no estimated data showing the scale of additional involvement of cooperatives in the trust management of the resources of other entities. On the other hand, the significance of the cooperative movement in the construction of new apartments should be assessed as marginal.

### **3.2. Financial effects of cooperative housing stock management**

Another important area of the analysis of the functioning of housing cooperatives are financial aspects, and among them, in particular, the shaping of the maintenance costs of resources. It is through the prism of these issues that one can assess the professionalism, efficiency and effectiveness of the actions and decisions they undertake.

The aforementioned costs are divided into two main subgroups: operating costs and costs of services provided. The structure of the operating costs of housing resources includes management and administrative costs, maintenance and renovation costs and other costs (maintenance of cleanliness, fees for collective antennas, costs related to the operation of common rooms), as well as taxes for the commune and other public and legal fees. As one might guess, it is in this group that the management skills of all entities responsible for the maintenance of housing resources are revealed. The costs of services provided are largely a derivative of the position, strength and negotiation skills of individual entities in the market game for prices with managers of utility media, which are most often municipal and locally monopolistic in nature. This subgroup includes the costs of central heating and hot water, costs related to cold water, sewage disposal or collection of liquid waste, costs of municipal waste collection and maintenance costs of elevators.

In 2022, operating costs for all forms of housing stock ownership in Poland accounted for an average of 47.0% of the costs of maintaining housing resources (Gospodarka mieszkaniowa..., 2023). The structure of the costs of maintaining housing resources divided into operating costs and costs of services provided was diversified by the form of ownership of resources. The lowest shares of operating costs were recorded for premises in the resources of housing communities and housing cooperatives (43.9% and 46.6%, respectively). In comparison with the results achieved by managers of municipal property and private companies (65.1% and 64.4%, respectively), a picture of high efficiency of housing cooperatives in managing operating costs emerges. What is even more interesting, in the structure of operating costs, the lowest shares of management and administrative-office costs were recorded for private companies premises, housing communities and housing cooperatives (respectively: 26.4%, 28.8% and 29.6%). For comparison, in the housing resources of the State Treasury this share was 50%, and in the Social Housing Associations 47.3%. Cooperatives are in the group of specialists who most effectively reduce the burden of management and administration work costs. This is another manifestation of rationality, caution and respect for the common goals of cooperative members in management. At the same time, cooperatives allocated as much as 40% of operating costs to renovations and maintenance of resources. Of all forms of ownership in Poland, the structure of operating costs in cooperative resources is the closest to the structure characteristic of housing community resources, based on the management of private owners' property. Again, such a situation should be assessed unequivocally positively.

As for the structure of costs of services provided, compared to other forms of ownership, cooperative resources generate a relatively high percentage of elevator maintenance costs. This is primarily due to the large share of high-rise multi-family buildings (6-storey and higher blocks) in the cooperative stock and the significant degree of technical wear of elevators in buildings that are several decades old.

In 2022, housing cooperatives carried out almost 419,000 renovations of their stock, which constituted approximately 2/3 of all renovations carried out in the entire institutionally managed housing stock in the country. It is worth adding that 36,772 renovations consisted of directly providing new installations to cooperative apartments, which in turn translated into 48.6% of all actions taken by managers of this type throughout Poland. At the same time, housing cooperatives are struggling with the largest scale of tenants in arrears with apartment fees. At the end of 2022, 892,393 premises with such arrears were recorded in cooperatives, which constituted as much as 46.3% of their total in Poland. The second group of entities with a fairly similar problem are housing communities - 32.3% of all such arrears in the country were generated in their resources.

Problems with effective debt enforcement by housing cooperatives have been an “Achilles' heel” known in Poland for years (Skotarczak, Blaszcze, 2016a). It is difficult to say unequivocally whether it is the length and complexity of the eviction procedure, or rather the communal and emotional reasons and the related attempts to find amicable solutions that make this sector, there are relatively few legally effective evictions. Amicable solutions usually mean the cancellation of part of the arrears, and long-term maintenance of such debts negatively affects the financial management of other cooperative members who regularly pay service fees. In the whole of 2022, less than 400 evictions from cooperative resources were carried out in Poland, and approximately 900 further eviction proceedings were pending in the courts at the same time.

### **3.3. Activity of cooperative members on the housing market**

Another issue, namely the activity of tenants of cooperative resources as participants in the real estate market, can be viewed through the prism of the number of concluded free market agreements for the sale of premises from this resource and also in the context of transformation of cooperative rights to residential premises into separate flat ownership.

Information from the Ministry of Justice and the Statistics Poland regarding both of these types of activity indicate that in the years 2014-2019, between 42,000 and 51,000 premises were subject to turnover annually and a persistent upward trend in the phenomenon was noted during that time (Czy mieszkania spółdzielcze..., 2024; Gospodarka mieszkaniowa..., 2023). In 2020, the surveyed activity dropped abruptly to 43,000 apartments, what was related to the COVID-19 pandemic. In 2021-2022, the declines continued: in total, only less than 51,000 apartments were sold over the two years. The general reduction in activity in this field is probably a consequence of the decreasing total amount of apartments that are subject only to cooperative rights, not separate ownership rights. In addition, one can also find analogies to the rules of the product life cycle - in this situation, the specific, legal and economic product is the transformation of cooperative rights into flat ownership. The phenomenon is naturally losing its momentum, after the most intensive years of 2007-2019.

The level of market activity in the area of cooperative resources is worth comparing with the number of sales of residential properties recorded in the country. As indicated by the Statistics Poland data, in 2014 there were almost 80,000 transactions on the secondary housing market, and their number grew steadily until 2019, when almost 129,000 residential properties were sold. In the years 2020-2022, 115,000-143,000 apartments changed owners every year. Therefore, the ratio of the number of transactions related to the cooperative ownership to the number of notary deeds of sale of the separate flat ownership at the beginning of the analyzed period was around 1/2, while at its end it decreased to about 1/5. This is a clear illustration of the gradual decline in the importance of the cooperative premises segment in the total activity of the housing market in Poland. At the same time, such a phenomenon can be interpreted as a relative stabilization of the behavior of cooperative members and one can perhaps look for a long-term balance in these resources. Such circumstances would probably make it easier for housing cooperatives to plan and implement a policy of managing their resources.

### **3.4. Prices of cooperative housing stock on the secondary real estate market**

Another interesting issue is the level of 1 sq. m. price on the secondary market of cooperative apartments and also those built using prefabricated technology (mainly the so-called "large panel" or concrete) in comparison with other housing resources. Since housing estates are usually rightly associated with the cooperative stock, and at the same time they are stereotypically referred to as large panel buildings, it is worth noting two relations on the secondary housing market:

- unit prices of cooperative premises compared to unit prices of separate flat ownership,
- unit prices of premises in multi-family buildings constructed with prefabricated technology (i.e. large panel) compared to unit prices of apartments in buildings usually built after 2000, using so-called improved traditional technology (using bricks or other small-sized elements).

Cross-sectional studies of market phenomena in this area are conducted by the National Bank of Poland, as part of cyclical analyses of local real estate markets in the most important cities among 16 voivodship (the study covers all provincial capitals except Gorzów Wielkopolski and Toruń). Based on the latest, approximate data, it was possible to calculate the average unit price ratios for the end of 2023 (Raport o sytuacji..., 2024). It turns out that in 16 provincial cities, the prices of cooperative resources constituted 95.3% (in 2022 it was 93.7%) of the prices recorded for separate flat ownership, while the prices of apartments in large-panel housing estates were at the level of 84.8% (in 2022 it was 83.8%) of the prices of apartments in buildings erected using improved traditional technology.

In large cities, the local market makes almost no distinction between the legal values of sold apartments. For market participants, the cooperative flat ownership and the separate flat ownership are almost identical. A mere 5 percent discount in the valuation of the objectively weaker cooperative right indicates a selective awareness of these differences and a roughly

equally attractive interpretation of the attributes of both types of apartments. It should be added that in 2023 in the case of Białystok, Warszawa and Kraków, the discussed ratio was at the lowest level (86.7%, 91.1% and 91.4% respectively), while in Kielce, Szczecin, Kielce and Zielona Góra it was the highest (100% in these three cities). Housing markets are characterised by locality, which explains such a significant differentiation in the value of the analysed indicator. Kielce, Szczecin and Zielona Góra should be considered an exception, where the unit prices of cooperative apartments were the same as the separate flat ownership in 2023. Such a phenomenon may be, for example, the result of the residents' conviction or knowledge about very high quality of management practices undertaken in cooperatives, *ergo* good assessments of the technical and utility values of cooperative resources than other housing resources on the secondary market.

The ratio of prices of large panel apartments to newer technologies at the level of 84.8% indicates a quite clear differentiation of both market options. In this comparison, prefabricated housing estates obtain prices about 1/6 lower. This is an average result, which proves the generally weaker perception of the condition of these resources from the point of view of the potential on the real estate market. However, it should be remembered that they were compared with the relatively most attractive resources on the secondary market, which were usually put into use after 2000. The comparative assessment of the attributes of apartments begins with the indexation of their age, and then a number of other factors, including: location, connection to the city center, quality of the surroundings, availability of parking lots, distance from social infrastructure and the commercial and service sector, architectural and aesthetic values, and current maintenance costs. It is not surprising that the market verdict is less favorable for large panel housing estates, built mainly in the 1970s and 1980s. On the contrary: one can rather feel a certain surprise here that the price difference is only 15%. This is evidence of the very high valuation of large panel housing resources. They are still in demand, they still fulfil their market role, consistent with their intended use, and with a sensible renovation economy, their technical lifespan is assessed positively in the perspective of 50-60 years.

There are cities in which enthusiasm for large panel estate housing is much worse than average - the lowest values of the analysed price index were achieved in Białystok, Łódź and Katowice (respectively: 73.8%, 73.4% and 74.1%). These are urban centers probably most strongly marked by the stigma of industrial development in the era of socialism. The rapid increase in population of Łódź and Katowice in the years 1945-1988 and the large-scale depopulation after 1990 meant that the supply of apartments in large panel blocks of flats built in the prosperity phase is surprisingly high today, given the current needs of the population, which has shrunk in numbers. With selective demand, these resources seem to be much less needed than before. Among the 16 provincial cities, the resources in housing estates were rated the highest in Gdańsk and Kielce (index values: 97.5% and 93.6% respectively). This is due to various reasons, among which the most probable should be considered the features of the

existing, local resources, e.g. its limited supply, location and communication advantages, and the quality of the surroundings.

#### 4. Discussion

The effect of all the analyses undertaken in the article of an economic, managerial and market nature seems to be a rather comprehensive, multi-threaded sense of surprise. A positive surprise, resulting from the long-term, tireless efforts of the housing cooperative sector in Poland after 1990 not only to survive, but above all to develop selectively, wisely and qualitatively. Despite the awareness of the limitations resulting from legal regulations, the widely implemented reconstruction of the business model, aimed at creating the ability to compete on the free market of management services, meant that housing cooperatives objectively achieved success (Błaszke, Skotarczak, 2022). The flourishing, the full emanation of institutional adaptive abilities is probably also a derivative of the power of subjectification of the residents of housing estates themselves, not only through often façade and merely formal membership in the cooperative, but through material and legal commodification.

The cooperative movement draws on some 130 years of Polish traditions in the area of housing, experienced its spontaneous flowering during the period of socialism, and after its fall survived in the shockingly difficult, new conditions of free market competition. After a thorough reorganization, cooperatives successfully find their place in the Polish reality of the 21st century. Of course, the cooperative movement has undergone a long path of evolution, as a result of which only housing cooperatives with great managerial and adaptive abilities have survived to this day and function well. This should all the more encourage an increase in the level of trust in this group of entities. One could even take risk saying that nowadays a new model of cooperative housing has emerged in Poland.

The great resilience and universality of the cooperative model suggests using its advantages not only in management, but also in investment activity on the housing market (Skotarczak, Błaszke, 2016b). Of course, this is not exactly about creating new competition for developers. The potential of cooperatives could be engaged in the broad development of affordable housing. Housing investment programs commonly supported from public funds can be implemented by the cooperative movement. It has the knowledge, experience, know-how in this area. This would require, above all, modifying the general vision of cooperatives in Poland, enabling them to conduct investment activity. Collectivization, the communization of housing goals does not currently mean a return to socialist times and ideas, but rather builds a collective belief in solid values - safety, support, mutual care for local society, for a common building, housing estate, public space, energy efficiency and sustainable renovation (Hauge, Thomsen, Löfström, 2013; Balmer, Gerber, 2017; Avilla-Royo, Jacoby, Bilbao, 2021). Including housing

cooperatives in the implementation of the goals of the state's housing policy seems to be a valuable idea, providing significant opportunities for action on a large scale. There are various models of affordable housing throughout Europe. Housing cooperatives could successfully fit into the landscape of affordable housing development, not only in Poland, but perhaps in other countries on the continent. The presented premises may constitute an incentive for deeper research on this issue.

## Summary

Housing cooperatives in Poland have undergone a profound evolution of their business model since 1990, adapting to competition on the property management market and to free market principles. Existing data from public databases and reports were used, which were subjected to data mining. The aim of the article is to show the comprehensive consequences of housing cooperatives functioning as managers – in the context of financial and market effects. At the same time, the paper analyses the role of cooperatives in managing large panel housing estates, commonly associated with the socialist period. The conclusions indicate that despite the challenges, the resources in housing cooperatives remain an attractive alternative to separate ownership of apartments in housing communities and other resources and have the potential to support the development of affordable housing. A new, effective model of post-socialist cooperative ownership has been formed in Poland. The article encourages further comparative research on the potential of housing cooperatives in other European countries.

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## REASONS FOR IMPLEMENTING INNOVATION ON THE EXAMPLE OF SMALL AND MEDIUM ENTERPRISES

Luiza PIERSIALA<sup>1\*</sup>, Monika KAPLER<sup>2</sup>

<sup>1</sup> Częstochowa University of Technology, Faculty of Management, Department of Logistics;  
luiza.piersiala@pcz.pl, ORCID: 0000-0002-3995-1167

<sup>2</sup> Częstochowa University of Technology, Faculty of Management, Department of Economics, Investments and Real Estate; monika.kapler@pcz.pl, ORCID: 0000-0003-0235-7727

\* Correspondence author

**Purpose:** The aim of the article is to determine the factors determining the introduction of innovations in the enterprise, as well as the way the company is perceived as innovative by employees.

**Design/methodology/approach:** In pursuit of this goal, the first one presents the level of innovation of the Polish economy compared to other European Union countries. Then, the results of research on enterprises from the SME sector are presented. The data show that Poland is one of the least of the literature on the subject and research results, the reasons for implementing innovations in enterprises were indicated

**Findings:** Most often, the surveyed respondents did not agree or rather disagreed that legal regulations are the reason for introducing innovations in the company (86.7% of responses), followed by reasons such as: "the desire to reduce costs" (48% of responses) and "the desire to increase the company's efficiency" (29.3% of responses). Most often, the respondents did not have an opinion that reasons such as: "forcing innovations by contractors" (61.3%), "market needs" (52.0%) and "the desire to increase the company's efficiency" (51.3%) are the reasons for introducing innovations in the company. Most often, the respondents agreed or rather agreed with reasons for introducing innovations in the company such as: "the desire to increase profits" (80.7%), "expanding the sales market" (80.0%) and "meeting the competition on the market" (69.3%).

**Originality/value:** Innovation is a tool supporting sustainable development. Only entities operating in a modern and innovative way gain a competitive advantage. The considerations contained in the article concern the perception of the company as innovative by employees and indication of the reasons for implementing innovations. The survey included enterprises representing the group of small and medium-sized enterprises, the so-called SMEs. The article is part of research on innovation in information systems in small and medium-sized enterprises

**Keywords:** sustainable development, innovation, small and medium-sized enterprises, management.

**Category of the paper:** research paper.

## 1. Introduction

In the face of growing environmental and social challenges, enterprise innovation has become a key element of the transformation of the economy towards sustainable development. In this context, small and medium-sized enterprises (SMEs) play a special role as flexible and dynamic economic actors that can introduce environmentally friendly and socially responsible innovations. Innovations are currently considered the driving force of economic changes taking into account the requirements of sustainable development. Their creation and implementation in business entities allows not only for development, but also for maintaining a competitive advantage. Innovation in small and medium-sized enterprises (SMEs) is a key factor in sustainable development that not only supports environmental protection, but also contributes to the competitiveness and long-term success of these companies. Supporting innovation and eliminating barriers can bring benefits to both businesses and society as a whole.

Entities in the micro, small, and medium-sized enterprise (SME) sector make up 99% of all companies in Europe. In Poland, this group is estimated at 99.8% (European Commission, 2024). At the European level, the sector is dominated by micro-enterprises (i.e., companies employing up to ten people), which account for approximately 92.2% of all firms in Europe. On the Polish market, this phenomenon is even more pronounced, as micro-enterprises constitute 96% of all firms (PARP, 2024). Small and medium-sized enterprises employ a significant portion of the workforce and play a key role in this transformation. The development and enhancement of innovation within this sector are crucial not only for gaining a competitive advantage but also for survival in the market.

Therefore, the aim of this research was to answer the following research questions:

1. Is the company innovative?
2. What are the reasons for implementing innovations in the surveyed enterprises, according to respondents?

## 2. Literature review

The innovativeness of small and medium-sized enterprises (SMEs) in the context of sustainable development is a topic that is gaining importance in entrepreneurship research. It should be emphasized that sustainable development is a complex and multidimensional concept, covering three basic goals: economic, social and ecological, and which can be applied to all entities creating the economy (Leśniak-Łepkowska, 2011, p. 23). This idea applies to all organizations participating in the economic life of a given country. The implementation of the concept of sustainable development by enterprises, according to many researchers, allows them to gain a competitive advantage (Koszel, Weinert, 2013, p. 155; Kabus et.al, 2024).

SMEs are a key part of the economy and their innovation plays an important role in the transformation towards more sustainable business models. The European Union has long been emphasizing the importance of the SME sector and their implementation of innovative solutions. This is manifested in the provisions of subsequent treaties and long-term strategies, in which research and development activities, cooperation between science and business representatives, and ultimately the commercialization of the results of scientific work play a key role. Research shows that SMEs have the potential to introduce innovations that support sustainable development, although they face various challenges. Innovations may include, among others: new technologies, products or processes that reduce the negative impact on the environment while contributing to economic growth (Lukács, 2005).

Many reports on the innovation of EU countries are published in Europe. These include OECD Economic Surveys, Global Competitiveness Report – World Economic Forum. However, for this analysis, the tool will be the most appropriate one called the European Innovation Scoreboard (EIS). It is an annual survey of the level of innovation to which all EU Member States plus Croatia, Serbia, Turkey, Iceland, Norway, Switzerland and the Former Yugoslav Republic of Macedonia are subjected. The current version of the survey allows countries to identify their strengths and weaknesses in terms of innovation. The authors of the EIS use 32 indicators, i.e. key elements contributing to the development of competitiveness and innovation, and they are divided into three main categories:

1. factors enabling innovation (human resources, financial resources);
2. factors showing the “actions of enterprises” and thus their degree of innovation (investments, connections and entrepreneurship, intellectual assets);
3. factors illustrating the impact of innovation on the economy (innovators, economic effects).

Based on the results of the EIS, published in 2023, the 27 EU countries were divided into four groups. Poland ranks below the European Union average and is classified as a "Moderate Innovator". In 2023, Poland maintained this position, recording a result that is around 70-80% of the EU average innovation. Compared to other EU countries, Poland shows strengths in areas such as human resources and ecological innovation, but weaker results in terms of financing and support and the use of digital technologies. In comparison, the innovation leaders in Europe are countries such as Sweden, Finland and Denmark, which belong to the "Innovation Leaders" group (EIS, 2024). However, expanding the international comparison could provide a more comprehensive perspective. Below is an expanded international comparison: countries such as Sweden, Finland, and Denmark consistently rank among the top in the EIS (Rognstad et al., 2024). These nations are characterized by strong investments in research and development robust intellectual property frameworks, and close collaboration between academia and industry. For example (Lee, 2024; Bakker, 2024):

- Sweden: Known for a high percentage of GDP devoted to R&D (around 3.5%), strong public funding, and innovative ecosystems such as Stockholm's tech hub.
- Finland: Strong focus on education and public-private partnerships fosters a culture of innovation, particularly in ICT and green technologies.
- Denmark: Emphasizes clean technology and circular economy solutions, supported by clear policies and funding.
- Poland: Classified as a "Moderate Innovator," Poland's innovation performance is about 70-80% of the EU average. Strengths include human resources and ecological innovation, but weaknesses persist in financing and the use of digital technologies.

Countries like Germany and the Netherlands provide clear examples of how targeted SME support programs, such as subsidies and innovation hubs, can enhance competitiveness. Scandinavian countries exemplify how universities and research institutions can act as catalysts for innovation. An expanded international comparison reveals that while Poland is progressing in innovation, particularly in SMEs, there is significant potential to learn from global leaders. Focusing on enhanced collaboration, increasing R&D investment, and streamlining regulatory frameworks could help Polish SMEs bridge the gap and better compete in the global market.

SMEs are of particular importance for Poland's economic development. They play a significant role in improving the quality of human resources, creating jobs, building a culture of entrepreneurship, supporting large industries and encouraging the creation of new business opportunities (Harindranath et al., 2008). Their flexibility and ability to quickly adapt to changing market conditions make them important actors in creating innovation. However, due to limited resources, SMEs face particular challenges in the process of implementing innovations, especially those related to sustainable development. According to the PARP report (2024), innovation in Polish SMEs is gaining importance. In 2024, 27% of enterprises in this category implemented product innovations, and 23% introduced process innovations. This growth is driven by the need to adapt to global trends such as digitalization and sustainable development.

In the light of the cited report, the search for new or improved solutions (innovations) results from the need to stay on the market and seek competitive advantages. In this context, responding as quickly as possible to changing customer needs, keeping up with competition and new market trends is a factor stimulating innovation processes in enterprises. The main reasons for implementing innovations in information systems include: changes in legal regulations and changes forced by market needs (e.g. the desire to expand the sales market), (Martínez-Conesa et al., 2020). According to Kowalkowski and Witell (2020), these are also: the desire to develop the company or improve its image, the so-called "forcing" of innovations by both customers, contractors and suppliers. The reasons mentioned also include: coping with constant competition on the market, the desire or need to improve work, the desire to increase profit, the desire to reduce costs, the desire to increase the company's efficiency or operational effectiveness (Foss, Saebi, 2018; Yudi et al., 2019; Krawczyk, 2022). The main reason that

leaves no choice and is somehow obligatory in relation to the decisions of enterprises regarding the implementation of innovations is certainly the aspect of legal regulations. Slogans proclaiming the need to increase the competitiveness of the Polish economy based on increasing the pace and scope of introduced innovations and the development of the knowledge society have been present in Poland for many years and as a long-term goal are not questioned. Unfortunately, slogans are not always accompanied by everyday practice of systematic actions of all participants of innovation processes, which is why we do not do well in international assessments of the competitiveness of the economy, lagging behind most EU countries. Since Poland joined the EU structures and joined the implementation of the so-called Lisbon Strategy, many actions of the Sejm and the government have been observed to improve the situation (Sosnowska, 2005, p. 17). A major problem in the implementation of innovation is the failure to comply with intellectual property law (Hoffman, Śnierzyński, 2015, pp. 125-141). Although all legal aspects are the basic reason for innovative changes in an enterprise, they are often the biggest obstacle and problem for SME sector enterprises (Rudawska, 2020, pp. 166-178). Very large bureaucracy, lack of knowledge of legal procedures, but also the instability of the legal system is a big challenge for SME sector entrepreneurs (Szopik-Depczyńska, 2014, pp. 113-120). Taking into account the literature review and the specificity of SMEs, the authors believe that the most important reasons for implementing innovations in SME information systems are:

- legal regulations,
- company development,
- improving the company's image,
- market needs,
- "forcing" innovations by customers,
- "forcing" innovations by contractors,
- "forcing" innovations by suppliers,
- meeting market competition,
- expanding the sales market,
- the desire to streamline work,
- the desire to increase profit,
- the desire to reduce costs,
- the desire to increase the company's efficiency,
- the desire to increase the company's operating efficiency.

However, despite progress, many SMEs struggle with restrictions in terms of access to financing and a lack of adequate human resources. The report shows that only 15% of companies use EU funds for research and development. Additionally, many companies do not have sufficient technological resources, which limits their ability to introduce innovations.

### 3. Methods

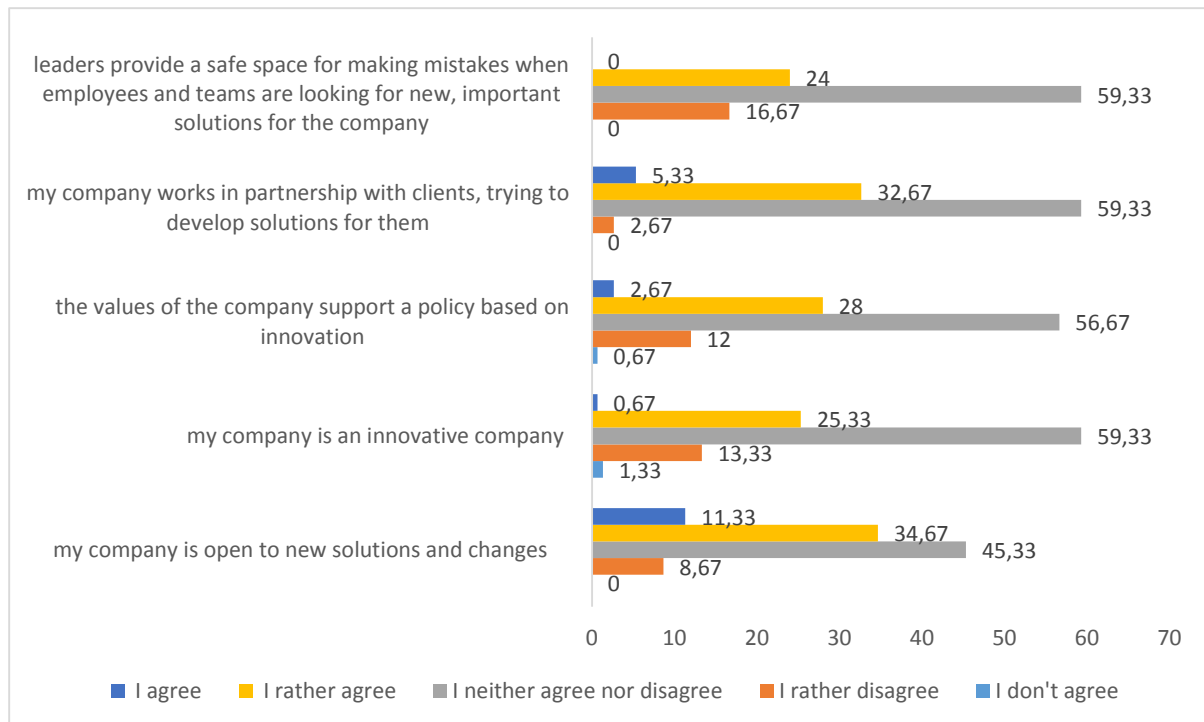
The study used a self-administered questionnaire technique. The survey was directed at the owners/managers of the surveyed companies, with a request for consent to participate. Data was obtained regarding active and registered SMEs in the Silesian Voivodeship, and companies were randomly selected to achieve a representative sample. The selection of the research sample was random, while the snowball method was also used to obtain respondents. However, this selection was based on the following premises: the research subject is SME sector enterprises, Silesian Voivodeship, the subject of the research is innovations in information systems in enterprise management, the research group includes all employees of enterprises. The questionnaire was divided into two sections: Part 1 focused on collecting demographic information about the company, while Section 2 concentrated on barriers to the adoption of information and communication technologies (ICT). Responses were provided using a five-point Likert scale (options: 1 - "strongly disagree", 2 - "somewhat disagree", 3 - "neither agree nor disagree", 4 - "somewhat agree", 5 - "strongly agree").

In total, 250 questionnaires were sent to the owners/managers of SMEs in the Silesian Voivodeship. A cover letter was included, outlining the purpose of the research and ensuring respondents' anonymity and that of their organizations. A total of 190 questionnaires were returned, of which 160 were complete, yielding a response rate of 54%. This sample size is considered sufficient for further analysis.

### 4. Results

In the survey, respondents were asked to respond to several statements regarding the innovativeness of the companies they work for. The percentage structure of ratings using a 5-point Likert scale regarding statements regarding the innovativeness of the company is presented in Figure 1.

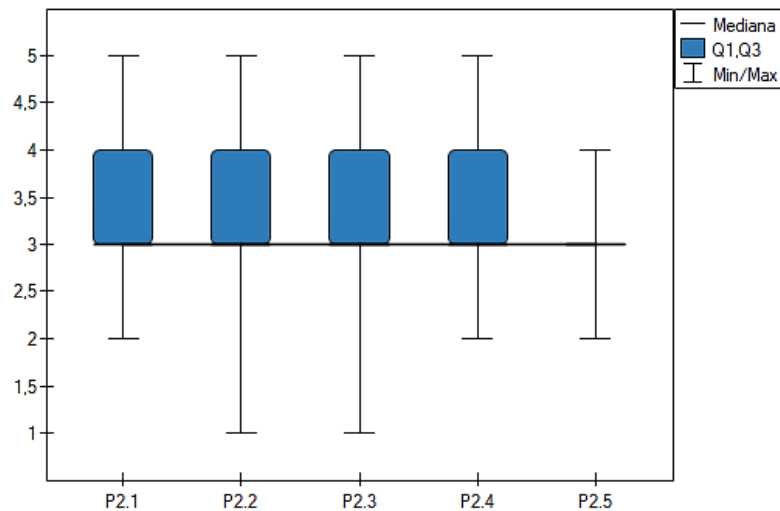




**Figure 1.** Percentage characteristics of responses to statements regarding the perception of the company as innovative.

Source: own study.

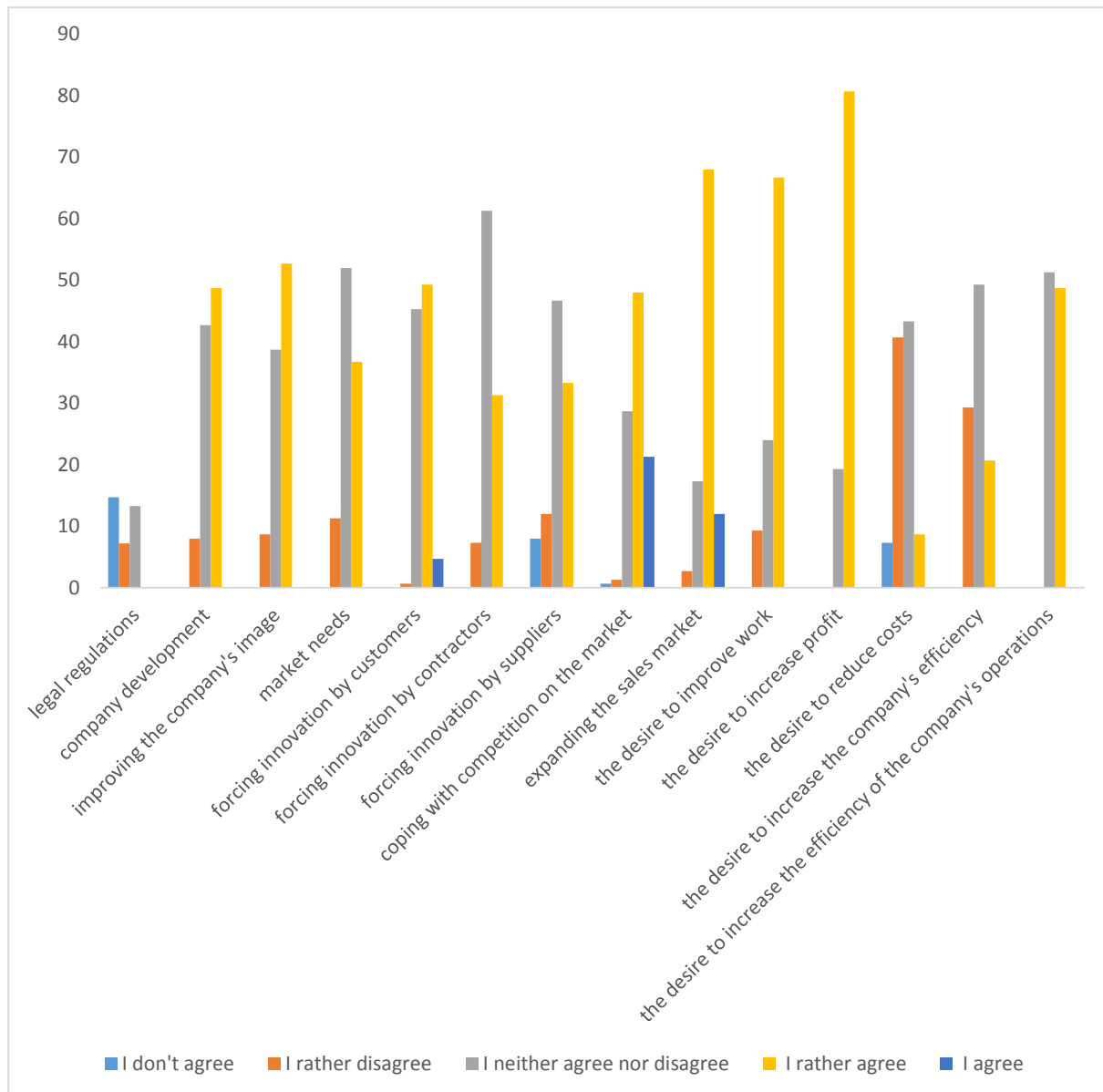
The most frequently indicated assessments of the surveyed statements concerning the perception of the company as innovative were assessments of the type: "I neither agree nor disagree". Respondents most often had no opinion in relation to statements such as: "my company is an innovative company" (59.33%), "my company works in partnership with customers, trying to develop solutions for them" (59.33%), "leaders provide a safe space for making mistakes when employees and teams are looking for new, important solutions for the company" (59.33%). Respondents never once agreed with the statements that: "my company is open to new solutions and changes" (0.00%), "my company works in partnership with customers, trying to develop solutions for them" and "leaders provide a safe space for making mistakes when employees and teams are looking for new, important solutions for the company" (0.00%). Respondents also never agreed with the statement that "leaders provide a safe space for making mistakes when employees and teams are looking for new, important solutions for the company". Box-and-whisker plots showing the values of positional statistics such as median, range, and quartiles for statistical analysis of the distribution of ratings for statements (arrangement of statements as in Figure 1) regarding the perception of the company as innovative are presented in Figure 2.



**Figure 2.** Distribution of ratings for the surveyed statements regarding the perception of the company as innovative.

Source: own study.

The smallest discrepancy in ratings, in terms of the rating scale used, concerned the statement marked as P2.5, i.e. "leaders provide a safe space for making mistakes when employees and teams are looking for new, important solutions for the company". In this case, respondents used only three ratings from the scale out of five possible options, which indicated their lack of a clear opinion as to whether or not they agreed with a given statement. The most dispersed ratings concerned statements marked as P2.2 and P2.3, i.e. "my company is an innovative company" and "the values professed by the company support a policy based on innovation". In the case of these statements, respondents used the entire rating scale. The median rating for all statements was 3, which means that 50% of the ratings were less than or equal to this value, while 50% were greater than or equal to this value. Then, the number of assessment categories was reduced from five to three, i.e.: 1 – "I do not agree or rather disagree", 2 – "I neither agree nor disagree", 3 – "I rather agree or agree". The respondents most often agreed or rather agreed with the statement regarding the company's innovativeness, such as: "My company is open to new solutions and changes" (46.00% of responses). The most responses of the "I do not agree or rather disagree" type concerned the statement: "Leaders provide a safe space for making mistakes when employees and teams are looking for new, important solutions for the company" (16.67% of responses). Another aspect of the research was to indicate what the reasons for implementing innovations in the surveyed companies are in the opinion of the respondents. The results in percentage terms are presented in Figure 3.



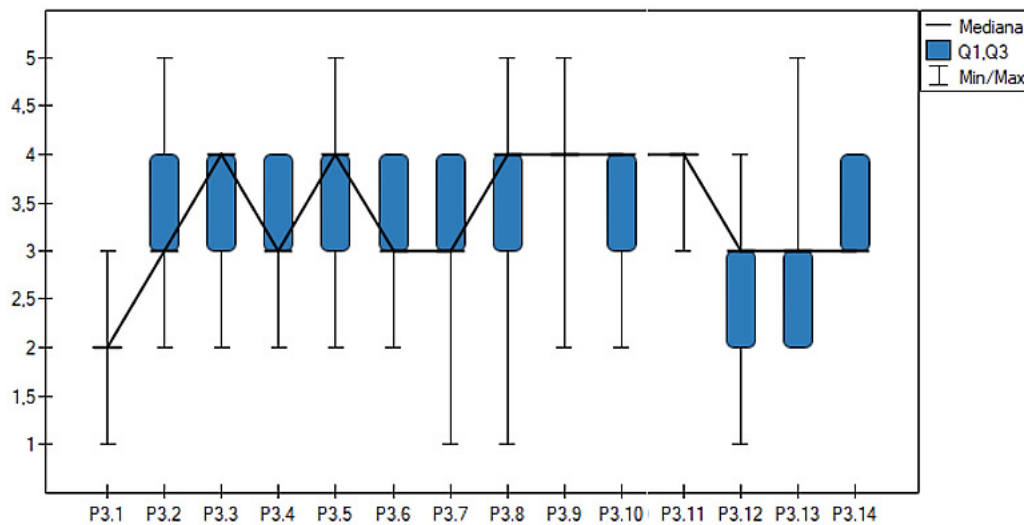
**Figure 3.** Percentage characteristics of responses regarding the reasons for introducing innovations in the company.

Source: own study.

The highest percentage of "agree" ratings concerned the reason for introducing innovations in the company such as: "meeting market competition" (21.33%), while the highest percentage of "disagree" ratings concerned the reason: "legal regulations" (14.7%). Most respondents did not have an opinion (i.e. neither agreed nor disagreed) that forcing innovations by suppliers was the reason for introducing innovations in their companies (61.3%).

Analyzing the distribution of answers in Figure 4, the most consistent in terms of scale were noted for the reasons for perceiving the company as innovative, marked as: P3.11, i.e. "the desire to increase profit" and P3.14, i.e. "the desire to increase the efficiency of the company's operations". In the case of these factors, only the ratings of the following types were used: "neither agree nor disagree" and "rather agree". The greatest divergence in the assessment

scale (the full assessment scale was used) was noted for the reason for perceiving the company as innovative, marked as P3.8, i.e. "coping with the competition on the market".



**Figure 4.** Distribution of ratings for the surveyed statements regarding the perception of the company as innovative.

Source: own study.

## 5. Summary

The theoretical framework highlighted the critical role of innovation in driving sustainable development and maintaining competitiveness within the SME sector, particularly in Poland. The empirical analysis reinforced these themes, revealing that primary motivations for innovation include the desire to increase profits, expand market reach, and address competitive pressures. Conversely, legal regulations and external enforcement by suppliers or contractors were less influential. Respondents largely emphasized internal drivers, such as efficiency improvement and cost reduction, while external factors like market needs were acknowledged but less consistently agreed upon. In summary, the results confirm the article's thesis that innovation is pivotal for SMEs' sustainability and market relevance. The findings underscore the necessity of addressing financial and resource barriers to enhance innovation, suggesting that policy and support mechanisms should target these areas to foster greater SME participation in innovative practices. These insights validate the article's focus and provide a foundation for future studies in broader geographical contexts or more dynamic market conditions.

Polish micro, small and medium-sized enterprises are characterized by a low level of innovation, especially in comparison with other EU countries. In light of the literature review and conducted research, it can be indicated that innovations in enterprises, especially in the small and medium-sized enterprise (SME) sector, are often the result of the need to stay on the

market and seek competitive advantages. Companies must respond quickly to changing customer needs, keep up with competition and new market trends, which stimulates innovation processes. The main reasons for implementing innovations include changes in legal regulations and market needs. Additionally, companies strive to increase profits, reduce costs and improve efficiency and effectiveness of operations. Of course, the conducted research has certain limitations: only organizations operating in Poland in the Silesian Voivodeship participated in the research, therefore the analyses take into account the specificity of innovations implemented in these organizations, therefore in the future it is worth considering verifying the formulated hypotheses in organizations operating in other voivodeships. This may be an indication for future research. The current situation also requires repeating the study in a more turbulent environment, which may additionally confirm the obtained views the future it is worth considering verifying the formulated hypotheses in organizations operating in other voivodeships. This may be an indication for future research. The current situation also requires repeating the study in a more turbulent environment, which may additionally confirm the obtained views.

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## THE RAPID ALERT SYSTEM FOR FOOD AND FEED (RASFF). THE PLACE IN SCIENTIFIC RESEARCH, LIMITATIONS AND POSSIBILITIES OF DATA USE

Marcin PIĞŁOWSKI

Gdynia Maritime University, Faculty of Management and Quality Science, Department of Quality Management;  
m.piglowski@wznpj.umg.edu.pl, ORCID: 0000-0002-4032-2333

**Purpose:** The goal of the study was to qualitatively and quantitatively evaluation of the data available in the Rapid Alert System for Food and Feed (RASFF) and to identify opportunities for further research concerning notifications reported in this system.

**Design/methodology/approach:** The research involved reviewing and critically assessing the data collected in the RASFF, conducting a two-way joining cluster analysis (in Statistica 13.3) on product categories and hazard categories, and building a map of links (in VOSviewer 1.6.20) between the keywords identified by the authors of the scientific papers.

**Findings:** The paper identifies the limitations of the RASFF, such as the lack of access to historical data, mistakes in the data, the exclusion of the United Kingdom from the system and the lack of information on operators involved in the food chain. It also indicates possible areas for further research of notifications reported in the RASFF, considering mainly product categories and hazard categories, as well as other types of data.

**Originality/value:** The article assesses the quality of RASFF data in a cross-cutting and comprehensive manner and identifies further opportunities for its analysis. The results of the research are intended for food safety researchers, food chain participants and food surveillance bodies.

**Keywords:** RASFF, food safety, European Union, cluster analysis, VOSviewer.

**Category of the paper:** research paper, general review.

### 1. Introduction

Table 1 shows examples of institutions and food safety databases in open access. These institutions' websites provide data or databases on food safety hazards. The range and type of data provided in these databases varies considerably (Allende et al., 2022; Bucchini et al., 2016; Cheftel, 2011; Fusco et al., 2015; Manning, Soon, 2019; Manning et al., 2022; Marvin et al., 2017; Talari et al., 2022). Until recently, the data collected in the Rapid Alert

System for Food and Feed (RASFF) covered a period of several decades, which made in-depth studies possible.

**Table 1.**

*Examples of institutions and food safety databases in open access*

Institution / Database and Website	Scope of data or activities
Canadian Food Inspection Agency (CFIA) <a href="https://recalls-rappels.canada.ca/en">https://recalls-rappels.canada.ca/en</a>	Recalls, advisories and safety alerts
European Union / Rapid Alert System for Food and Feed (RASFF) <a href="https://webgate.ec.europa.eu/rasff-window/screen/search">https://webgate.ec.europa.eu/rasff-window/screen/search</a>	Risks from the food chain
Food and Agriculture Organization of the United Nations, World Health Organization / International Food Safety Authorities Network (INFOSAN) <a href="https://www.fao.org/food-safety/emergencies/infosan/en/">https://www.fao.org/food-safety/emergencies/infosan/en/</a>	Food safety incidents and emergencies
Food and Drug Administration (FDA) <a href="https://www.fda.gov/safety/recalls-market-withdrawals-safety-alerts">https://www.fda.gov/safety/recalls-market-withdrawals-safety-alerts</a>	Recalls, market withdrawals and safety alerts
Food Standards Australia New Zealand (FSANZ) <a href="https://www.foodstandards.gov.au/food-recalls/alerts">https://www.foodstandards.gov.au/food-recalls/alerts</a>	Australian food recall alerts
Foodborne Diseases Active Surveillance Network (FoodNet) <a href="https://www.cdc.gov/foodnet/index.html">https://www.cdc.gov/foodnet/index.html</a>	Infections transmitted commonly through food
Hong Kong Centre for Food Safety <a href="https://www.cfs.gov.hk/english/index.html">https://www.cfs.gov.hk/english/index.html</a>	Ensuring that food is safe and fit for consumption
World Health Organization / Global Environment Monitoring System - Food Contamination Monitoring and Assessment Programme (GEMS/Food) <a href="https://extranet.who.int/gemsfood/">https://extranet.who.int/gemsfood/</a>	Food contaminants (biological and chemical)

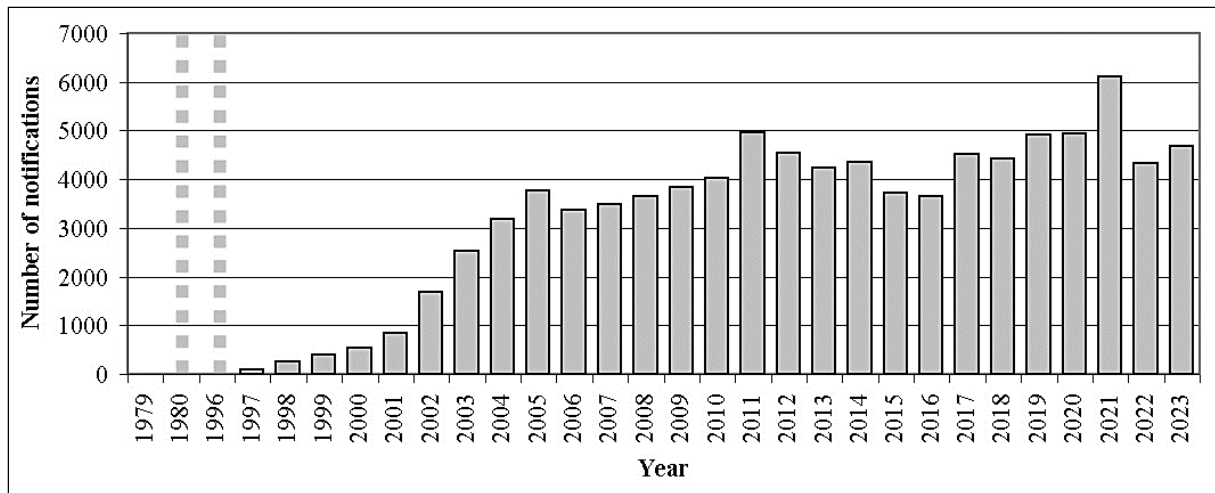
Source: own research.

The RASFF was established in 1979, but its legal basis is now Regulation (EC) 178/2002, also known as the General Food Law. The purpose of this system is to ensure the exchange of information between member countries in order to support a rapid response by food safety authorities if a risk to public health arises in the food chain. The members of the RASFF are the 27 countries of the European Union (EU), countries of the European Free Trade Association (EFTA), the European Commission – DG Health and Food Safety, the European Food Safety Authority (EFSA) and the EFTA Surveillance Authority (European Commission, 2024a).

In Figure 1 presented the number of notifications in the RASFF in 1979-2023. In the initial period (up to and including 1996), the number of these notifications was a maximum of around 30 per year, therefore it has been omitted.

The number of notifications in the RASFF shows an upward trend with a peak in 2021 (over 6000) and a significant decrease in 2022 and 2023 (to about 4500). This was due to significantly fewer notifications for pesticide residues, pathogenic micro-organisms, composition, as well as food additives and flavourings and allergens. In turn, the year before (i.e. between 2000 and 2021), there was a significant increase in the number of pesticide notifications (around 800). The reason for the stopping in the fast-moving growth trend may have been the Covid-19 pandemic and the associated decline in trade (including imports), but beyond that, also the changes made in the RASFF, because some hazards were excluded from it and moved to other systems, to which there is no longer open access.





**Figure 1.** The number of notifications in the RASFF.

Source: own research.

Indeed, on the basis of Regulation 2019/1715 (European Commission, 2019), in 2021 the Alert and Cooperation Network (ACN) has been established, comprising the RASFF (non-compliances with possible health risks), the Administrative Assistance and Cooperation Network – AAC (non-compliances without health risks) and the Agri-Food Fraud Network – FFN (suspicions of fraud) (European Commission, 2024c). The AAC was made available for European countries from 2015 and the FFN was set up already in 2013. These systems work on voluntary basis and only for cross-border non compliances. In turn, in the case of the RASFF, its members are obliged to report information. The FFN is a network that links EU member states and Europol (Popping et al., 2022). All these systems operate now together to maintain the food safety in the European Union (Kowalska et al., 2019). However, it is worth mentioning that following the changes made in the RASFF, the MedISys-Food Fraud (MedISys-FF) has become the only publicly accessible system collecting data on food fraud (Marvin et al., 2022), but access to this data requires a login.

The RASFF has been modified in various ways over the years of its operation. However, there are rarely published works that critically evaluate these changes, as well as the available data. It should also be noted that various authors have used the data available in the RASFF, but have not indicated possible directions for further research. Therefore, the goal of the study was to qualitatively and quantitatively evaluation of the data available in the RASFF and to identify opportunities for further research concerning notifications reported in this system.

## 2. Methods

Data was obtained from two databases: the restored (archived) one for 1979-2021 (European Commission, 2023) and the official one for 2022-2023 (European Commission, 2024b) as xls files and then merged covering a total of 89,098 notifications. This data was processed in the programs: Microsoft Excel 365 (Microsoft Corporation, Redmond, DC, USA) and LibreOffice Calc 7.6.5.2 (The Document Foundation, Berlin, Germany), using the following functions: vertical search, pivot tables, filtering, sorting and transposition. The different types of data have been critically assessed including shortcomings, mistakes and possible difficulties that may arise in their processing.

The data was further converted into percentages of notifications of products in hazard categories and hazard categories in products and placed in source tables. To investigate similarities between products and hazard categories, a two-way joining cluster analysis in Statistica 13.3 (TIBCO Software Inc., Santa Clara, CA, USA) was conducted. This method is used when values contained in both columns and rows of the source table can be expected to simultaneously contribute to the discovery of meaningful patterns of clusters (it is therefore a two-dimensional analysis). The structure of the obtained clusters is not homogeneous by nature, but it is recognised that this method can be a powerful exploratory tool for data analysis (TIBCO, 2024). The findings of the cluster analysis were presented in contour/discrete charts using coloured squares, starting from white (smallest clusters or no clusters) through green, yellow, orange, red to brown (largest cluster). The adoption of the white colour was due to the need to fade out the dark green colour, which would have taken up most of the charts rendering them difficult to read.

Subsequently, in order to tentatively identify possible directions for further research on notifications reported in the RASFF for the ten most frequently reported product categories (or subgroups thereof) and the ten most frequently reported hazard categories, the number of works published in this area up to and including 2023 was examined. For this purpose, the databases of the following publishers were reviewed: Elsevier (Elsevier, 2024), Springer (Springer, 2024), Taylor & Francis (Taylor & Francis, 2024), Wiley (Wiley, 2024) and the Multidisciplinary Digital Publishing Institute (Multidisciplinary Digital Publishing Institute, 2024).

A map of links between the keyword “RASFF” and other words indicated was also built. First, papers with the mentioned keyword “RASFF”, published up to and including 2023 (176 articles), were searched on the Web of Science website and the data relating to them were exported in a text file (Web of Science, 2024). This file was then used to create a map in the VOSviewer 1.6.20 (Centre for Science and Technology Studies, Leiden University, The Netherlands) based on the bibliographic data. The following options were used: type of analysis (co-occurrence), unit of analysis (author keywords), counting method (full counting) and threshold, i.e. minimum number of occurrence of a keyword: 2.

### 3. Results

#### 3.1. Types of data reported. Mistakes, shortcomings and difficulties with interpretation

In Table 2 presented data available in restored (archived) and official RASFF databases. Next to the individual data types, their original names are given in brackets if they were different.

**Table 2.**

*Data available in restored (archived) and official RASFF databases*

Detail	Restored (archived) database	Official database	
Data <sup>a)</sup>	<b>Data available in both databases</b>		
	Notification number (Reference) <sup>b)</sup>	Notification number (Reference) <sup>b)</sup>	
	Date <sup>b)</sup>	Date <sup>b)</sup>	
	Product category	Product category (Category)	
	Product type (Type)	Product type (Type)	
	Notification type (Type2)	Notification type (Classification)	
	Notifying country (Notifying)	Notifying country	
	Country of origin (Origin)	Country of origin (Origin)	
	Subject	Subject	
	<b>Other data</b>		
Risk decision <sup>c)</sup>	Risk decision	Notification basis <sup>f)</sup>	
Product	Product (Product name/ Name ) <sup>f)</sup>	Distribution status <sup>f)</sup>	
Hazard category	Hazard category <sup>f)</sup>	Action taken (Measures taken) <sup>f)</sup>	
Hazard (Substance/finding)	Hazards <sup>g)</sup>	Distribution <sup>h)</sup>	
Full hazard <sup>d)</sup>	Hazards with specificity	ForAttention <sup>i)</sup>	
Result and Unit <sup>e)</sup>	Result (Analytical results and Unit) <sup>f)</sup>	ForFollowUp <sup>h)</sup>	
Notification basis (Control type) <sup>e)</sup>		Operator <sup>h)</sup>	
Distribution status <sup>e)</sup>		Status	
Action taken <sup>e)</sup>			
Period	1979 – 2021	2020 – until now	
File format	two xls files (for 1979-2020 and 2021) <sup>j)</sup>	xls or csv file <sup>k)</sup>	
Website	<a href="https://data.europa.eu/data/datasets/restored_rasff?locale=en">https://data.europa.eu/data/datasets/restored_rasff?locale=en</a>	<a href="https://webgate.ec.europa.eu/rasff-window/screen/search">https://webgate.ec.europa.eu/rasff-window/screen/search</a>	

Note <sup>a)</sup> The individual data types are given in a standardised form so that they can be clearly named and compared with each other (whereas the original names of the individual data types, if they were different, are given in brackets). <sup>b)</sup> Data including year of notification. <sup>c)</sup> For 2021 only. <sup>d)</sup> Detailed name of hazard. <sup>e)</sup> Some data missing, especially for earlier years of the functioning of the system. <sup>f)</sup> Data available when viewing notification details. <sup>g)</sup> One or more hazards. <sup>h)</sup> Country or countries. <sup>i)</sup> INFOSAN and/or country and/or countries. <sup>j)</sup> The files are available directly on the website indicated. <sup>k)</sup> The file is available after selecting search criteria and then exporting data from the database. It can contain a maximum of 5000 rows.

Source: own research.

Only the first eight data types are available directly in the xls files from both databases and these are: notification number, date, product category, product type, notification type, notifying country, country of origin and subject. Other types of data are only available in one of the two databases or, in the case of the official database, only when viewing the notification in question. In the obtaining of this data, its processing or analysing, mistakes, shortcomings may be noted, possible difficulties related to its interpretation may also be pointing out (Table 3).

The main impediment for the researcher is the lack of data on notifications prior to 2000 in the officially available RASFF database. In order to include the notifications before that year in the research, it is necessary to retrieve them from the restored database or from data already retrieved, saved and retained. However, this data will be structured differently, so it is necessary to pre-process it before combining. Another difficulty is the redirection of data on certain hazard categories from the RASFF to other networks (i.e. already mentioned above AAC and FFN), which are only accessible to the supervisory authorities of the particular system members. This data should be made available in open access, through the RASFF or other extended system.

**Table 3.**

*Mistakes, shortcomings in data and possible difficulties with interpretation of data from the RASFF*

Detail	Characteristics
Mistakes and shortcomings in data	<ul style="list-style-type: none"> <li>– Description of the notification (in the cell “subject”) in a language other than English.</li> <li>– Different names of the same product, mistakes in the Latin name of the product.</li> <li>– Additional details in the product name - e.g. state or degree of processing, part of the product, colour; adding the name in the national language to the English name of the product (from the point of view of the researcher this is not necessary information); therefore, when preparing the data for analysis, it is necessary to standardise their names, which is very labour-intensive; the solution should be to place the basic product name in one cell and its extended description in another cell.</li> <li>– Frequent lack of information on quantity of substance reported as a hazard, lack of information on tested values and units.</li> <li>– Lack of information on notification basis, distribution status and action taken (especially in the earlier years of operation of the system) in the restored database, and no such information at all in the files exported from the official database (to obtain such information one has to browse through each notification separately).</li> <li>– Placement of a product in an inappropriate product category (in a restored database).</li> <li>– Frequent lack of country of origin in the official database (it is possible to obtain this information from the cell “subject”, if the country of origin is indicated there).</li> <li>– Lack of a cell relating to product name in the file exported from the official database (this can be found in the cell “subject”, which, however, requires analysis of each notification separately).</li> <li>– Exclusion of the United Kingdom as a country that can report notifications in the RASFF after its exit from the EU; this country was quite active and had reported 10.1% of all notifications to the end of 2020, so its exclusion from the system interrupted the continuity of reporting an important part of the notifications; the solution could be to remain this country as a member of the RASFF as other non-EU countries are (Switzerland, Norway, Iceland and Liechtenstein).</li> <li>– Duplication of data in the consumer portal (RASFF Consumer Portal), which may raise questions as to whether such a separate portal is needed.</li> </ul>

Difficulties with data interpretation	<ul style="list-style-type: none"> <li>– Lack of access to data prior to 2020 in the official RASFF database (this data is only available to the supervisory authorities of the member countries), so that in order to examine notifications over a longer period of time, it is necessary to combine data from two databases: the restored one and the official one, however, the data contained in the xls files from these databases have a different structure.</li> <li>– Moving some notifications to other networks: the Administrative Assistance and Cooperation Network (AAC) and the Agri-Food Fraud Network (FFN) and not having access to them (information on them is only available to the supervisory authorities of the member countries).</li> <li>– Listing of several countries of origin in a file exported from the official RASFF database without separating them into separate cells, which hinders analysis.</li> <li>– There is no information on the of hazard category in the file exported from the official RASFF database, which is due to the fact that one notification may concern two or more hazards in one or different categories (there were 18.7% such notifications in the whole history of the system). However, this information can be obtained indirectly by selecting the relevant criterion as a hazard category before exporting the data, and if the research would include several hazard categories, the data for each of them should be exported separately and then (if necessary) combined.</li> <li>– Adoption of the term “Food contact material” as one of the product types and “Food contact materials” as one of the product categories (such similar terms can be misleading); similarly, adoption of the terms “Food additives and flavourings” and “Feed additives” both as product categories and as hazard categories.</li> <li>– Changes of names of product categories and changes of names of hazard categories (e.g. “Heavy metals” to “Metals”).</li> <li>– Introduction of information on border rejections into the RASFF since 2008 only (border rejections can therefore not be investigated earlier); however, this should be considered as a development of food safety law in the European Union, and also the development of the RASFF.</li> <li>– Introduction of the division of information notifications into information for attention and information for follow-up from 2011 onwards. In order to examine these types of notifications throughout the pre-2011 period it is therefore necessary to revert to their initial name, i.e. information notifications, but this loses more detail about this type of notification; however, it should also be regarded as a development of food law and the RASFF.</li> </ul>
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Source: own research.

Finally, the open-access RASFF database should contain information on all notifications since 1979, and the data file exported to Excel should contain at least: reference (i.e. notification number), notification date, product type (e.g. food, feed, food contact material), product category, product, hazard category, hazard, subject (i.e. detailed description of the hazard), notifying country, country of origin, notification basis, action taken and distribution status. Other, more detailed information could be made available during the review of an individual notification. This would make it possible to analyse and track trends in reported hazards throughout the entire period of operation of the RASFF.

A significant inconvenience for the researcher is also the exclusion of the United Kingdom as a notifying country from the system, which, as indicated, entails the interruption of an important part of notifications in the RASFF, thus disrupting the ability to track trends over the long term. After its exclusion from the system, this country did not submit any more notifications between 2021 and 2023. Meanwhile, as pointed out, the United Kingdom could be treated similarly to other non-EU member countries of the system (e.g. Switzerland or Norway).

In addition, some data are either missing from the RASFF or incomplete, reported in national languages rather than English, or not standardised by name. This indicates the need for appropriate training for staff of the surveillance bodies in the member states, as well as the

relevant European Commission authorities verifying and making available these notifications in the RASFF. In turn, a significant deficiency in the RASFF database is the lack of information on trade names and the identity of individual companies. However, the European Commission argues that this is due to the need to balance openness with the protection of commercial information and does not affect consumer safety (European Commission, 2024b).

### 3.2. Products and hazards categories. Main reported problems

In Table 4 presented number of notifications and percentage (in descending order) of products notified in the RASFF by groups, product categories or subgroups. In some cases their names were shortened and/or also were ordered by subgroups. In turn, in Table 5 presented number of notifications and percentage (also in descending order) of hazards notified in the RASFF by groups and hazards categories. In some cases their names were also shortened. It is also worth noting that Table 4 (as well as Table 5) shows the number of records saved in the RASFF database rather than notifications due to the fact that a single notification may relate to several different hazards (as already mentioned in Table 3).

In the files exported from the official RASFF database (i.e. for 2022-2023), data on product categories are available, but there is no data on hazard categories. Therefore, each hazard category was exported separately. However, the sum of the number of notifications (records) exported for particular hazard categories was around 2,300 less than the sum of all notifications during these two years. According to the response from the Directorate-General for Health and Food Safety, only hazards selected from the hazard catalogue are classified by hazard category. However, this can only take place if they are the result of sampling or analysis. If, in turn, a risk is indicated in the notification, but not based on a sample or the hazards are not selected for it after analysis, such a notification will not be included in the search results by hazard category. It added that Directorate-General is working to improve the data to avoid this problem in the future (Europe Direct Contact Centre, 2024).

**Table 4.**

*Number of notifications and percentage of products notified in the RASFF*

<b>Group of products (Number; Percentage)</b>	<b>Product category / Subgroup of product category (Number; Percentage)</b>
Food of plant origin (39,627; 44,5%)	Fruits and vegetables (14,376; 16.1%), Nuts and seeds (13,818; 15.5%), Herbs and spices (5,773; 6.5%), Cereals and bakery (3,938; 4.4%), Cocoa, coffee and tea (1,722; 1.9%)
Food of animal origin (26,083; 29,3%)	Fish (8,263; 9.3%), Poultry (5,045; 5.7%), Meat (4,431; 5.0%), Crustaceans (2,837; 3.2%), Molluscs (2,226; 2.5%), Milk (1,509; 1.7%), Cephalopods (617; 0.7%); Eggs (531; 0.6%), Honey (527; 0.6%), Gastropods (56; 0.1%), Animal by-products (41, below 0.1%)
Other food products (11,525; 12.9%)	Dietetic foods (5,123; 5.7%), Confectionery (1,526; 1.7%), Prepared dishes (1,163; 1.3%), Other food product (1,105; 1.2%), Soups, broths... (1,061; 1.2%), Fats and oils (935; 1.0%), Additives, flavourings (381; 0.4%), Ices and desserts (231; 0.3%)
Beverages, water and wine (1,246; 1.4%)	Beverages (982; 1.1%), Water (196; 0.2%), Wine (68; 0.1%)

Cont. table 4.

Food contact materials (5,022; 5.6%)	Food contact materials (5,022; 5.6%)
Feed and pet food (5,595; 6.3%)	Feed (4,216; 4.7%), Animal nutrition (451; 0.5%), Pet food (928; 1.0%)
All products	89,098; 100.0%

Source: own research.

**Table 5.**

*Number of notifications and percentage of hazards notified in the RASFF*

<b>Group of hazards (Number; Percentage)</b>	<b>Hazard category (Number; Percentage)</b>
Chemical (40,799; 45,8%)	Mycotoxins (14,718; 16.5%), Pesticide residues (11,879; 13.3%), Metals (4,090; 4.6%), Additives, flavourings (4,043; 4.5%), Allergens (2,832; 3.2%), Veterinary products (2,827; 3.2%), Industrial contaminants (345; 0.4%), Chemical contamination (65; 0.1%)
Biological (22,109; 24,8%)	Pathogenic micro-organisms (17,241 ; 19.4%), Microbial contaminants (2,716 ; 3.0%), Biological contaminants (1,137; 1.3%), Parasitic infestation (885; 1.0%), Non-pathogenic micro-organisms (101; 0.1%), Biotoxins (other) (29; below 0.1%)
Physical (3,496; 3,9%)	Foreign bodies (2,852; 3.2%), Radiation (644; 0.7%)
Other food hazards (22,694; 25,5%)	Composition (5,468; 6.1%), Migration (4,394; 4.9%), Adulteration / fraud (2,254; 2.5%), Poor or insufficient controls (1,904; 2.1%), Environmental pollutants (1,668; 1.9%), Novel food (1,307; 1.5%), Organoleptic aspects (1,163; 1.3%), Natural toxins (other) (962; 1.1%), Genetically modified (932; 1.0%), Not determined / other (696; 0.8%); Labelling (662; 0.7%), Packaging (521; 0.6%), Process contaminants (297; 0.3%), Feed additives (236; 0.3%), Encephalopathies (230; 0.3%)
All hazards	89,098; 100.0%

Source: own research.

In Figure 2 shown percentage share of products (subgroups or categories) in hazard categories and in Figure 3 presented percentage share of hazards categories in products reported in the RASFF. These figures were generated in Statistica using two-way joining cluster analysis.

Taking into account the products and hazards with the highest number of notifications (Table 4 and Table 5) and as well as the percentages (Figure 2 and Figure 3), it can be noticed that the most important problems were: mycotoxins in nuts and seeds, pesticide residues in fruits and vegetables, cocoa, coffee and tea, metals in fish, pathogenic micro-organisms in poultry, meat and milk (as well as feed), composition of dietetic foods and migration from food contact materials. It is also worth noting that in three cases the notifications within hazard categories were strongly related to products, and these are: mycotoxins in nuts and seeds, pesticide residues in fruits and vegetables and also hazards linked to migration from food contact materials. Indeed, significant clusters occurred here both when considering the percentages regarding products in relation to hazards and hazards in relation to products.

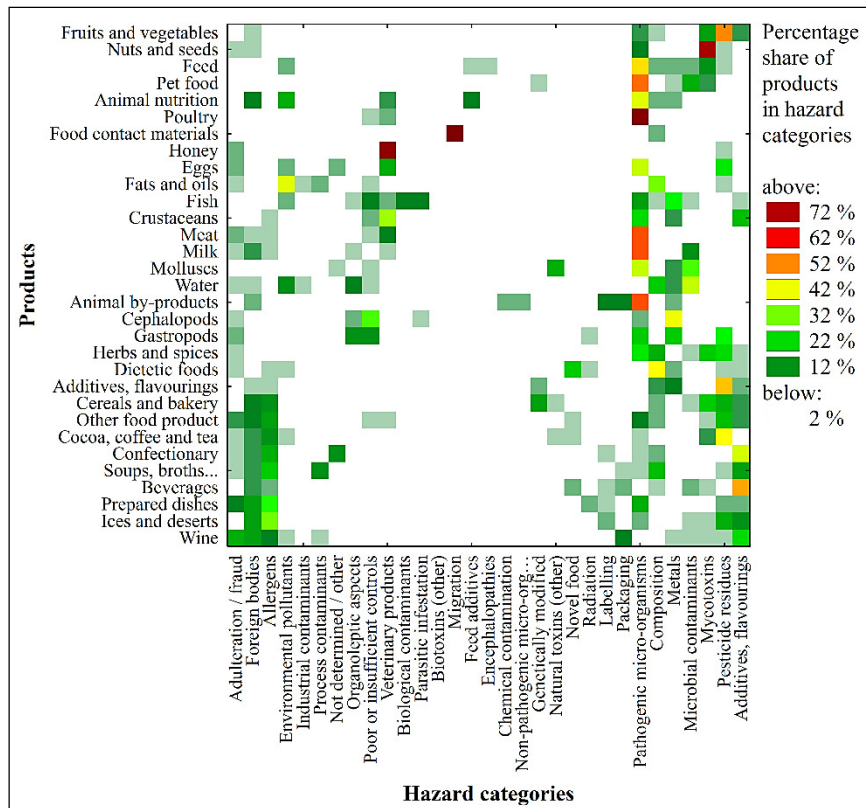


Figure 2. Percentage share of products in hazard categories reported in the RASFF.

Source: own research.

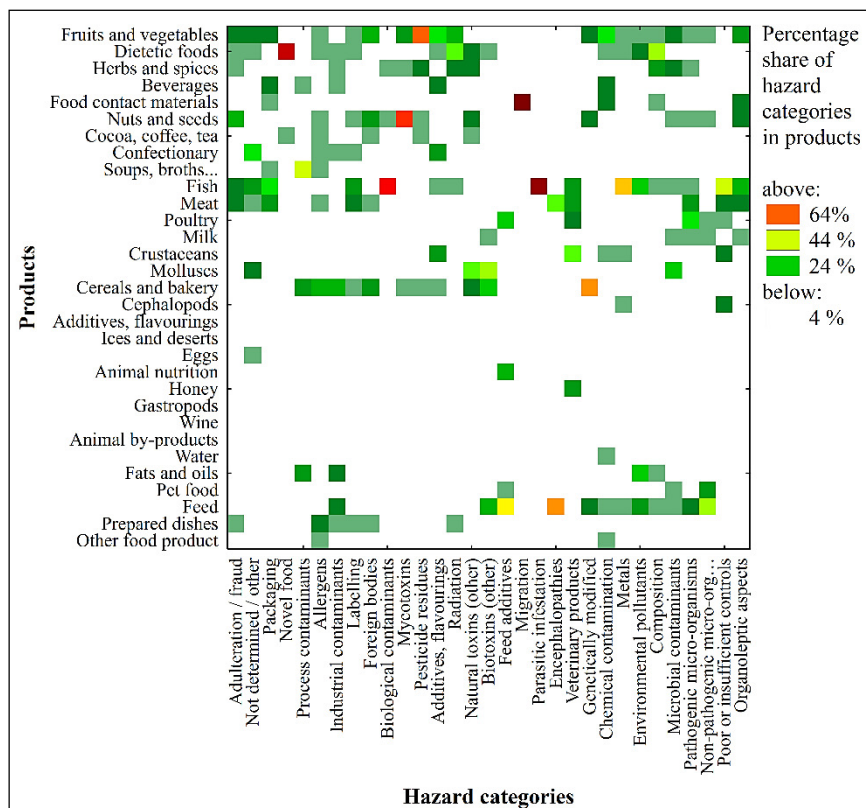


Figure 3. Percentage share of hazard categories in products reported in the RASFF.

Source: own research.



It is moreover notable that if only the percentages (and not the numbers) are considered, it is also possible to identify problems reported for products with a much lower number of notifications and these are e.g.: hazards associated with novel food in the context of dietetic foods and genetic modifications of cereals and bakery, biological contaminants and parasitic infestation in fish, veterinary products in honey, additives and flavourings in beverages, and also feed additives and encephalopathies in feed.

When comparing the colours (and shades) in the Figures 2 and Figure 3 with their legends, it can be seen that their coverage is not accurate, which can make it difficult to interpret the results. This is undoubtedly a drawback of two-way joining cluster analysis, however, these charts are automatically generated and optimising the settings is quite limited. Therefore, attention was mainly paid to the largest clusters, i.e. those marked in brown or red. It is also worth noting that most of the chart areas are marked in white, indicating that clusters are very small or do not exist.

## 4. Discussion

### 4.1. Scientific works relating to the RASFF

Table 6 shows the number of works on the ten most frequently notified product categories (or subgroups thereof) and hazard categories reported in the RASFF up to and including 2023 (Elsevier, 2024; Springer, 2024; Multidisciplinary Digital Publishing Institute, 2024; Taylor & Francis, 2024; Wiley, 2024). There are presented in the descending order. The indicated product categories together account for approximately 80% of all notifications in the RASFF (and similarly the hazard categories too). In the case of category “Additives, flavourings”, the results are not conclusive, as they can be both as products, but can also be reported as hazards.

**Table 6.**

*The number of works on the ten most frequently notified product categories (or subgroups) and hazard categories reported in the RASFF up to and including 2023*

Searched keyword (Number of notifications in the RASFF)		Publisher (Number of works)				
		Elsevier	Springer	Taylor & Francis	Wiley	MDPI
RASFF		1,026	429	220	578	21
RASFF and Product category/ Subgroup of product category	Fruits and vegetables (14,376)	272	138	64	259	5
	Nuts and seeds (13,818)	149	59	30	130	0
	Fish (8,263)	416	180	114	337	4
	Herbs and spices (5,773)	143	54	34	131	4
	Dietetic foods (5,123)	44	21	99	303	1
	Poultry (5,045)	258	101	59	125	1
	Food contact materials (5,022)	120	39	33	74	2
	Meat (excluding Poultry) (4,431)	251	102	60	125	1
	Feed (4,216)	920	422	201	529	18
	Cereals and bakery (3,938)	98	44	20	79	1

Cont. table 6.

RASFF and Hazard category	Pathogenic micro-organisms (17,241)	52	20	19	93	4
	Mycotoxins (14,718)	334	114	69	180	2
	Pesticide residues (11,879)	280	128	123	246	3
	Composition (5,468)	455	167	148	408	1
	Migration (4,394)	147	83	56	130	2
	Metals (4,090)	332	112	62	182	5
	Additives, flavourings (4,043)	99	53	69	219	0
	Foreign bodies (2,852)	133	90	23	79	1
	Allergens (2,832)	154	68	20	107	4
	Veterinary products (2,827)	340	157	74	331	1

Note. MDPI – Multidisciplinary Digital Publishing Institute.

Source: own research.

If one compares the total number of works with the keyword “RASFF” only with the number of works containing this word and the name of the product category or hazard category, it can be seen that most works only mention this system. On the other hand, however, it may also be noted that some works must have referred to several product categories and/or hazard categories together. Another finding that can be drawn from comparing the number of works and the number of notifications is that there is no correlation between them. Thus, some problems are examined frequently and others rarely or not at all.

In terms of product categories, both Elsevier and Springer published a high number of works on feed, followed by food itself, with the most common being: fish, fruits and vegetables, poultry and meat. Authors of works issued by these publishers most often referred to hazards related to: composition, additives and flavourings, veterinary products, mycotoxins, pesticide residues and metals. In Taylor & Francis and Wiley publications, the search results are similar, but there are far more works published on a product category such as dietetic foods. It is also worth noting that Wiley publishes two journals related to one of the RASFF members (the EFSA), and they are: EFSA Journal and EFSA Supporting publication. In turn, the Multidisciplinary Digital Publishing Institute published only single works on issues reported in the RASFF, although, as with the aforementioned publishers, most works referred to feed.

Authors of papers on the RASFF mostly only refer to this system or carry out an analysis of the reported notifications. Much less often do they make critical comments on the data collected in the RASFF database. Among them are D’Amico et al. (2018), who, analysing notifications on seafood, pointed out that the data sent to the RASFF portal may depend on a number of factors: periodic changes in the attention of member countries due to different problems, subjective perceptions of those who report notifications (in terms of risk decisions), reporting of multiple notifications or non-reporting (resulting in too many or too few notifications), types or frequency of checks at border posts. D’Amico et al. (2014), examining notifications of fishery products from China, also noted that they are reported in the RASFF under different trade or scientific names (as also indicated in Table 3), due to linguistic difficulties or translation mistakes.

Petrović (2013), referring to notifications on viruses in the RASFF, drew attention that they are not representative and are not based on common criteria therefore should be interpreted with care. Banach et al. (2016) noted that data collected in the RASFF do not always identify pathogenic microbial species or the severity of chemical agents (e.g. genotoxic, carcinogenic, mutagenic). Notifications of food poisoning are very limited and mainly concern biological hazards. Data gathered in the RASFF is not always consistent in terms of relevant information on identified hazards. In many cases there are editing mistakes (e.g. products and hazards are misspelled), categories are misrepresented (e.g. non-pathogenic organisms in the pathogenic micro-organisms category) or information relevant for early identification may be inadvertently omitted (if, for example, they do not pose a hazard to a member country). In addition, some organisms, agents and commodities are rarely examined. Consequently, under-reporting may occur. On the other hand, overlapping hazards may result in over-reporting. Similar observations were made by Soon et al. (2020), who analysed outbreaks and recalls and stated that it is possible that the RASFF double counts some incidents, but this cannot be conclusively determined without checking line by line.

In turn, Lawrence et al. (2022) recalled that the United Kingdom, Spain, Germany, Italy and Belgium accounted for the largest number of notifications relating to seafood, meaning that the share of the total data set in the RASFF on this kind of products is shaped by institutions from mentioned countries. A similar observation was expressed by Kowalska and Manning (2021). They drew attention to the significant variation among EU member states in their participation in the RASFF. They also highlighted that trends in RASFF data should be interpreted with caution due to changes in the law and purposive sampling.

Manning et al. (2022), reviewing notifications reported in the RASFF and relating to dietetic foods, dietary supplements and fortified foods, noted that in the early 2000s, European legislation in this area was changed, which contributed to an increase in the frequency of actions carried out by food control authorities. There had also been a dynamic market development and increased competition between producers and distributors of dietetic foods, which may have contributed to the adulteration of products for economic gain. It is also worth noting that in May 2004, the number of RASFF member countries increased significantly due to the enlargement of the EU, which could also have had an influence on the number of notifications in this system. This aspect was indicated by studying the notifications concerning cereals and bakery products originating from Poland (Kowalska et al., 2018).

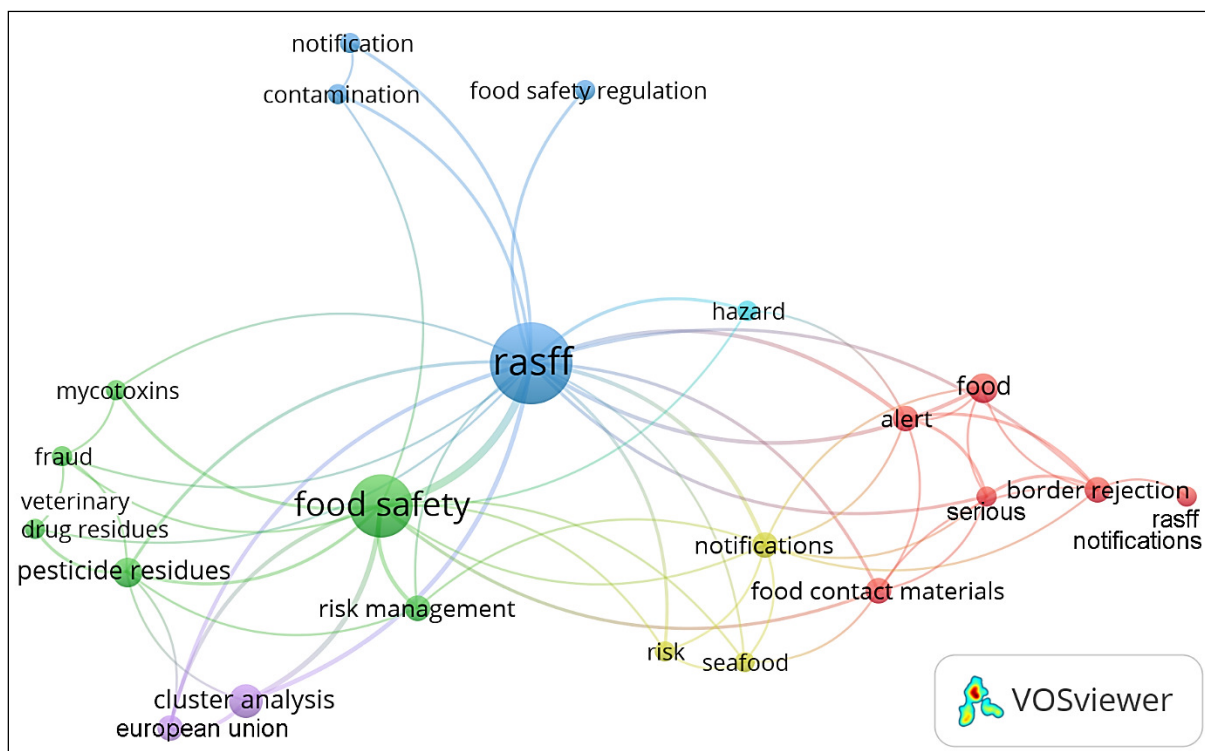
Whereas, Dabbenne et al. (2014) noted that the number of notifications of food recalls reported in the RASFF increased in 2011, which could be due to the introduction of new legal regulations and food safety standards, the development of new detection methods, as well as increasing imports from less developed countries, where food safety requirements are usually at a lower level. Meanwhile, in examining notifications relating to fruits and vegetables reported in the RASFF, it was also noted that although a country may be mentioned as the country of

origin of a product, this does not necessarily indicate that the hazard comes from this country (European Commission, 2024b; Johannessen, Cudjoe, 2009).

In turn, Popping et al. (2022) noted that many notifications in the RASFF relate to contaminants resulting from non-compliance with regulatory requirements, but not necessarily related to health concerns (for example, in the case of pesticides, veterinary drug residues or mycotoxins). They also add that although the RASFF database is a valuable resource, it lacks detailed information (for example, mislabelling of allergens can be classified as a food fraud, while the presence of melamine is classified as a food safety incident even when it is also a food fraud).

#### 4.2. Map of links

Figure 4 (generated in VOSviewer) shows map of links between the keyword “RASFF” and other keywords specified by the authors. It consists of 22 items, 6 clusters (marked with different colours) and 61 links. It should be reminded that in creating the map, those keywords that occurred at least twice were taken into account.



**Figure 4.** Map of links between the keyword “RASFF” and other keywords indicated by the authors.

Source: own research.

The word “RASFF” (blue colour in the middle of the map) is most often combined with “food safety” (green colour). On the left side of the map, also in the green cluster are four hazards categories. i.e.: mycotoxins, fraud (adulteration/fraud), veterinary drug residues (veterinary products) and pesticide residues. The map also shows one product group – seafood (olive at the bottom), one product category – food contact materials and two notification types

– alerts and border rejections (red at the right). Thus, it should be noticed that the authors did not indicate in keywords many of the product categories and hazard categories reported in the RASFF, however, they may have referred to them in their works. Whereas, among other data, only the notification type was specified. A more detailed map (i.e. also taking into account individually occurring keywords) could give a more complete characterisation of the links, but interpreting this map would require dividing it into individual parts and enlarging them.

It should be pointed out that searching using keywords in databases of scientific papers (Table 6) also concerns the text of the papers, and is therefore very accurate, but may only involve a single occurrence of the word itself (rather than presenting the results of a detailed study). In turn, authors of scientific works define keywords (Figure 4) in a subjective manner. Thus, the number of works related to the RASFF, as well as the keywords used by the authors, are not necessarily indicative of the scope of their research. However, considering Table 6 and Figure 4, it is noteworthy that there is a relatively small number of works on products such as nuts and seeds, herbs and spices and hazards including pathogenic micro-organisms and migration. This may be due to the very different types of products and hazards in these categories and the associated difficulty in interpreting the results. However, these are issues that could potentially be an area for further in-depth analysis of notifications reported in the RASFF.

## 5. Conclusions

The biggest inconvenience associated with the Rapid Alert System for Food and Feed (RASFF) database is the lack of access to historical data, i.e. up to and including 2019, and the redirection and collection of data on certain hazard categories (for example, adulteration) previously available in the RASFF to other networks, accessible now only to the supervisory authorities of European Union countries. Open access to all these data should be reinstated, allowing free use by researchers, consumers and companies, involved in the food chain. It would also be appropriate to consider the re-inclusion of the United Kingdom in the RASFF, as its exclusion from the system has interrupted the continuity of a significant share of the notifications, so there is no possibility of tracking trends in a reliable way.

Deficiencies in the RASFF data should be remedied and standardised in terms of notation and language (appropriate guidance should be addressed by the European Commission to the RASFF member contact points). In addition, where appropriate, full Latin names of products and hazards should be required, which would avoid many inaccuracies in the data. The file exported from the database should also include data on hazard categories, as well as, other data. However, it is also important to point out that the RASFF database does not include information on the number/quantity of notified products and the scale of the hazards, which makes it difficult to assess the real risk for the consumer.

As a reason for the non-disclosure of trade product and company names in the RASFF database, the protection of the economic interests of these companies, based in the European Union, should be indicated. Meanwhile, the European consumer should have access to them, as is the case in the United States or Australia, where this type of data is published in the open. It is worth noting that in the European Rapid Alert System for Dangerous Products (RAPEX) for non-food products, such data are presented, but this is probably due to the fact that they are mainly sourced from outside the EU.

Most authors analyse RASFF notifications only in terms of numbers or percentages, whereas studies of this type should be more cross-sectional and multidimensional, indicating relationships and similarities between different product categories and hazard categories, as well as the other type of data. Potential areas for further research could have been notifications for nuts and seeds, herbs and spices and hazards including pathogenic micro-organisms and migration, also taking into account data such as: year of notification, notifying country, country of origin, notification basis, distribution status and action taken. However, it should be borne in mind that the results of the analysis of the data reported in the RASFF should be interpreted with caution. This is because the number and details of notifications depend on the number of RASFF members at any given time, as well as on the varying activity of the supervisory authorities of the different countries resulting from food safety problems in a particular country, and the awareness, training and experience of authorities' staff.

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## SUSTAINABLE ORGANIZATIONS – THE STATE OF RESEARCH BASED ON BIBLIOMETRIC ANALYSIS

Joanna PRÓCHNIAK

University of Gdańsk, Faculty of Management; joanna.prochniak@ug.edu.pl, ORCID: 0000-0003-1096-3196

**Purpose:** The aim of the article is to identify the current academic research on the perception of sustainable organizations management and development.

**Methodology approach:** The study uses a systematic literature review (SLR) methodology using the SCOPUS database to identify the framework of sustainable organizations in research. The VOSviewer tool was used to exercise the co-occurrence of keywords to select specific research topics to be included in the analysis.

**Findings:** Organizations have a key role to play in mitigating climate change, so new business models are needed to manage social, regulatory and economic interrelationships. New sustainable models are shaped by shareholders' business objectives, stakeholder expectations and regulatory frameworks. The aspects that emerged from the bibliometric data analysis of co-occurrences and word clusters were the following: socio-economic framework (with stakeholders analyzed independently), managing for sustainability, innovation, circular business models and supply chain management. In spite of many sustainability studies, there is still a gap in knowledge on how to proceed and build sustainable business models of organizations.

**Research limitations and implications:** Analyzing the spectrum of research on sustainable organizations to date can support future research on sustainable value creation generators and models for sustainable organizations. An important limitation factor for analyses based on the literature is the risk of omitting important aspects of sustainable organizations, as research based on co-occurrence of words has such limitations.

**Practical implications:** The research impacts interrelated and complex relationships among helices in the Triple helix model: academia, business, and regulations. It aims to trigger innovations in the business sphere.

It is useful to bring academic research into practice as part of a Triple Helix approach and its more developed forms, clearly addressing regulatory challenges and practical application in business.

**Originality/value:** Identifying the state of research on sustainable organizations aims to recognize the current trends in sustainable organization better and understand the picture of academia approach.

**Keywords:** sustainable organizations, sustainable development of organizations, sustainable business models.

**Category of the paper:** Research paper, literature review.

## 1. Introduction

Sustainability has emerged as a megatrend, putting organizations under pressure of sustainability practices while maintaining economic viability (Carayannis et al., 2017). The greatest pressure to implement and develop a sustainable approach is imposed on businesses - corporations and financial institutions.

Sustainability perceived as the 'triple bottom line' (TBL or 3BL) requires achieving and balancing the three types of goals: social, environmental, and financial (Maletič et al., 2014) or: socio-cultural, environmental, and economic (Ismail, Jaafar, 2022). Sustainable organization encompasses 3P ("people, planet, and profit"), so the development is aligned with ESG (environmental, social, and governance) goals. The role of organizations for sustainable development is also emphasized in the United Nations Sustainable Development Goals, which might lead to conflicts, when reconciling environmental concerns with the monetary aspects. Goals and scopes derive from the expectations of stakeholders. Hence new business models are needed to govern social, regulatory, and economic interrelations.

The economic side of sustainability encompasses both financial and non-financial (social) aspects. The perception of the economic dimension of sustainability dynamically evolves. The 2014 Non-Financial Reporting Directive (NFRD) (2014/95/EU Directive), which mandated the largest corporations to engage in non-financial reporting, included references to both the financial and non-financial goals of the company. The regulation evolved into new reporting regulations (Corporate Sustainability Reporting Directive - CSRD), and new reporting standards introduced by EFRAG - the European Sustainable Reporting Standards (ESRS). Afterwards, all aspects of sustainable development have a financial dimension, and the term "non-financial" seems to be awkward and even criticized. Therefore, non-financial issues are now within an economic dimension. Studies hardly combine sustainability reporting and sustainability approach (Hahn et al., 2023).

Managing a sustainable organization requires understanding of how sustainable development goals and stakeholders affect the functional perspective of an organization. Stakeholder pressure triggers new regulatory frameworks for many types of organizations, organizational policies, and management (Mashele, Chuchu, 2018). The context of sustainable organizations is shaped by the expectations of stakeholder groups, whose influence varies across different organizations (Di Maddaloni, Derakhshan, 2019). Legal, regulatory, and good practices concerns relate to ESG goals and stakeholders' advocacy, entailing operational and transactional costs (Tura, Hanski, et al., 2019). Stakeholder impact on organizations can be explained by institutional theory where organizational theory and behaviors are influenced by diverse forces, including social ones. Stakeholders demonstrate moral, social, or legal legitimacy (Marjamaa et al., 2021). It is not settled, who is of the greater legitimacy –

the management or the stakeholders with strong legitimacy (Etienne et al., 2011). Social legitimacy can be explained by permitting to act companies (Hahn, Kühnen, 2013).

Among the issues, there is a distinction between diverse types of organizations and an understanding of their role in sustainable development. Kaufmann and Danner-Schröder (2022) explore six types of organizations that address sustainability context: movements, temporary organizations, partnerships, established organizations, multistakeholder networks, and supranational organizations.

Most recent studies address the newest context of sustainable organizations, like VUCA - Volatility, Uncertainty, Complexity, and Ambiguity (Perez-Uribe et al., 2024) or micromanagement for millennials (Ryan, Cross, 2024). Hence, with the above in mind, the main research question (MRQ) arises as follows: How do researchers conceptualize the sustainable organizations in VUCA and BANI world? Therefore, the article aims to identify the current academic research on the perception of sustainable organizations management and development. In order to achieve the research objectives, a systematic literature review was used, followed by the method of synthesis and logical inference.

## 2. Methodology of bibliometric research

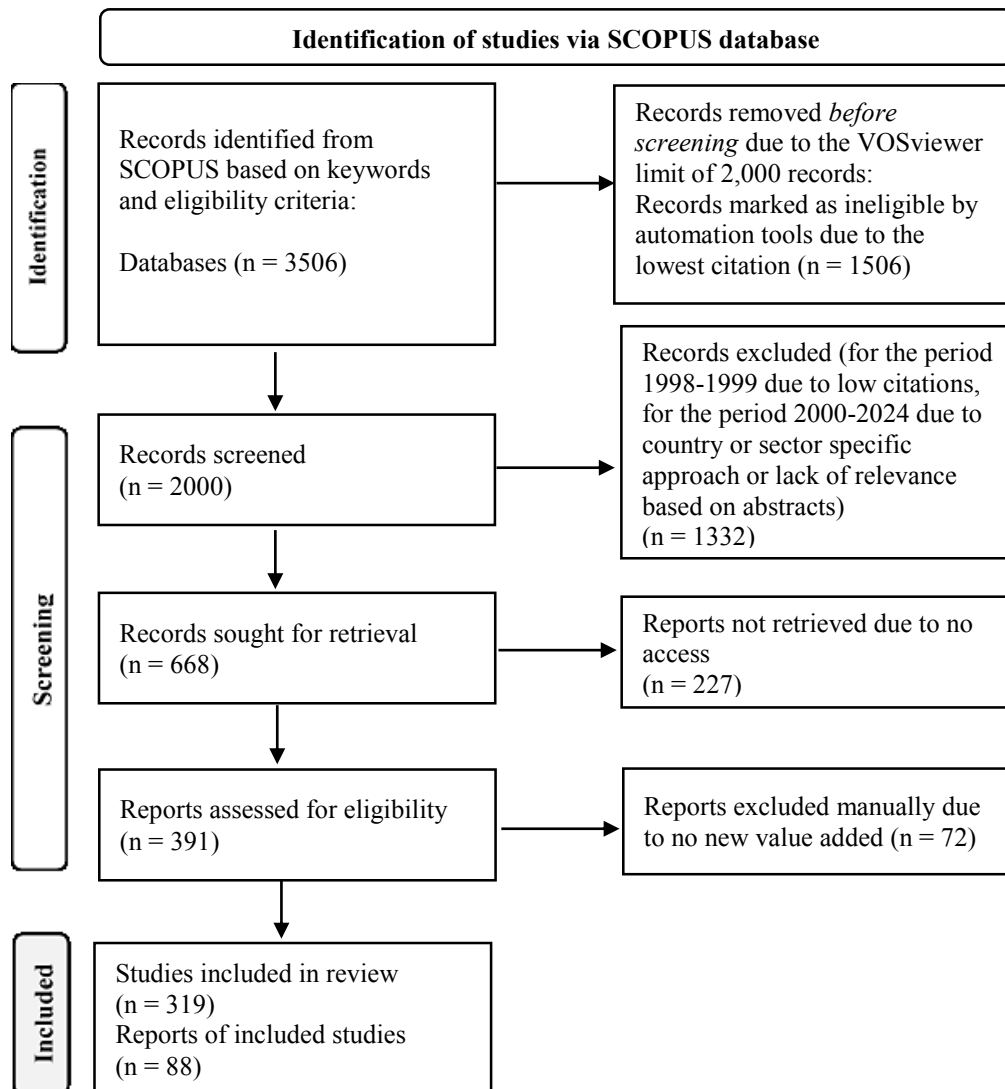
The bibliometric research - a systematic literature review (SLR) methodology based on reviewing and analyzing publications was performed to provide the framework and insights on the sustainable development of organizations. The SCOPUS database was considered in the study to identify and select the articles. PRISMA protocol was applied in the bibliometric research to achieve the empirical findings. Co-occurrence of keywords using the VOSviewer tool was used to select specific topics taken up in the research.

With the MRQ and the literature review procedure in mind (Bölen et al., 2021), the following supporting questions (SQ) were posed:

- SQ1: What is the current trend of research on sustainable development of organizations, sustainable organizations?
- SQ2: What are the approaches to a universal sustainable organizational framework?
- SQ3: How mature is academic research in the field of sustainable organizations?

After examining word combinations, the following keywords were used with all combinations for the collection of research documents from SCOPUS: “sustainable development of organization”, “sustainable organization”, “sustainable business”, “sustainable company”, “sustainable development of the company”, “sustainable development of business”, “sustainable AND organization”. The restrictions were added as follows: solely English language and peer-reviewed documents (article, book chapter, review, book editorial, conference review included), publishing year starting from 1998, limited subject area

(to Business, Management and Accounting Economics, Econometrics, and Finance). First, 3506 documents were identified (as of August 2024), but due to the VOSviewer software limitations (of up to 2000 articles), further restrictions were made by choosing the best cited and relevant records from the period 1998-1999 and for the period 2020-2024 manually selected by the relevance of abstracts, achieving 1,922 records. Then the records were selected manually by relevance, excluding the country or sector-specific articles. Finally, 668 records were used for analysis using VOSviewer to select topics based on word co-occurrence and the final study was made on 391 documents that were fully accessible.



**Figure 1.** PRISMA 2020 flow diagram for SCOPUS search of sustainable organizations.

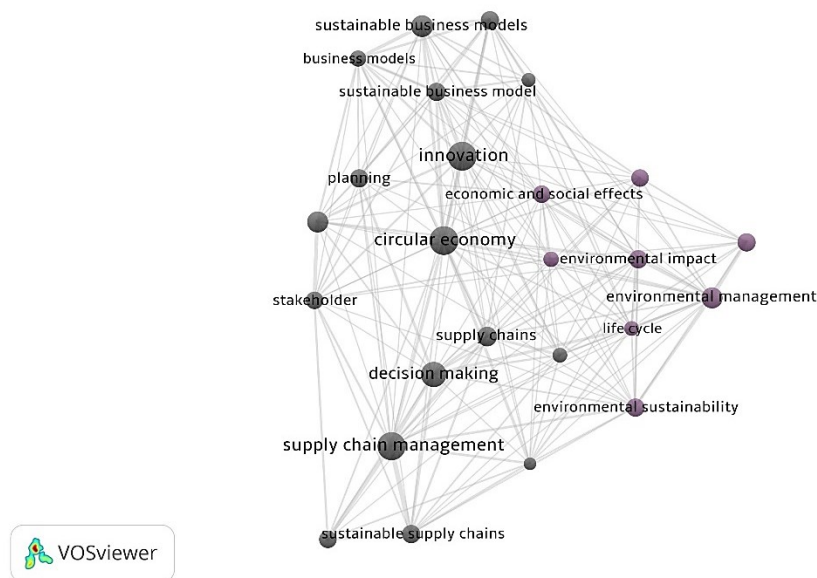
Source: Page, et al., 2021.

Articles included in the final review were analyzed manually in search of the state of knowledge on emerging topics.

### 3. Results and discussion

The current topic areas of sustainable organizations were selected based on keyword co-occurrence using the VOSViewer software. 35 keywords with the greatest total strength of the co-occurrence links were generated by the software to visualize bibliographic coupling density.

The dominant keywords that did not add value to the analysis were excluded (for example: sustainable development, sustainable organization, business, business development).



**Figure 2.** The Network Visualization of Literacy Topic Area based on keywords in Scopus.

Source. Own elaborations based on VOSViewer.

The general research topics were identified based on bibliometric data analysis of the co-occurrence and words' clusters and are as follows: socio-economic framework (with stakeholders analyzed independently), managing for sustainability, innovation, circular business models, and supply chain management. Themes and general comments are summarized below. What is missing are sustainability drivers. Many articles deal with a specific industry, specific conditions but with no conclusions for an universal approach.

#### 3.1. Socio-economic considerations on sustainable organizations

The socio-economic approach underscores the role of organizations in achieving sustainability goals (Rosati, Faria, 2019; Annunziata et al., 2018; Maletič et al., 2014). Rai et al. (2006) mention the need for balancing the long-term well-being with financial performance manifested by resource allocation, pricing, financial analysis, risk management, cost control, and cash flow management (Rai et al., 2006). According to Tura, Keränen et al. (2019) a focus on sustainability and economic performance should consider social pressure. Hudec (2017) relates to various socio-economic factors with regard to economic excellence

(Hudec, 2017). Sometimes social performance is put in the back, for example in manufacturing (García-Muiña et al., 2021).

The “economic sustainability” is not explained well in research, and authors warn of using the conventional economic perspective (Bocken, Short, 2021). The economic dimension has references to initial investment costs, asset allocation, infrastructure use, the dominance of economic indicators, and decision-making processes (Tura, Keränen, et al., 2019). Management studies recognize economic value as co-dependent on social and environmental factors (Dembek et al., 2023). However, this co-dependency is not enough explored (Daddi et al., 2018). Many considerations prioritize sustainability within a decision-making process (Mashele, Chuchu, 2018). In fact, sustainability objectives intermingle (Deveci et al., 2022).

Trocka (2023) sees the economic dimension of sustainable development as technological progress that includes the efficiency of the use of raw materials, and human resources. Much research focuses on long-term company value creation but with no satisfactory conclusions. Some studies link sustainability, and value creation with national-level governance playing a significant role in promoting sustainability (Abhayawansa et al., 2021). In a financial context, economic value derives from the distribution of economic costs and benefits among stakeholders (Boons, Lüdeke-Freund, 2013). Economic value can be captured from maintaining or regenerating natural social and economic capital (Lüdeke-Freund, 2020). Economic value derives from strategy, innovation, and business environment (Lüdeke-Freund, 2020). Value added (captured value) can be created by utilizing economic gains retained in products after their use (Dentchev et al., 2016; Stål, Corvellec, 2018).

### **3.2. Stakeholders of sustainable organizations**

Stakeholders enforce a sustainable approach, so stakeholder theory is widely debated (Daddi et al., 2018). However, stakeholders do not appear as co-occurrences of keywords in the reviewed studies in the Scopus database. It is perceived as a gap and opportunity for expanding research (Allen et al., 2021). The most cited study underlines interconnectedness between ESG factors and value creation for all stakeholders (Rai et al., 2006). The EU CSRD points to stakeholder groups rather than individuals (Commission Delegated Regulation (EU) 2023/2772, 2023).

Stakeholders represent separate or mixed roles in organizations being: shareholders, regulators, society, consumers (Jennings, Hoffman, 2021). Their social expectations are not specific (Adams, 2017) and not fully known (Stål, Corvellec, 2018). Scholars recall two approaches: instrumental - the management of stakeholders in achieving organization goals, and normative – managing for stakeholders (Di Maddaloni, Derakhshan, 2019). Di Maddaloni and Derakhshan (2019) recall instrumental approach and stakeholder attributes to provide resources for the organization. The limited resources within the organization lead to the predominance of the management of stakeholders and managerial priorities toward stakeholders as a formal relationships or legal authority over the organization.



The normative approach leads to changes in organizational structures to meet the legitimate interests of stakeholders in the value-creation processes (Di Maddaloni, Derakhshan, 2019). The sustainability economic for stakeholders can be explained by signaling theory, where sustainability commitment meets the expectations of stakeholders to build competitive advantages for the company (Rosati, Faria, 2019).

### **3.3. Management for sustainability**

The management for sustainability can be understood differently (Isaksson et al., 2023), but the sustainability of organizations lacks reference to managerial theory (Daddi et al., 2018). Organizational and cultural issues in sustainability recur (Boons, Lüdeke-Freund, 2013), but the research mostly presents the activities, with no explanation of how to combine them into systems (Dembek et al., 2023). Manningen and Huiskonen (2022) refer to an integrated strategy, which drives managers to sustainability performance (Manninen, Huiskonen, 2022). Some studies agree on the need for new business models, redesign, and development of technological, social and organizational processes to bridge the gap between innovation and economic performance (Durán-Romero et al., 2020; Mendoza et al., 2017; Witjes, Lozano, 2016). Other studies perceive new business models as partial solutions (Abdelkafi et al., 2023), emphasizing circular approach or organizational institutionalism conditioned by norms, rules, and practices (Stål, Corvellec, 2018) or cultural-cognitive pillars (Hoepner et al., 2021). The regulatory considerations include decoupling theories - organizational buffering to protect the organization core operations from institutional demands. Decoupling typically entails the mitigation of the environmental footprint associated with economic activity and advancement through the enhancement of resource efficiency and reduction of natural resources use (Santa-Maria et al., 2022; Benstead et al., 2018). Environmental changes lead to a new unpredictable external business environment and new climate risks to be managed (Alexander et al., 2018; Allen et al., 2021).

A frequent aspect of sustainable management is sustainable leadership (Blas et al., 2022) with many contexts that appear on Scopus search:

- green transformational leadership for high innovation and effectiveness (García-Morales et al., 2008; Zhao, Huang, 2022),
- sustainable leadership for transforming sustainable culture (Streimikiene et al., 2021),
- servant leadership (Jit et al., 2017; Feng, Adams, 2023),
- ethical leadership for better performance and influencing the culture (Kawiana et al., 2023),
- responsible leadership for building trustful relationships with stakeholders (Maak, 2007; Muff et al., 2020),
- collaborative agency as alternative to leadership, where diverse stakeholders are involved (Raelin, 2016).

Responsible leaders leverage organizational intelligence to achieve desired outcomes, integrate effectiveness and quality of performance (Dellve, Eriksson, 2017). Sustainable leadership aims to improve environmental performance and generate business value (Armani et al., 2020). The integration of sustainable concerns leads to sustainable organizational excellence and resilience using interrelated concepts like organizational change, policies, structure, and performance (Carayannis et al., 2017) or use of tools and management models (Val et al., 2020). Quality for sustainability underlines the role of quality management in achieving sustainable goals (Fundin et al., 2020).

### **3.4. Innovation**

New business models include new ways to create (do how) and capture (do why) value, focusing on new ways of generating revenues and creating value for customers, suppliers, and partners (Manninen, Huiskonen, 2022).

Sustainability is often connotated with innovation processes that motivate establishing new business models (Lüdeke-Freund, 2020). The innovative approach aligns with the existing economic focus, but is organized differently. Sustainable business models create monetary and non-monetary value added by e.g. manipulating existing resource (Santa-Maria et al., 2022), resource extraction or energy transition (Lüdeke-Freund, 2020). Technologically, sustainable innovation (inputs), are converted into economic outputs (Lüdeke-Freund, 2020) that create long-term outcomes (impacts and risks). Sustainable business models promote outcomes for society and the environment under condition of economic sustainability (Bocken, Short, 2021). The environmental pressure brings also innovation strategies or diversity of innovation portfolio (Carayannis et al., 2017).

Another conclusion here is that research tends to be focused on specific issues, such as: digitalization (Acciarini et al., 2022), plastic management (Dijkstra et al., 2020), or agile manufacturing (Mohaghegh et al., 2023).

### **3.5. Circular economy and circular business models (CBM)**

The circular economy (CE) received a lot of attention as a trigger for the transformation of business models (Tura, Hanen et al., 2019). CE - first derived in the ecology discipline, aims at reducing the environmental impact by better resources using. Mendoza et al. (2017) refer to resource consumption, waste generation, and management. There are a number of frameworks for the circular economy. BEDE (Backcasting and Eco-design for the Circular Economy), proposed by Mendoza et al. (2017) and Heyes et al. (2018), supports implementing innovations within circular approach. Often mentioned in research is the Ellen MacArthur Foundation which proposes ReSOLVE checklist of six actions for circular economy implementation (Heyes et al., 2018). In contrary to the take-make-use-dispose model, circular – the closed-loop approach meets the tension between economic and environmental issues (Murray et al., 2017; Tura, Hanen et al., 2019). It also decouples economic pressure from environmental impacts and

consumption (Mendoza et al., 2017). Decoupling in a sustainable approach also applies to economic and socio-cultural aspects (Ismail, Jaafar, 2022). A circular approach in an economic orientation can lead to a transition into a cost-saving concept both environmental and socio-economic issues (Witjes, Lozano, 2016).

The strong focus on circular business models (CBMs) derives from the belief that they are main contributors to sustainable development (Heyes et al., 2018; Stål, Corvellec, 2018; Santa-Maria et al., 2022). Researchers note insufficient knowledge on the implementation of the circular approach, sector specific issues or small companies (Heyes et al., 2018; Stål, Corvellec, 2018). Also, not enough incorporation of the circular economy into strategic thinking is underlined. Mendoza et al., after reviewing the circular economy models, classified such models into 4 categories: sustainable innovation, sustainable product design, closed-loop supply chains and product-service systems (Mendoza et al., n.d.).

A lot of sector or topic-specific studies on circular sustainability derive from diverse types of organizations and specific operations (Agrawal et al., 2022), industry 4.0 in circular economy transition (Bai et al., 2020; Chari et al., 2022; Ciliberto et al., 2021; García-Muiña et al., 2021; Shayganmehr et al., 2021) or logistics role (Mishenin et al., 2018). Still, there is no single agreed or universal sustainable business model. In addition, net-positive environmental value and circular economy are already not enough in organization activity (Bocken, Short, 2021).

### **3.6. Sustainable supply chain management**

Sustainable supply chains are perceived as pivotal in mitigating dependencies and resource price reduction (Tura, Keränen et al., 2019). The substantial significance of this shift is under pressure of that 13% of the environmental pollution can be attributed to activities within the supply chains (Alzoubi et al., 2020).

Aligning a sustainable supply chain strategy with the principles of the circular economy is imperative (Genovese et al., 2017). So, supply chains are increasingly incorporating the tenets of the circular economy (Allen et al., 2021). Various supply chain models, including open-loop, closed-loop, and circular supply chains, may exert varying influences on sustainability outcomes contingent upon the specific contextual factors at play (Vegter et al., 2020).

The most cited article refers to the integration of Green Supply Chain Management (GSCM) and Green Human Resource Management (GHRM) (Jabbour, De Sousa Jabbour, 2016). The study also focuses on the perception and networks of stakeholders regards sustainable supply chains (McLoughlin, Meehan, 2021; Rane et al., 2021).

Studies address a myriad of topics: encompassing green product development, eco-friendly procurement, ethical sourcing, sustainable transportation, eco-conscious operational and production practices, matters about corporate governance and reporting, as well as the management of product carbon emissions (Glover et al., 2014). Research reveals a clear and direct association between sustainable supply chains and company performance (Alzoubi et al., 2020).

## 4. Discussion

As can be noticed, there is no complex perception of sustainable organizations in research. Certain topics appear more often in keyword co-occurrence. With regard to the main research question, the general perception of sustainable organizations is not concrete. However, there are some trends in research highlighted: circularity, decoupling socio-economic approach, supply chains and innovation. What is missing here are the elaborated elements that make up sustainable organizations, such as do value drivers for value based management. An issue worthy of inclusion in the study is green human resource management, highlighted as important but not the result of co-occurrence.

Many papers present the organizations' commitment to sustainability, however with no a precise explanation of possible strategies and behaviors. Also, the existing research doesn't bring answers to how the sustainability approach influences corporate economic performance (Maletič et al., 2014) or generate the value for organization (Manninen, Huiskonen, 2022).

Ogutu et al. (2023) made a Web of Science bibliometric meta-data analysis on current trends in sustainable organization management to distinguish popular keywords, which were: management, impact, model and framework. The popular trend topics occurred: performance, impact, tourism, management and innovation (Ogutu et al., 2023). Lozano uses ANOVA test to examine how the organizations address the dimensions of sustainability (Lozano, 2023). In a survey study published in 2018, Lozano aimed to conceptualize a framework for organizational sustainability (Lozano, 2018). Ikerd, in the study on managing business for sustainability analyze different aspects – metrics, motives and management implications concluding that economies are nested in societies that are nested in nature (Ikerd, 2024).

Delbridge et. al skeptically confirm that the exchange between organization studies and sustainability management has been limited. The authors notice that sustainability is often used in research as a case or metaphor (Delbridge et al., 2024). The authors seek the research potential on organizing sustainability in: social justice, bridging the local and global scale concerns, democratizing governance and collectivity (Delbridge et al., 2024).

Despite attempts already made to define and prioritize the dimensions of sustainable organizations, and conceptualization of them is still evolving and not matured. Some aspects are well developed, such as leadership, while the issues of circularity and its impact are not yet.

The conceptualization of sustainable organization can include double materiality and the socio-economic impact of an organization's performance on users and other affected stakeholders through the implementation of circularity, leadership, innovation and sustainable chain management.

## 5. Conclusions

There is a growing number of research on sustainability, but still with no consensus on sustainable organization model. The study brings the considerations on the attractive sustainability topics in academia research and gives input to the Triple Helix Model boosting the innovation proposals for sustainability approach. The Triple Helix Model triggers interactions and transfer between three helices: (1) Academia (knowledge, research), (2) Business (industry) and (3) Government (regulations) (Cai, Etzkowitz, 2020; Kopczynska, Ferreira, 2021).

It is useful to bring academic research into practice as part of the Triple Helix Model approach and its more developed forms, clearly addressing regulatory challenges and practical application in business.

In trying to understand the sustainable development of organizations, external regulations pressure results in the internal frameworks, such as economic or managerial that incorporate sustainable development through circular economy or sustainable supply chains (Dwivedi et al., 2021). In a sustainable approach, organizations seek solutions oriented on the environment, and social goals, along with the economic perspective (Henry et al., 2019), ensuring effective intra-organizational relationships, particularly to enhance the credibility of organizational actions and efficient management. The business framework includes organizational components and structures enabling sustainable approach. Managerial and legal concerns of sustainable organizations bring new concepts and business models.

The aim of the study was achieved and, although the research did not develop organizational drivers of sustainable organizations, it might be a contribution to further research and exchange between helices. The research - “academic helix” is worth expanding to other databases (e.g. Web of Science) to obtain irrefutable conclusions about sustainable organizations. The academic research on sustainable organizations is mature in sectoral and specific approach, but still with no generalizations. The limitation of the study can be data source bias as an overrepresentation of certain journals has been observed. Also field scope and definitions might be interpreted differently across studies. Despite a diligent selection of sources, emerging topics could be not fully integrated into the literature.

Both the overrepresentation of certain journals in which specific topics are repeatedly addressed and the mere question of the popularity of specific issues can lead to the omission of important aspects and valued authors. A very important aspect that interferes with the possibility of realizing a satisfactory study is the issue of lack of access to the full content of important articles in the database.

In the case of this study, a topic that was not included in the analysis based on the popularity of co-occurring terms and the possibility of accessing the texts was green human resource management. Among the Polish authors indexed in Scopus who refer to this issue are Piwowar-

Sulej (Piwowar-Sulej, 2024; Sołtysik et al., 2024; Piwowar-Sulej, 2021). Lack of full text access is undoubtedly an important problem facing academics in Poland.

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## RETHINKING SOCIAL VALUE CREATION IN ORGANISATIONS: INSIGHTS FROM CSV AND IVC

Izabela PRZYGOCKA

Uniwersytet Ekonomiczny w Poznaniu; izabela.przygocka@phd.ue.poznan.pl, ORCID: 0000-0001-6631-6233

**Purpose:** The purpose of this article is to trace the evolution of social value creation within organisations, highlighting the transition from profit-centric approaches to more integrated frameworks that consider social and environmental concerns. It aims to compare key concepts of social value to understand how organizations' motivations for creating social value have transformed.

**Design/methodology/approach:** The research employs a qualitative literature review to explore the evolution of social value creation within organisations. By analysing key concepts such as Creating Shared Value (CSV) and Integrated Value Creation (IVC), the author adopts a deductive approach to identify trends and shifts in organisational perspectives. This approach helps to understand how these frameworks blend social and environmental issues into organisational practices, enriching the discussion on social value creation.

**Findings:** The analysis reveals a significant shift in organisations' motivations for creating social value, moving from profit-centric models to a broader focus on positive societal impact. It was found that organizations increasingly recognize their role in addressing social and environmental challenges. This evolution highlights the importance of integrating social value into core business strategies.

**Originality/value:** This article presents a fresh perspective on the evolution of social value creation within organisations, highlighting the transition from profit-driven approaches to integrated frameworks that consider social and environmental concerns. It offers valuable insights for academics, practitioners, and policymakers interested in how organisations can effectively contribute to societal well-being. The research underscores the dynamic nature of social value creation and its implications for organisational strategy. It serves as a resource for those seeking to align business practices with social impact goals.

**Keywords:** Social Value, Creating Shared Value, Integrated Value Creation, Value Creation, Corporate Social Responsibility.

**Category of the paper:** Conceptual paper.

## 1. Introduction

Social value in management theories is less explored and more challenging to grasp than economic value. Often, it is only mentioned in the literature as one of the elements of enterprise value, alongside economic and ecological values, with little to no attention given to defining it. However, with increasing pressure from various stakeholders and changes in the market, issues of non-economic value and the need for a broader approach to value creation by enterprises are being raised more often than before (Stead, Stead, 2019). An inadequate understanding of social value may lead organisations to overlook its significance and treat it merely as an additional effect of their actions rather than something essential and valuable.

This article explores the evolving concept of social value within organisations by analysing various theoretical approaches to social value creation in the academic literature. It provides a comparative analysis of the Creating Shared Value (CSV) concept proposed by Porter and Kramer and the Integrated Value Creation (IVC) framework developed by Wayne Visser. By examining these frameworks alongside earlier concepts of social value, such as blended value, sustainable value, and the triple bottom line, the article highlights the transition from profit-centric models to more integrated approaches. This analysis not only tracks the changes in the perception of social value created within organisations over the last three decades but also enables insights into the future direction of organisational approaches to social value creation. Ultimately, the article contributes to ongoing discussions about the role of organisations in society and their capacity to achieve a more significant social impact.

The analysis in the article is structured as follows. It begins by emphasising the importance of social value creation within organisations and addressing the challenges in establishing a commonly accepted definition of this concept. Next, the author describes and analyses basic concepts of social value from the early 2000s, such as blended value, sustainable value, and the triple bottom line. Following this, the author delves into the characteristics of Creating Shared Value by Porter and Kramer as well as Integrated Value Creation by Visser, and compares these approaches to social value creation. In the Results section, the author discusses the evolution of creating social value within organisations, focusing on the role of organisations in society and their relationships with their environments.

## 2. Methods

This conceptual article uses a critical literature review to explore various theories and views on creating social value within organisations. The author began the literature analysis by searching well-recognised scientific databases, such as Web of Science, Scopus, ScienceDirect,



Wiley Online Library, and Google Scholar (primarily for Polish-language literature). The searches included keywords like “social value creation”, “social value”, and “social impact”, as well as their Polish equivalents: “kreowanie wartości społecznej”, “wartość społeczna” and “wpływ społeczny”. Following the initial search, a preliminary selection of articles was conducted based on titles, abstracts, and keywords, eliminating those deemed irrelevant.

Given the significant confusion surrounding the concept of social value within organisations and the diverse approaches researchers took, it was more effective to follow references to social value and the bibliographies in the articles from the initial search. A thorough analysis of these texts and their references led to the identification of additional articles that offered valuable insights into social value in organisations and its evolution in academic literature. Due to the conceptual nature of this article and the diverse and evolving nature of theories on social value creation, a critical review, in this case, was deemed more appropriate than a systematic review. This approach enables a deeper analysis of key works, focusing on how perspectives have evolved rather than listing all studies on the topic.

The analysis focused on identifying, comparing, and synthesising different approaches to social value creation. The main goal was to highlight the similarities and differences in existing views on social value and to identify changes in organisations’ approach to creating it. Showcasing this evolution serves as a basis for discussing the future of social value creation in organisations and the potential changes in corporate social responsibility strategies to achieve a more significant social impact.

### **3. The rising interest in the social value concept**

Regarding creating social value, the most common and explored concept in management theory is probably Creating Shared Value (CSV), proposed by Porter and Kramer (Porter, Kramer, 2006, 2011). Alongside it, and somewhat in opposition to it, Integrated Value Creation (IVC), presented by Visser (Visser, 2015, 2017, 2018), has also provided an interesting discussion. Both concepts combine economic and social goals and explore ways to maximise them. However, they represent entirely different approaches to the social responsibility of organisations and motivations for creating non-economic value. Comparing them provides a basis for analysing various approaches to creating social value in organisations.

Before analysing these concepts, it is worth emphasising that the idea of mixed, shared, or common value, or generally expanding the value creation in enterprises beyond economic values, appeared much earlier and was described by many authors (e.g., Hart, 2003; Elkington, 1994, 1998). In this article, the analysis of literature on creating social value began with books and papers from the turn of the 20th and 21st centuries because in the last twenty-some years,

the topic of social value – especially that created by enterprises – has gained popularity, both in literature and in business practices (Visser, Kymal, 2015). This is due, among other factors, to increasing pressure to report social and environmental practices introduced by enterprises. These pressures come from various stakeholders – state and international bodies, which tighten regulations concerning, among others, pollution emissions, resource utilisation, or transparency; investors who want to know if companies positioning themselves as responsible are indeed so; and society, which demands that organisations – both non-profit and for-profit – demonstrate effectiveness in solving social problems or at least addressing them in some way.

The idea of creating non-economic value in enterprises in the academic literature is also strongly connected with stakeholder theory, which brought more significance to the various groups of stakeholders outside of those who prioritise economic value creation. Freeman proposed stakeholder theory in the 1980s as an alternative to the neoclassical approach to the purpose of the business, which was mainly to maximise profits (Visser, 2017). It puts a much bigger focus on creating social value, as it forces to analyse organisational practices from the perspective of multiple parties: not only shareholders but also a broad spectrum of stakeholders such as local communities, NGOs, employees and their families (Freeman, Mcvea, 2001). A stakeholder approach highlights the role of relationships with the environment. It shows that caring about stakeholders and being open to cooperating with them may offer organisations a more sustainable path than blindly maximising profits at all costs (Hall et al., 2015). With that, it provides greater space for creating social value alongside economic value, which was the priority in a neoclassical approach.

An additional context for the popularisation of the idea of creating social value in organisations is the growing social awareness of crises, the solution of which requires the involvement of various entities, not only those from the public sector. A prime example is the climate crisis and environmental problems in general (Stead, Stead, 2019). It is worth noting that in the face of such a major environmental crisis, ecological and social values become almost synonymous, and environmental protection can be seen as an action for the benefit of society, especially when it comes to building societal awareness and engagement in pro-environmental actions. This interconnection is noticeable in all the concepts presented in following parts of this article. Therefore, in this text, the author will use the term "social value" to encompass both social and ecological values created within organisations.

#### 4. Problems with defining and measuring social value

Integrating social and environmental considerations into the strategies for creating social value within organisations is just one of the many complexities associated with the concept of social value. Depending on the needs or focus areas of the authors discussing this topic, social value in academic literature is described differently, and even more often, it is not explicitly defined at all. As a result, it becomes a very fluid and broad concept, and, according to the author, it functions more as a concept or idea rather than a clearly defined term. According to Mulgan, although a universally accepted definition of social value does not exist, it can be said that “it refers to wider non-financial impacts of programmes, organisations and interventions, including the wellbeing of individuals and communities, social capital and the environment. These are typically described as „soft“ outcomes, mainly because they are difficult to quantify and measure” (Mulgan, 2010, p. 1). Social value in literature is also closely related to social impact, which seems equally challenging to define. Some authors understand social value as the same notion as social impact, while some describe social impact as the result of creating social value. Nevertheless, social impact can be described as “beneficial outcomes resulting from prosocial behavior that are enjoyed by the intended targets of that behavior and/or by the broader community of individuals, organisations, and/or environments” (Rawhouser et al., 2019, p. 2). A broader definition was proposed by Burdge and Vanclay, who described the social impact as all social and cultural consequences resulting from public or private actions that alter the way people live, work, spend their leisure time, form relationships, and organise themselves to meet their needs (Burdge, Vanclay, 1995, p. 59).

The main reason that defining social value or social impact is challenging is how much more complex it is to measure it, especially compared to economic value. However, even though it is more problematic, this does not mean that social value cannot be measured and shown in numbers. One example of a tool for doing this is social return on investment or SROI. It is described as a "tool for analysing the mechanisms of the creation and duration of an organisation's impact on society, the environment, and the economy, measuring the value of this impact, and reporting it" (Forum Odpowiedzialnego Biznesu, 2012, p. 39). The SROI ratio is the ratio of investment in a project to the benefits that society has gained from it (Forum Odpowiedzialnego Biznesu, 2012). This is useful for enterprises for several reasons, such as showing an increase in the effectiveness of their CSR programs in social reports or upping their attractiveness to investors. Another tool that helps to measure social value and quantify it is, for example, Cost-Benefit Analysis (CBA) (Robb et al., 2024).

There are also many qualitative beneficiary-focused methods of measuring social value created by organisations. Examples are case studies, history collection, focus groups, and satisfaction surveys among beneficiaries (Snarska, 2018). Due to the need for data collection and analysis, these methods can be very time-consuming and costly. However,

they allow for an in-depth examination of the effects of actions aimed at creating social value, which helps evaluate a given project and improve the effectiveness of future activities. They can also support analysing the process of generating social value and how beneficiaries perceive it.

It is also worth mentioning experimental methods for measuring social value, which, although they are the most challenging and often the most costly to implement, provide the most certainty in accurately measuring the social impact of a given action. These methods include observing beneficiaries by external specialists, conducting studies using control groups, repeated standardised tests, and the difference-in-differences method (Kroeger, Weber, 2014; Snarska, 2018).

There are many tools for measuring social impact in both academic literature and organisational practices. The problem is that it is impossible to indicate the one that is suitable for every kind of social value created as it can be very diverse (from improving clean water access to changing beliefs and behaviours) and enabling comparisons between very different types of social value creation (from singular CSR actions to complicated and long-term social programmes). Due to these problems and many more, the literature on tools for measuring social value is often divergent and fragmented (Perrini et al., 2020). Another reason for such a situation is the trouble with the constant evolution of social value perception, which will be described in the following sections.

## **5. Sustainable value, blended value and triple-bottom-line concepts**

The analysis of the concept of social value should start with Hart, who, in his article from 1997, emphasised that for businesses to effectively contribute to solving environmental problems, they must consider the Earth as the context in which they operate (Hart, 1997), rather than just their business environment. This allows them to operate in a way that extends beyond the organisation's boundaries and economic success and also includes actions towards sustainable development. He identified three key groups of such actions: pollution prevention (minimising or eliminating waste before it is created), product stewardship (minimising pollution at every stage of the product life cycle), and clean technologies (Hart, 1997). These actions were to be carried out in line with the fourth element, the vision of sustainable development, which every company wishing to have a positive impact on the environment should have. This formed the basis for the concept presented in Hart's and Milstein's article from 2003. Hart and Milstein proposed a definition of a sustainable enterprise: *A sustainable enterprise is one that contributes to sustainable development by delivering simultaneously economic, social, and environmental benefits—the so-called triple bottom line* (Hart, Milstein, 2003, p. 1). They also introduced the concept of sustainable value, comprising the elements

mentioned in the previous article: pollution prevention, product stewardship at every stage of its life cycle, clean technologies, and the vision of sustainable development. They added that companies can create value in various ways: by reducing resource consumption and pollution, operating more transparently and responding to the needs of civil society, developing technologies that can positively impact the natural environment, and meeting the needs of the poorest individuals through inclusive wealth creation and redistribution (Hart, Milstein, 2003). The authors emphasised that implementing these actions and creating sustainable value leads to increasing economic value (which they defined as shareholder wealth) and promoting more sustainable development worldwide. This is achieved by effectively utilising opportunities opened up by these actions, such as reducing production costs resulting from resource conservation or entering new markets by creating products for poorer customer groups (Hart, Milstein, 2003).

Emerson presented a different approach to corporate value in his article from 2003. He introduced the concept of blended value (Emerson, 2003). This was his response to the needs of investors who, for various reasons, wanted to invest in businesses that, in addition to economic success, demonstrated a responsible approach to the environment. He wanted to create an indicator that would simultaneously assess how a company performs regarding economic, social, and environmental development. The author defined blended value as combining the maximisation of social, environmental, and economic value within a single enterprise. He emphasised that blended value can be applied to both for-profit and non-profit organisations (Emerson, 2003), as in both cases, reporting on value creation in these three areas is not only possible but also necessary.

Similar motivations for introducing a concept that goes beyond a company's economic value to Emerson's had Elkington. At the end of the 20th century, he proposed the Triple Bottom Line (TBL), a now well-known concept in organisational social responsibility. He also assumed that creating social and environmental values could be reported similarly to creating economic value (Elkington, 1994, 1998). Elkington later added the widely popular "3P" to the triple bottom line concept, an abbreviation for people, planet, and profit. This notion captures the three components of the triple bottom line in another, easier-to-remember way. In his book from 2004, Elkington defined TBL as a concept that boils down to businesses focusing not only on generating economic value but also on the social and environmental value they create or destroy (Elkington, 2004). He is one of the few authors who mention the "destruction" of social value - usually, it is only discussed in terms of its creation and treated as an added value rather than something that can be both positive and negative.

## 6. Creating Shared Value (CSV)

The concept of Creating Shared Value (CSV) was proposed in 2006 by Porter and Kramer in their widely cited article "Strategy and Society". They described it as actions that benefit society significantly and are valuable for business (Porter, Kramer, 2006). They emphasised that environmental action can be strategic, giving the company a competitive advantage. The authors provided a more concrete definition of CSV in their 2011 article. They described Creating Shared Value as *policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates. Shared value creation focuses on identifying and expanding the connections between societal and economic progress* (Porter, Kramer, 2011, p. 2). It is worth mentioning that this concept was born from criticism of Corporate Social Responsibility (CSR) and was intended to replace it and bring a more effective approach to creating value for businesses and society (Urbanowska-Sojkin, Weinert, 2016; Wójcik, 2016). Porter and Kramer criticised mainly responsive, non-strategic CSR actions, which were often used to improve the organisation's reputation without bringing significant social or economic value. They also pointed out the excessive focus of business on meeting the needs of various stakeholders, which did not bring long-term and measurable positive effects, either to society or to businesses (Porter, Kramer, 2006). They saw the reason for CSR ineffectiveness in the fact that this concept was based on opposing the needs of society and business, thereby placing economic and social value on opposite sides. They also disagreed with the notion, derived from articles on corporate social responsibility, that creating social value must be accompanied by limiting or slowing down economic success. In opposition to this, they based their concept of creating shared value not on the differences and oppositions between society and business but on their mutual penetration and interdependence. They argued that *the mutual dependence of corporations and society implies that both business decisions and social policies must follow the principle of shared value* (Porter, Kramer, 2006, p. 9).

In their consideration of creating shared value, the authors emphasise the superiority of economic goals over social ones. Their 2011 article highlighted that *shared value is not social responsibility, philanthropy, or even sustainability, but a new way to achieve economic success* (Porter, Kramer, 2011, p. 2). This is not surprising - Porter's scientific work is deeply rooted in the positioning school, so naturally, competitive advantage became the guiding principle of creating shared value. On the other hand, as an excellent example of CSV, the authors mention social enterprises (Porter, Kramer, 2011). However, for typical for-profit organisations, creating economic value seems to be the primary goal in the concept of CSV, with social value being more of a positive external effect of the company's activities aimed at building a competitive advantage.

On the other hand, claiming that the concept of creating shared value involves "exploiting" social issues to enhance competitive advantage would be a mistake. Porter and Kramer clearly emphasise that businesses should focus on social issues where there is a genuine opportunity to create shared value – contributing to improving social welfare. The authors have identified which social issues businesses should address to maximise shared value, noting that *no business can solve all of society's problems or bear the cost of doing so. Instead, each company must select issues that intersect with its particular business. Other social agendas are best left to those companies in other industries, NGOs, or government institutions that are better positioned to address them* (Porter, Kramer, 2006, p. 10). They have identified three categories of social issues that help analyse business actions from this perspective: generic social issues, which are essential to society but do not affect the competitiveness of the company in the long term; value chain social impacts and social dimensions of competitive context (Porter, Kramer, 2006).

Creating shared value has a solid place in management literature, but there is quite a lot of criticism around Porter and Kramer's concept (Menghwar, Daood, 2021). Some consider it a repetition of other ideas within CSR literature and not a very original notion, as the idea of creating both social and economic value was already used and described in the corporate social responsibility concept (Aakhus, Bzdak, 2012; Camarena et al., 2016; Crane et al., 2014, Menghwar, Daood, 2021). The authors' approach to philanthropy and sustainability was also criticised, as Porter and Kramer highlighted that creating shared value has to benefit the business – when in reality, sustainability and philanthropic projects do not always fulfil this condition (Aakhus, Bzdak, 2012). As Aakhus and Bzdak wrote in their article from 2012, *It may be that Porter and Kramer's emphasis on finding the business and social value sweet spots leads to blind spots about what societies value* (Aakhus, Bzdak, 2012, p. 237). In other words, CSV seems to be a concept that is primarily beneficial to business and then only to specific easy-to-take-care social issues and *does not provide guidance for the many situations where social and economic outcomes will not be aligned for all stakeholders* (Crane et al., 2014, p. 10). This leads to another area of CSV criticism – how business-centric this approach is and how superficial it can be because the authors focus more on encouraging to look for a win-win project rather than changing the processes in the company for more responsibility and sustainability (Crane et al., 2014; Menghwar, Daood, 2021; Stead, Stead, 2019).

## 7. Integrated Value Creation (IVC)

Creating shared value (CSV) became one of the pillars of Wayne Visser's concept of integrated value creation. Visser, known primarily for introducing the concept of CSR 1.0 and CSR 2.0 and describing the phases of corporate social responsibility development, proposed

the concept, which combines corporate social responsibility, sustainable development, and Porter and Kramer's creating shared value while also extending earlier ideas of social value creation – sustainable value, blended value, value for shareholders and other stakeholders (Visser, 2018). The author defined IVC as *a methodology for turning the proliferation of societal aspirations and stakeholder expectations into a credible corporate response, without undermining the viability of the business* (Visser, Kymal, 2015, p. 12).

In this definition, we can see that responding to stakeholder expectations is necessary. Meanwhile, in the CSV concept, these expectations are shown as something that can be an indicator for the company but should not dictate its decisions (Porter, Kramer, 2006). IVC, on the other hand, emphasises the integration of business with its environment, as Visser created this concept based on the need to reverse the process of societal disintegration and fragmentation, namely the separation between the economy, society, and the natural environment (Visser, 2017). This may be the most significant advantage of IVC over the CSV, as CSV was criticised because of its very business-centric approach. As Crane, Palazzo, Spence and Matten wrote in their critique of CVS: *Societal responsibility in a broader sense would rather manifest in industry-wide solutions and multi-stakeholder initiatives where corporations would perceive themselves as a stakeholder of the problem rather than as the center of a stakeholder network* (Crane et al., 2014, p. 18). The integrated value creation concept includes this approach of looking at the company as one of the “neighbours” to the stakeholders, rather than treating the company’s environment as something to use to its advantage.

Visser emphasises the importance of a strategy in IVC, highlighting that this strategic approach has to regard both creating social and economic value. The author also stresses that creating integrated value should be present in all company processes. *IVC helps a company to integrate its response to stakeholder expectations (using materiality analysis) through its management systems (using best governance practices) and value chain linkages (using life cycle thinking). This integration is applied across critical processes in the business, such as governance and strategic planning, product/service development and delivery, and supply and customer chain management* (Visser, Kymal, 2015, p. 4). The author proposed a 7-step integrated value creation process, which was intended to help implement strategic and effective actions. It includes steps the company must take to generate this value in every aspect of its operations. The IVC implementation process consists of context analysis, stakeholder assessment, leadership review, risk assessment, breakthrough analysis, process redesign, and system integration.



## 8. Comparison of Creating Shared Value and Integrated Value Creation

The concept of creating shared value proposed by Porter and Kramer and Visser's concept of integrated value creation share many similarities. First and foremost, both assume that organisations can simultaneously create social and economic value. Secondly, both are based on the assumption that society, the economy, and the natural environment are interconnected, and creating benefits in these areas should not be mutually exclusive. Thirdly, both concepts assume that a strategic approach to creating value maximises social and economic goals. Fourthly, the authors of both concepts suggest starting value creation with an analysis of the environment and context in which they operate, emphasising that this will make organisational actions more effective in both the social and economic dimensions. Both concepts also involve leveraging synergies by smartly utilising the environment and building partnerships with other organisations or stakeholders.

However, these concepts have many differences, as does the authors' approach to creating social value. The table below (Tab. 1) presents these differences.

**Table 1.**

*The differences between creating shared value and integrated value creation*

	<b>Creating shared value (CSV)</b>	<b>Integrated value creation (IVC)</b>
The foundation of the concept	A narrower concept than IVC, intended to be an alternative to corporate social responsibility. Grounded in building competitive advantage and generating greater economic value.	A holistic concept encompasses the principles of CSV and previous value concepts, such as blended or sustainable value. Grounded in corporate social responsibility and sustainable development.
The purpose of introducing the concept	Improving the image of companies and business practices in the eyes of society.	Improving ethical, social, and environmental conditions worldwide.
Approach to the environment	Utilising the environment and partnerships to maximise economic and social value. Listening to stakeholders but limiting their impact on decisions made within the organisation.	Analysing the environment to identify societal disintegration and seeking solutions that enable the creation of social value while simultaneously increasing the organisation's economic value. Commitment to listening to stakeholders and meeting their needs.
Approach to the social issues	Addressing social issues related to the organisation in a way that maximises the creation of both economic and social value. Focusing on seeking mutual benefits and interests for both society and business.	Addressing social issues is a goal in itself, pursued in a manner that does not compromise the profitability and security of the organisation. Embedding the organisation within a social and environmental context.
Ways of creating social value	<i>Companies can create economic value by creating societal value. There are three distinct ways to do this: by reconceiving products and markets, redefining productivity in the value chain, and building supportive industry clusters at the company's locations</i> (Porter, Kramer, 2011, p. 4).	<i>IVC helps a company to integrate its response to stakeholder expectations (using materiality analysis) through its management systems (using best governance practices) and value chain linkages (using life cycle thinking). This integration is applied across critical processes in the business, such as governance and strategic planning, product/service development and delivery, and supply and customer chain management</i> (Visser, Kymal, 2015, p. 4).

Note. Author's self-elaboration based on Porter, Kramer (2006, 2011), Visser (2011, 2015, 2017, 2018), Nashchekina et al., 2020, and Wójcik, 2016.

## 9. Results

The literature's analysis of the concept of social value and its evolution over time allows us to draw the following conclusions about creating social value within organisations.

First, the approach organisations take towards social value has evolved. Analysing the concepts outlined above, one can observe that the significance of social value has been steadily increasing. The initial concepts, such as the triple bottom line or sustainable value, were primarily developed based on the needs of investors, thus being firmly focused on generating maximum economic value. These concepts essentially expanded the notion of corporate value by adding new elements that could enhance the attractiveness of these organisations to investors. They demonstrated that the pressure for greater focus on social value originated externally and was closely tied to the organisation's economic success. Creating shared value (CSV) also heavily leveraged social value to achieve economic benefits. However, the authors emphasised generating such value within the organisation and considered creating social value as part of their strategy, not only as a nod to the investors. Visser's concept of integrated value creation (IVC), in turn, allowed social value to take on a significant role not only in the organisation's strategy but also, to some extent, become part of its purpose. Thus, as social value's importance increased, its role and significance within organisations changed. The motivations of companies also evolved—from using social value creation for self-interest to making social value creation as important as economic success.

This leads to the second conclusion. Social and economic values are often closely interlinked and influence each other (Kroeger, Weber, 2014). So, a fundamental issue with all social value and corporate social responsibility (CSR) concepts is the difficulty of distinguishing between focusing primarily on business benefits and a more social orientation. One of the problems here is that economic goals are relatively easy to measure - they can be quantified, and progress can be assessed. In contrast, a company's commitment to addressing social issues is more challenging when quantifying, particularly when such efforts are not directly tied to the company's core operations (Nashchekina et al., 2020). This makes it challenging to determine definitively, even when discussing theories of CSR and social value creation, which are more oriented toward business benefits and which lean more toward social benefits. Głowacki also notes that the primary challenge in defining social value is precisely separating social and economic outcomes (Głowacki, 2010).

This leads to the third conclusion—it is nearly impossible to identify a single, cohesive definition of social value. Depending on the focus and needs of the authors discussing the topic, it is described differently and often lacks a concrete definition. As a result, social value becomes a fluid and broad concept, functioning more as an idea than a clearly defined term. Due to a certain elusiveness in defining social value in a straightforward manner that researchers widely accept, it can be compared to the issue of corporate social responsibility (CSR),

with which it is closely intertwined. Beschorner and Hajduk (2017) describe it interestingly in their article: *CSR is the conceptual bracket for the discourse on and practice of corporate responsibility. As such, the notion is subject to (historical) change in the same way as other basic terms like “freedom”, “democracy” or “public” and necessitates constant (re)definition by discourse. CSR is less about one specific understanding or definition, but rather about a reflection on different ideas and visions of corporate responsibility as well as empirical practices* (Beschorner, Hajduk, 2017). Unlike social value, it is possible to identify several definitions of CSR, including those shaping regulations around corporate responsibility. However, both concepts can be understood very differently depending on the chosen perspective (e.g., stakeholder group), purpose (e.g., measuring the outcomes of a particular action or implementing holistic organisational changes), changing market conditions (e.g., consumer pressure for corporate involvement in addressing a specific social issue), or social trends. It is evident in the analysis of the evolution of the social value concept presented above – as each author has a different vision of creating social value within organisations depending on their scientific background, their perspective on the role of organisations in society, and the importance they give to the idea of corporate social responsibility. In summary, the understanding of both CSR and social value evolves based on what different stakeholders—ranging from employees to customers, the broader society, and state bodies—prioritise at a given time.

As mentioned in the article, the notion of social value and social impact is quite broad. Ashoka's introduction of levels of impact represents this well as it shows how we can understand the organisation's social impact on different scales. The organisation proposed four levels of impact: direct service, scaled direct service, system change, and framework change (Ashoka, n.d., 2022; Snarska, 2018). Direct service is based on working with people who need direct support, such as food or legal help. It has a concrete feedback loop – you give beneficiaries something and can see them benefit immediately. Scaled direct services are efficient, well-organised solutions that benefit many individuals and societies. The third level is systems change, so introducing a new model that addresses the root cause of a problem, such as micro-credit in poorer communities. Next, we have framework change, which impacts people's beliefs, mindsets and behaviours (Ashoka website: 4 Levels Of Impact, Rethinking the Impact Spectrum; Snarska, 2018).

By focusing on creating social value alongside economic value, organisations can have a positive impact on several things, from addressing society's very concrete needs - such as hunger, poverty, and a lack of a sense of safety - to changing the frameworks in which society operates - by changing attitudes and behaviours towards specific social issues such as climate crisis or diversity and inclusion. It shows how organisations can create social value and explains why finding the concise and commonly accepted definition of social value or social impact is so problematic. Additionally, it leaves much space for organisations to evolve in terms of creating a positive impact on their social and ecological environment.

## 10. Discussion

When we look at the social value concepts presented in this article, we can see their evolution and the change in the authors' approach to the companies' role in creating values outside of maximising economic goals. The evolution is evident in the shift from simply wanting to help investors in choosing the more responsible companies (blended value and triple bottom line) and locking the social value in numbers by using it as a way to increase competitive advantage and restore society's respect for business (Porter's and Kramer's concept of creating shared value) to wanting to have a positive impact on society and the environment, which company is a part of (Visser's concept of integrated value creation). The evolution of companies' scale and methods of creating social value is ongoing. In the authors' opinion, it will go toward expanding the definition of social value and focusing more on organisations' impact on their closest stakeholders: employees, business partners and communities around them. Companies may increasingly focus on the fourth level of impact presented by Ashoka - framework change - which involves changing attitudes and behaviours toward social and ecological issues. Organisations may shift from solely creating social value externally to fostering it internally, empowering employees to contribute to positive change during working hours. This transition would enhance the authenticity of the organisation's social initiatives as employees and closely connected stakeholders become more aware and engaged in the social value creation process. Engaged stakeholders can actively drive positive change and amplify its impact through collaboration with the organisation. This can be accomplished by educating employees and business partners about the social issues the company aims to address and providing them with the resources and opportunities to take action. For instance, inviting them to discuss planned CSR programmes or encouraging participation in local social initiatives. To conclude, as companies continue to evolve in their scale and methods of creating social value, it becomes increasingly clear that organisations play a crucial role in promoting a socially responsible culture that benefits both their stakeholders and society as a whole.

## 11. Summary

This article traces the evolution of organisational perspectives on social value, emphasising the shift from profit-centric approaches to more holistic frameworks that integrate social and environmental concerns. It highlights how the importance of social values has changed over time, both within and outside organisations.

The concepts of Creating Shared Value (CSV) by Porter and Kramer and Integrated Value Creation (IVC) by Visser were compared, revealing similarities and differences in their approaches to creating social value and the ideas surrounding corporate social responsibility (CSR). While both concepts aim to integrate economic and social goals, CSV focuses more on enhancing competitiveness and achieving economic objectives while simultaneously creating social value. In contrast, IVC adopts a more holistic approach grounded in strategic CSR and sustainable development, prioritising social value in all organisational operations. However, it remains challenging to establish clear boundaries between business-oriented and socially-oriented approaches to social value creation, particularly given the complexities involved in measuring social and economic values. Economic outcomes are quantifiable and easier to represent numerically, whereas assessing social impact is considerably more complex. This comparison and introduction of the earlier concepts, such as blended value, sustainable value and triple bottom line, showed that social value can be understood differently in every organisation and that organisations can have different motives for creating it.

By delving into the complexities of social value creation, the article contributes to ongoing discussions on the evolving role of social value in organisational activities. At the end of the article, by presenting levels of impact and the idea of creating less tangible social value (a change in mindsets and behaviours), the author proved that the approach to social value in management studies is still evolving.

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## AUTOMATION OF GRANT APPLICATION WRITING WITH THE USE OF CHATGPT

Krzysztof RYBIŃSKI

Department of Business and International Relations, Vistula University, Warsaw, Poland;  
k.rybinski@vistula.edu.pl, ORCID: 0000-0002-4604-7993  
European Humanities University, Vilnius, Lithuania

**Purpose:** This paper examines the integration of generative AI, specifically ChatGPT, into grant application writing, evaluating its impact on efficiency, quality, and equity in research funding. The study aims to address systemic challenges in grant writing, such as high time investment, low success rates, and inherent biases against underrepresented groups.

**Design/methodology/approach:** The research analyzes the development and submission of four grant proposals to public and private funding bodies in the U.S. and EU. ChatGPT was employed to automate key components of the process, including generating proposal structures, drafting content, and formatting team qualifications. The outcomes were compared in terms of time efficiency, success rates, and the quality of applications.

**Findings:** The use of ChatGPT reduced the average grant preparation time from 30-50 days to 3-5 days while achieving a 50% success rate, significantly exceeding typical success rates of 10-20%. The findings highlight ChatGPT's potential to enhance the inclusivity of funding processes by mitigating biases and lowering entry barriers for junior faculty and underrepresented groups.

**Research limitations/implications:** The study is limited by the small sample size of four grant applications and the inherent variability of AI-generated outputs. Future research should explore scalability, reproducibility, and the ethical implications of AI use in academic and professional settings.

**Practical implications:** The adoption of AI in grant writing can streamline the application process, allowing researchers to focus on substantive project development. Funding bodies are encouraged to adapt evaluation standards to distinguish between human-authored and AI-generated content, ensuring fair assessments.

**Social implications:** By reducing biases and increasing accessibility, AI-driven grant writing can democratize research funding opportunities, fostering greater equity and diversity in academic and scientific communities.

**Originality/value:** This study provides the first empirical evaluation of ChatGPT's application in grant writing, offering insights into its transformative potential for academia, policy, and research funding practices. It is valuable to researchers, funding organizations, and policymakers seeking to leverage AI for more inclusive and efficient grant processes.

**Keywords:** generative AI, ChatGPT, grant writing automation, policy guidelines.

**Category of the paper:** research paper.

## 1. Introduction

This paper embarks on an exploration of a novel question within the realms of research funding and the broader missions of academic and civil society organizations. It examines the transformative impact of generative artificial intelligence (AI) and Large Language Models (LLMs) on the grant writing process. This exploration is multifaceted, addressing several critical dimensions.

In our study, we meticulously investigate the broad impacts of generative AI on the grant application workflow, structuring our analysis around five critical research questions. Initially, we examine the influence of generative AI on the time necessary to compile a grant application, focusing on its capacity to streamline the preparation phase, thereby reducing required time and labor. This productivity-centric question seeks to elucidate the efficiency improvements attributable to AI implementation. Subsequently, we evaluate how generative AI affects the quality of grant proposals, probing whether these technologies can enhance the content and presentation of applications, and thus address the quality aspect of our exploration. Furthermore, we scrutinize the evolving skill set demands for project teams applying for grants in the era of generative AI, particularly the necessity for skilled prompt engineers in producing superior proposals, which could significantly alter the skill requirements for successful grant writing. Moreover, we investigate the segmentation of the grant application process that could be entirely automated versus those segments needing human intervention or supervision, aiming to pinpoint areas where AI can autonomously function and where human expertise remains irreplaceable. Finally, we consider the wider repercussions of generative AI's proliferating use on both the structuring of the grant application process and the criteria for grant evaluation, a policy-oriented inquiry that assesses the need for updating existing protocols to maintain equity and efficacy in grant distribution. These inquiries are intended to offer an exhaustive perspective on the transformative impact of generative AI within the grant application sphere.

Generative AI, including tools like ChatGPT and other LLMs, is revolutionizing productivity across various sectors by automating complex business processes (Abdullahi, 2023; Alavi, Westerman, 2023; Candelon et al., 2023; Advarhyu et al., 2023; Marr, 2023). The economic impact of generative AI is significant, with projections suggesting an annual addition of \$2.6 to \$4.4 trillion to the global economy sectors (Chui et al., 2023). It is anticipated to increase labor productivity by 14-40% depending on the skill level of the workforce (Savchuk, 2023; Sommers, 2023).

Studies by Noy and Zhang (2023) confirm these trends, showing that ChatGPT can significantly enhance productivity in writing tasks. The average time taken is reduced by 40%, and output quality is improved by 18%, while also decreasing inequality among workers. This suggests that generative AI can elevate the standard of grant proposals, intensifying competition for funding and complicating the task of discerning quality proposals for reviewers.

Generative AI is increasingly used in firms' innovation processes and offers the potential for more radical innovations (Roberts, Candi, 2024). ChatGPT and other LLMs are utilized in a wide spectrum of applications, from programming assistance to creative content generation in many areas: human resources, programming, social media, office automation, search engines, and education, which documents the potential of LLMs to revolutionise business processes and services (Chiarello et al., 2024). The identified growth areas for ChatGPT applications include educational support and skill development, workflow enhancement, information retrieval, natural language interaction and assistance, and content creation and ideation (Cong-Lem et al., 2024). A growing body of literature examines the various forms of human-computer interaction in generative AI applications, focusing on their role in simplifying tasks for humans, adapting to user feedback, and defining the user's position within the AI loop (Raees et al., 2024).

The academic literature provides ample evidence of generative AI's capacity to disrupt traditional processes, enhance productivity and improve organizational performance (Rana et al., 2024). For instance, Abdullahi (2023) and Alavi and Westerman (2023) highlight the broad applicability of generative AI in automating tasks that were previously thought to require human creativity. This suggests a paradigm shift in how work is conceptualized and executed. The findings of Noy and Zhang (2023) are particularly relevant, demonstrating that the integration of ChatGPT in writing tasks not only enhances efficiency but also improves the quality of outputs. This is a critical factor in the context of grant writing where the articulation of ideas and clarity of presentation are paramount.

Research, such as a study from the University of Montana led by Dr. Erik Guzik Shimek (2023), demonstrates the creative capabilities of generative AI. AI-generated grant applications score highly in fluency and originality, challenging the traditional view of AI as a tool for routine tasks. Further studies reveal that AI-generated innovations are often indistinguishable from those created by humans (Zhou et al., 2024), sometimes even perceived as more innovative (Stock-Homburg, 2023), but the evidence on AI being able to surpass human creativity is still mixed (Grassini, Koivisto, 2024). ChatGPT's ability to produce high-quality academic abstracts that can deceive experienced scientists (Else, 2023), assist students in crafting well-referenced essays (Stokel-Walker, 2022), and its adoption in audit processes by major firms (Goto, 2023), highlights its potential to significantly enhance efficiency and creativity in professional and academic settings. However, this raises important ethical questions and concerns about bias in AI-generated content.

The adoption of ChatGPT and similar generative AI tools in academic writing is on the rise, as evidenced by a review identifying 104 papers generated with such technologies, with a significant number of authors failing to disclose their use of AI (Jain, Jain, 2023). The expansion of generative AI in academia is expected to accelerate, driven by new tools that support a wide range of academic activities (Garrido-Merchan, 2023; Glickman, Zhang, 2024). This proliferation brings to the forefront critical ethical considerations, the potential for bias, and the importance of maintaining academic integrity (Birhane et al., 2023; Chemaya, Martin,

2024), highlighting the need for transparent methodologies and rigorous validation to ensure the reliability of AI-assisted academic outputs (Ganjavi et al., 2023; Morris, 2023). There is also a continuous dialogue within the academic literature regarding the governance of artificial intelligence, the velocity of AI adoption, its influence on work, and the prerequisites for data governance in the artificial intelligence epoch. (Goos and Savona, 2024).

While LLMs have proven useful in advancing scientific research and streamlining the academic writing process, their application in grant writing holds even greater potential. The automation of generic components in funding applications and the desire for LLM-powered tools to draft initial proposals underscore this potential (Morris, 2023). The interest in leveraging ChatGPT for automated grant writing is evident in the organization of highly rated seminars and educational initiatives targeting graduate students (Kurlinkus, 2023; Steel, Fariborzi, 2023). Despite this growing interest, empirical studies examining the impact of generative AI on the grant writing process, including its efficiency, quality, and success rates, are lacking. I aim to address this gap by providing a comprehensive analysis of four grant applications generated by ChatGPT.

The structure of this paper is as follows: Section 2 offers background information on this research, including a concise overview of the four ChatGPT-assisted grant applications. Section 3 details the research methodology and the extent to which the grant writing process relied on ChatGPT-generated content. Section 4 presents the outcomes for all four grant applications. Section 5 discusses these results in the context of the research questions introduced in this section. Finally, Section 6 concludes the paper, outlining future research directions in this emerging field.

## **2. Background**

In this pioneering study, I harnessed the capabilities of ChatGPT to craft four grant proposals, targeting funding opportunities from a diverse array of organizations: the Alfred P. Sloan Foundation and the National Endowment for Democracy (NED) in the United States (with two proposals directed here), alongside the Central Project Management Agency (CPMA), a Lithuanian entity tasked with the administration of projects financed by European Union and state funds. These proposals were designed to secure support for a variety of initiatives: the establishment of a specialized research and teaching lab at a university, a project aimed at bolstering civic society and human rights through innovative technology, and two proposals focused on groundbreaking sociological research to evaluate the impact of civic education.

I took the role of co-Principal Investigator in all four grant applications. My familiarity with the subjects of these proposals varied significantly, ranging from profound expertise, evidenced by numerous peer-reviewed publications, to a basic, non-expert level of understanding, and in one instance, minimal knowledge of the field. The funding sought in these applications spanned from \$50,000 to \$200,000, cumulatively approaching half a million dollars. The majority of the proposals represented the interests of a university, while one was submitted on behalf of a research center governed by NGO principles.

The composition of the project teams also varied, including both external experts, who contributed primarily through discussions and CV submissions, and internal staff from the university or center. All team members were briefed on the innovative approach of utilizing ChatGPT for the grant writing process and agreed to this methodology. Each team, in conjunction with their respective institution, fulfilled the formal criteria for grant eligibility.

As the sole author and submitter of these applications, I ventured into this process without prior experience in applying to the specified funding bodies. My background includes a mixed success rate in securing research and civil society funding, and a Google Scholar h-index of 14. The overarching aim was to generate high-caliber proposals that adhered to the grantors' guidelines and would ultimately be successful in securing funding. In anticipation of a favorable outcome, both the institutions and the expert teams were prepared to undertake the projects, equipped with the necessary skills and experience for effective and timely execution.

Neither the university nor the research center had previously engaged in these funding bodies' calls for grants, remaining unknown to the U.S. grantors. However, the university had benefited from CPMA's EU-financed technical assistance for institutional capacity building. The diverse nature of the applications—encompassing large and small institutions, internal and external team collaboration, funding from both private foundations and government agencies, and projects ranging from research-intensive endeavors to civic society initiatives with technological and research elements—provided a comprehensive test of ChatGPT's efficacy in generating grant proposals across various subjects, geographic locations, and funding requirements.

In a notable development, a one more project team was established at the university with the intention of submitting a grant application to the CPMA. This team also did not possess previous experience in applying for CPMA grants. Unlike in my case, this newly formed group did not utilize generative artificial intelligence to facilitate the application process. Despite fulfilling the formal prerequisites, the team was unsuccessful in submitting their application. This outcome suggests that the support provided by generative AI could be highly beneficial in the application process.

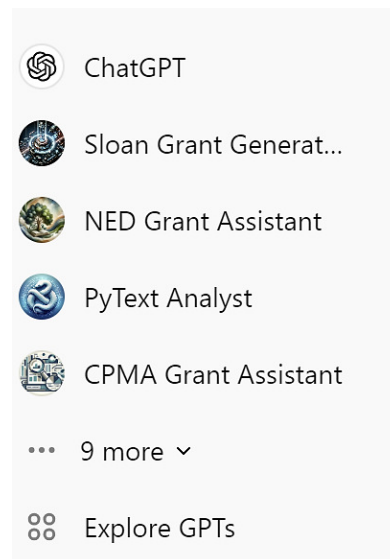
As outlined in Table 1, among four grant proposal two were accepted and two were rejected, with a success rate of 50%.

### 3. Methodology

This section delineates the methodology employed in the preparation of grant applications. Among the cases studied, three applications were crafted anew, while one was an iteration of a previous submission, adjusted in scope and geographical extent. A unified approach was adhered to across all instances, detailed as follows.

#### Setting up a generative AI assistant

For this study, a new instance of a generative AI assistant, specifically a ChatGPT-4 model, was configured with capabilities crucial for the task at hand. These included the ability to parse information from the Internet and both PDF and Word documents; generate text adhering to American English standards in three instances and British English in one, ensuring compliance with the linguistic preferences of the funding bodies; and craft text with a positive tone aimed at enhancing appeal to evaluators. Additionally, the assistant was programmed to accurately format references and to seek clarifications through follow-up queries if the initial prompts were ambiguous.



**Figure 1.** ChatGPT grant writing assistants (screenshot).

#### Data provision to the AI assistant

In each scenario, the AI assistant was furnished with two key documents: detailed grant application guidelines from the grantor's website, typically spanning 10-20 pages, and a concise project description. The latter varied, ranging from a brief 2-3-page overview crafted by the project team to a 23-page prior grant application produced by the ChatGPT assistant. Furthermore, CVs of project team members, varying in format and content, were provided. The assistant's task was to harmonize these CVs into a consistent format as per the grantor's stipulations, selecting information pertinent to the project's scope.

### **Prompting and text generation process**

The initial phase involved instructing the ChatGPT assistant to outline the application structure to align with the grant guidelines. Subsequently, it was tasked with generating distinct sections of the application. Upon assembling a complete draft, the assistant evaluated the coherence and adherence to guidelines, proposing modifications to enhance the application's persuasiveness. These recommendations were then reintegrated into the generation process to refine the application. In certain instances, the assistant affirmed the initial draft's compliance, negating the need for alterations.

It is important to note that each of the four cases in our study was different and required slightly different prompts. The overarching objective was not to derive a universal set of prompts but to investigate whether generative AI could produce high-quality research proposals within a notably short time frame. Although we cannot provide the exact unified prompts used, each step in Table 1 corresponded to a separate, case-specific prompt that was modified between proposals as needed. Furthermore, certain sections of each proposal required multiple iterations of prompt revision to achieve the desired detail or clarity. This approach allowed us to tailor the text generation process to each unique proposal context while maintaining a consistent methodological framework.

Notably, the text generation process was autonomous, with no manual alterations made to the AI-generated content. While some sections, such as those detailing project risk management or promoting gender equality, were proficiently crafted on the first attempt due to the availability of standardized guidelines online, other sections necessitated iterative refinement. This was particularly true for the standardization of CVs, where multiple iterations were sometimes required.

In the concluding phase, all requisite formal documents were collected, and the complete application package was submitted to the funding entity.

### **Leveraging a pre-existing proposal**

An integral component of this research was assessing the AI's capability to repurpose an existing grant application for a new submission, adhering to ethical guidelines. A 23-page PDF of the original application, alongside the grant guidelines, was uploaded to the AI assistant. The assistant was then provided with a succinct list of required modifications, which included narrowing the scope of grant activities, altering the geographical focus, and adjusting the anticipated outputs and outcomes to emphasize scholarly publications over policy impact. As elucidated in the Results section, the AI assistant adeptly navigated this task, yielding a proposal of commendable quality, approved by the funding entity.

This methodology showcases the potential of generative AI in streamlining the grant application process, highlighting the technology's adaptability to varying linguistic standards and its proficiency in enhancing the appeal of proposals to evaluators.

## Segmentation of grant application process into steps

In this study, I systematically quantified the duration required for each stage involved in generating a grant proposal using ChatGPT assistant. These stages encompassed the initial configuration of the GPT assistant, the uploading of grant guidelines, the input of brief project descriptions, the creation of a grant structure, the production of pertinent text for each section, the formulation of team curricula vitae in alignment with specified guidelines, the compilation and justification of the budget, the evaluation of the grant application's adherence to guidelines, the generation of any missing components, and the final verification and simulation of the grant application assessment process. Additionally, I scrutinized specific challenges encountered during each phase and elucidated the strategies employed to resolve these issues, providing a comprehensive overview of the process and its intricacies.

Although the preparation of an application can be segmented in various ways, I have proposed a distinct division that maximizes the capabilities of generative AI. This structured breakdown not only leverages the full potential of AI but also delineates which segments of the process can be fully automated versus those that necessitate human intervention or supervision, thereby optimizing the integration of technology and human expertise in the application preparation process.

## 4. Results

As outlined in the Introduction, this study explores five key facets of generative AI's influence on the grant application process: productivity, quality, project team skills, automation of the application writing process, and policy implications. The findings detailed in this section, and summarized in Table 1, delve into the initial four dimensions. Discussion of policy implications, in contrast, is reserved for the discussion section, where we contextualize our findings within the broader framework of evolving grant application standards and practices.

Averall the time needed for preparing the full application, not counting the time needed for collecting the formal documents, such as the applicant's audited financial report, varied from 14 to 20 hour of my work. The preparation process did not involve any other person. This time requirement also does not include the time spent by the project teams to prepare short project outline.

I generated four applications using ChatGPT, two were accepted and two were rejected by the grantors. From the Sloan Foundation I received a highly favorable evaluation with no requests for clarifications, amendments, or corrections. CPMA approved the proposal and the budget, with few minor clarification requests regarding the costs' classification and justification. NED rejected both proposals stating that with limited resources available, only a small number of the many proposals they receive could be approved.



I had only limited experience in working with ChatGPT, mostly concentrated on using the ChatGPT for generating the Python code for my research needs. Also, I have not utilized any publications that outline different prompting strategies. Therefore it can be concluded that the presented results in terms of productivity and quality cannot be achieved by a novice ChatGPT user, but neither they require the skills of the professional prompt engineer.

The following stages of the grant application writing have been fully automated: generation of the grant structure (with the exception of the CPMA grant, when the structure was imposed by the application portal), generating text for each section, generating teams qualifications based on the provided CVs, generating budget justification, assessment of draft compliance with the guidelines, generating the missing components, final application verification and simulation of grant application assessment, and generating the introductory letter.

The following stages require human input: preparing a short project outline, preparing the budget in Excel format and collecting the formal documents specified in the grant guidelines. It should be noted that in one case I used the existing grant application and provided bullet points with necessary modifications, so the process was partly automated. While there are many applications available for ChatGPT that can create nicely formatted Excel tables, it is still very difficult to automatically generate the appropriate budget table. Although I envisage that with ongoing rapid technology advancement soon it will be possible to generate the budget proposal based on the provided template, list of items (such as names of function and major cost items), while the generative AI will search Internet for specific cost estimates.

I encountered the following problems when generating the specific sections of the grant proposal. The generations of team members CVs in line with the grant outline requirements and highlighting experience and skills relevant for the project required several iterations, mostly since the actual CVs provided by the project team members were in different format. Also, in the case of the grant application where I had a very limited domain knowledge I relied much more on the ability of the GPT assistant to search the Internet for best practices in the area of civic education and human rights advocacy. This required more iterations than in the case of projects where I had significant expert knowledge.

The detailed results of the grant application generation process are documented in Table 1.

**Table 1.**

*Stages of the generation of four grant applications by the ChatGPT assistant, time needed and key observations.*

Grant writing stage	Grant 1 - Sloan		Grant 2 - NED		Grant 3 - NED		Grant 4 - CPMA	
	Comment	Time (hours)	Comment	Time (hours)	Comment	Time (hours)	Comment	Time (hours)
Initial GPT Assistant Configuration	The inaugural utilization of the GPT for generating grant applications necessitated an extended initialization period compared to subsequent instances. The configuration parameters were consistent with those applied in the other three scenarios.	1	Standard Functionalities Enabled: Included capabilities such as interpreting Word and PDF documents, conducting internet searches for best practices, and adapting to the language specifications mandated by the funding organization.	0.25	Standard Functionalities Enabled: Included capabilities such as interpreting Word and PDF documents, conducting internet searches for best practices, and adapting to the language specifications mandated by the funding organization.	0.25	Standard Functionalities Enabled: Included capabilities such as interpreting Word and PDF documents, conducting internet searches for best practices, and adapting to the language specifications mandated by the funding organization.	0.25
Upload Grant Guidelines	Grant guidelines uploaded as a 13-page PDF document.	0.1	Grant guidelines uploaded as an 8-page Microsoft Word document.	0.1	Grant guidelines uploaded as an 8-page Microsoft Word document.	0.1	Grant guidelines uploaded as a 26-page Microsoft Word document.	0.1
Upload Short Project Description.	A two-page project description including a general timeline was submitted.	0.1	A comprehensive three-page project description was submitted, detailing the theoretical components and delegating the creation of the implementation component to the GPT system.	0.1	The grant application was augmented with individual one-page descriptions for each of the three distinct activities, along with a general overview of the research center's activities that applied for the grant.	0.1	The second grant application, produced by GPT, was adapted by expanding the research component and curtailing the implementation section. Additionally, geographical coverage adjustments were made, resulting in the second and fourth grant applications being synergistic.	0.25

Cont. table 1.

Generate Grant Structure	Utilized GPT to construct a structured grant application in a Microsoft Word format, adhering to provided guidelines.	0.1	Employed GPT to formulate a structured grant application in a Microsoft Word format, in accordance with the specified guidelines.	0.1	Engaged GPT to develop a structured grant application in a Microsoft Word format, consistent with established guidelines.	0.1	The grant application, submitted through a specialized portal, conformed to a mandatory structure specified by the portal.	NA
Generate the Appropriate Text for Each Section.	Multiple iterations were necessary to generate the appropriate text for certain sections.	4	Multiple iterations were necessary to generate the appropriate text for certain sections.	6	Repeated iterations were needed for particular sections, with the text generation process involving verification by the project leader due to limited domain knowledge, resulting in a longer development time compared to other applications.	8	Numerous iterations were needed to produce text that complied with the character limits imposed by the application portal for each section. The complexity of the application, due to it being submitted to an organization distributing European Union funds, was significantly higher than that for applications to United States grantors.	10
Generate Synthesized Team Qualifications to Meet Specified Guidelines	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	1	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	0.75	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	0.75	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	0.75

	grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.		grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.		grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.		grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.	
Budget Compilation and Justification	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	4	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	5	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	6	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	4
Assessment of Draft Compliance with Guidelines	The draft grant application was uploaded to the GPT system, which was then tasked with evaluating the document to ensure its adherence to the guidelines and overall completeness.	0.25	The draft grant application was uploaded to the GPT system, which was then tasked with evaluating the document to ensure its adherence to the guidelines and overall completeness.	0.25	The draft grant application was uploaded to the GPT system, which was then tasked with evaluating the document to ensure its adherence to the guidelines and overall completeness.	0.25	In light of the application's submission through the portal, an alternate version was maintained in a Microsoft Word document. This draft was uploaded to GPT, which was then directed to confirm its thoroughness and compliance with the required standards.	0.5

Cont. table 1.

Ask GPT to Generate the Missing Components	GPT identified and supplemented missing components of the application, providing enhancements for certain elements.	2	GPT identified and supplemented missing components of the application, providing enhancements for certain elements.	2	GPT identified and supplemented missing components of the application, providing enhancements for certain elements.	3	GPT made suggestions to improve some components.	1.5
Final Verification and Simulation of Grant Application Assessment	GPT conducted the final assessment of the grant application, offering minor enhancements. Furthermore, GPT evaluated the proposal's quality, predicting a favorable outcome.	1	GPT conducted the final assessment of the grant application, offering minor enhancements. Furthermore, GPT evaluated the proposal's quality, predicting a favorable outcome.	1	GPT conducted the final assessment of the grant application, offering minor enhancements. Furthermore, GPT evaluated the proposal's quality, predicting a favorable outcome.	1	GPT performed the final evaluation of the grant application, providing minor suggestions for improvement. Utilizing the assessment criteria from the guidelines, GPT rated the application, which resulted in a highly favorable evaluation.	1.25
Generate Introductory Letter		0.1		0.1		0.1		0.1
<b>TOTAL hours</b>		<b>13.65</b>		<b>15.65</b>		<b>19.65</b>		<b>18.7</b>
Additional Tasks Not Supported by Generative AI (yet)	Two additional documents pertaining to the legal and financial status of the applicant were necessitated.	NA	Two additional documents pertaining to the legal and financial status of the applicant were necessitated.	NA	Two additional documents pertaining to the legal and financial status of the applicant were necessitated.	NA	Eleven additional documents concerning the legal and financial status of the applicant were necessitated.	NA
Requested Grant Amount	50,000 USD	NA	198,000 USD	NA	148,440 USD	NA	99,488 EUR	NA
Grant Application Outcome	The application was approved, receiving a highly favorable evaluation with no requests for clarifications, amendments, or corrections.	NA	The application was rejected, evaluation not available.	NA	The application was rejected, evaluation not available.	NA	The application was approved, minor corrections were requested regarding the classification of expenditures, the total requested budget was approved.	NA

## 5. Discussion

On average it takes 116 Principal Investigator (PI) hours and 55 Co-Investigator (CI) hours to write a grant proposal for federally funded research in the field of astronomy and psychology (von Hippel and von Hippel, 2015) and 38 days in medical research (Herbert et al., 2013). The success rate is in the range of 10 to 25 percent depending on the field (Herbert et al., 2013; Santoro, 2021; von Hippel, von Hippel, 2015). For EU-funded research, such as Horizon 2020, application success rates are around 15 percent (Schembri-Wismayer et al., 2018). Schweiger (2023) surveyed Austrian applicants from research and industry and found that preparing a new proposal takes about 50 working days. Moreover, more than 90% of researchers perceive that they currently spend too much time preparing proposals and only 10% of researchers believe that the current competitive funding system has a positive effect on the quality of research.

In the case of grant applications discussed in this paper the time needed to prepare a research idea in the form of a 2-3 pager was in the range of 2-4 days, accompanied by one or two meetings or Zoom conference calls. The actual generation of the grant application took between 14 and 20 hours. It means that the time needed for preparing a grant application from the ideation to submission stage was massively reduced, from around 30-50 days to 3-5 days. At the same time the success rate was 50 percent, well above average research grant application success rates reported in the literature.

The applying institutions, the team members and the PI had no prior experience of applying to the targeted funding organizations. The Principal Investigator's Google Scholar h-index is 14 and the PI has published 11 papers in Q1-Q3 refereed journals in the previous five years. It means that the experience and the track record of the applicant cannot be considered as very advantageous, and that funding organizations' decisions were based on the quality of generated applications.

It should be noted that the author of this paper and the co-PI in all four submitted applications has only limited experience in using generative AI, and has no formal training in prompt engineering. It means that even such limited generative AI experience is adequate for the effective use of ChatGPT functionality to create high quality grant proposals in a very short time. It is clear that generative AI applications are set to become more than tools, they have the potential to become valuable "members" of the project team (Bianchini et al., 2022).

The remainder of this section discusses the implications for the grant application procedures and standards as well as wider research funding policy implications. It also presents the limitations of the proposed research methodology.

## **Evolution of grant application standards – dealing with commoditized requirements**

Various sections of grant application can be easily generated within minutes with the help of LLM by a person that has very limited or no domain knowledge, i.e. can be “commoditized”. Examples of such sections in the four grant applications analyzed in this paper are<sup>1</sup>: abstract or summary of the project (H), background of the project (M), literature review (M), project evaluation methods and plan (M), dissemination strategy and communication plan (M), budget justification (M), other sources of support and sustainability of future funding (L), diversity, equity and inclusion plan (H), curricula formatting (H), applicant organization background and strength (M), stakeholder engagement plan (M), risk assessment and mitigation strategy (H).

As these sections are easy to generate in high quality with the help of LLMs, the marginal utility of these sections in the overall evaluation of the grant proposal will likely fall over time. At the same time evaluators will have to commit significant time and effort to read and assess these sections’ contribution to the overall quality of the grant proposal. Many researchers complain that evaluating long grant proposals eats into their valuable time that can be devoted to genuine research or teaching. This situation calls for a review of application standards adopted by funding organizations to orient the grant evaluation process on application sections that cannot be commoditized and reduce or fully eliminate the evaluation of parts that can be written by generative AI. Ideally the grant application should be split into parts, first that requires a human expert contribution and is related to the merits of the project, and second that includes commoditized parts. The first part would be evaluated by field experts, and the second part will be subject to formal evaluation by funding organization officers.

## **Guidelines for using generative AI for grant applications**

In order to streamline the formal evaluation of the second part, the funding organization could recommend the LLM that should be used to generate sections in this part of the application and even release the set of recommend prompts that should be used for generation of the second – commoditized - part of the application. This information could be a part of funding organization guidelines on the use of generative AI for preparing grant applications.

It should be noted that outright ban on the use of ChatGPT for grant application generation will be highly ineffective and is not recommended. However, while encouraging the use of generative AI for writing the second part of the grant application, the funding organization could explicitly ban the use of generative AI in preparing of the first part of the grant application, that describes the research idea, methodology, data used and expected products, outputs and outcomes of the proposed project. Tools such as ChatGPT could be used in this part only for correcting the language, which will be especially useful for English language non-native speakers. The grant application should be accompanied by a project team statement that the use

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<sup>1</sup> H denotes highly commoditized area, M – medium commoditized area, L – area with some potential for commoditization.

of generative AI in writing the first part of the application was limited to language correction only. However, the use of generative AI should be allowed or even encouraged when submitting interim or final reports related to received funding. Overall, the proposed principles would contribute to ensuring the integrity and originality of grant proposals and address ethical concerns related to generative AI in the grant writing process.

### **Creating a level playing field for junior faculty**

The grant success rate for junior faculty can be as low as 10 per cent (Freel et al., 2017) indicating that the path to financial independence is very long for early stage researchers. While mentorship initiatives (Bagaka's et al., 2015; Jackevicius et al., 2014; Spence et al., 2018) and dedicated funding programs for young faculty (Wang et al., 2018) address this problem to some extent, the above proposal to encourage the use of generative AI to write commoditized parts of grant applications would contribute to creating a level playing field for young scientist. They would spend less time and effort trying to write long grant proposals fulfilling all, often complicated and not directly related to their research field, formal requirements and could devote more time to work on their research ideas. It will create fair and equal opportunities for everyone involved, especially for researchers who are just starting out or might not have as much grant-writing experience or resources as others.

### **Implications of generative AI use for equity and access in grant funding opportunities.**

Because generative AI has no ethnicity, nationality or gender, these proposals should help in reducing the bias towards women and minorities in research funding and recognition, often reported in the literature (Lauer, Roychowdhury, 2021; Lerchenmueller, Sorenson, 2018; Zhou et al., 2024). Moreover, standardizing and commoditizing of these sections of the grant application would ensure, that the submitted applications do take into account requirements related to the diversity of project team members and project beneficiaries.

### **Grant application information sharing requirements**

It is recommended that with an appropriate time delay the funding organizations publish anonymized texts of grant applications, both those that received and did not receive funding. It would serve several purposes. Firstly, it would facilitate a greater transparency of the funding decision process. Secondly, scientists could learn from their own and their peers' past mistakes. Thirdly, LLMs could be fine-tuned using the grant applications data to provide better assistance for scientists when generating the second, commoditized, part of their future applications. Fourthly, such information-sharing standard would allow funding organization to learn from the experience of other funding organizations. Finally, availability of such data would encourage research on the efficiency of various funding schemes. This proposal also contributes to the ongoing discussion on the need to mandate sharing of user information in data-driven markets (Graef, Prüfer, 2021).



### **Insights into future workforce skill requirements and training needs for effective AI collaboration in grant writing**

The research underscores the rapid evolution of AI technologies and their application in grant writing, suggesting that adaptability and a commitment to continuous learning are essential for future grant writers (Meyer et al., 2023; Jain, Jain, 2023). Professionals will need to stay abreast of the latest AI advancements and understand how to apply these tools effectively within the grant writing process. The findings also indicate that AI can significantly reduce the time required for grant writing while potentially improving the quality of proposals (Glickman, Zhang, 2024; Lin, 2023). Future training should emphasize the strategic use of AI to enhance creativity and efficiency, teaching individuals how to leverage AI for brainstorming, drafting, and revising grant proposals. This includes understanding the strengths and limitations of AI and integrating human creativity with AI capabilities to produce innovative and compelling grant applications.

Reflecting on concerns highlighted in the literature, future workforce development must address ethical considerations and transparency in AI usage (Fui-Hoon Nah et al., 2023; Korinek, 2023). Training needs to cover the ethical implications of using AI, including issues around data privacy, intellectual property, and the potential for bias. Furthermore, individuals should be trained on the importance of transparently disclosing AI assistance in grant proposals to uphold integrity and trust in the scientific community.

Finally, the research suggests the importance of interdisciplinary collaboration in developing and applying AI tools for grant writing (Garrido-Merchan, 2023; Gozalo-Brizuela, Garrido-Merchán, 2023). Future training programs should, therefore, include developing skills for effective collaboration across disciplines, enabling grant writers to work alongside AI developers and subject matter experts, which extends the recommendations provided in Arnold et al. (2021). This collaborative approach ensures that AI tools are tailored to specific research contexts and that grant proposals are grounded in deep disciplinary knowledge.

### **Research limitations**

This research has several limitations. Despite efforts to include a diverse set of projects into the analysis (research-oriented projects and civic society development projects with research component, projects with and without use of innovative technology, using human-generated short project outlines and previously generated proposal and the input, US-based and EU-based grantors, state and private sector grantors, different geographies and scale) the sample consists of only four grant proposals. So it may be argued that the results (two applications approved, two applications rejected) depend on luck as much as on the quality of the generated proposals. Nonetheless, as it is the first such research in the literature, I consider that it still offers important insights into the role of the generative AI in grant application writing.

The second limitation, which is typical for all applications of the LLMs is related to a lack of the reproducibility of the research results. If I attempted to generate grant applications again, even using the same prompts, the generated text will be different. It is due to the very nature of the LLMs but also is related to the fact that new versions of these models are released often and even if one uses that same model, their creators continuously modify the rules of their use to ensure better functionality and quality, stronger adherence to the ethical standards and reduction of various biases. To some extent this problem can be mitigated by downloading pre-trained LLMs that are available as open source, for example from the huggingface.co platform. But it leads to another problem. To run such models one often needs an access to powerful GPUs, which are very expensive and are not available in most personal computer used by researchers. Instead, one can use paid cloud services provided by Microsoft, Google or AWS, but it requires that the project team includes a data engineer capable of setting up such compute environment. But it seems that this very hot area of applied research utilizing LLMs will have to struggle with the research non-reproducibility for a foreseeable time. In this respect LLMs closely mimic the human behavior. A human researcher would not be able to replicate his grant proposal word-for-word, if asked to do it after some time elapsed.

A further limitation of AI-generated proposals is the challenge of ensuring accurate and in-depth domain-specific content. While generative AI models can synthesize coherent and well-structured text, they may lack the nuanced subject-matter expertise necessary to convey advanced technical details or discipline-specific knowledge accurately. This shortfall often becomes evident in specialized grant applications requiring familiarity with cutting-edge research, intricate methodological frameworks, or context-specific legal and ethical considerations. AI systems can occasionally produce “hallucinations” or factual inaccuracies that appear plausible but are actually incorrect, underscoring the importance of expert review. Consequently, even when proposals are generated rapidly, they still require thorough validation by individuals who possess the relevant academic or professional background. Without such oversight, the risk of errors in AI-generated content - especially in highly specialized fields - can undermine the credibility and competitiveness of the proposal.

## **6. Conclusions and directions for further research**

In the evolving landscape of grant writing, particularly within the realms of federally funded research and EU projects like Horizon 2020, the investment of time and resources is substantial. Fully human-prepared grant application takes 30-50 days to complete, with success rates lingering around the 10-20% mark. This considerable effort, juxtaposed against the modest odds of securing funding, underscores a demanding and competitive environment.

Recent insights, however, reveal a paradigm shift facilitated by the integration of generative AI, specifically tools like ChatGPT, into the grant writing process. An innovative approach highlighted in this research showcases the potential to drastically reduce the time required for preparing grant applications to a mere 3-5 days. This reduction in preparation time does not come at the expense of application quality or success rates, suggesting a significant efficiency gain. The applications in question, submitted without prior experience with the targeted funding bodies and by teams led by a Principal Investigator with moderate academic track records, suggest that the quality of the application, rather than the reputation of the applicants, becomes the focal point in funding decisions. Among four submitted grant proposal two were accepted and two were rejected, with a success rate of 50 percent.

This shift is further underscored by the admission that the success in utilizing generative AI for grant proposal generation was achieved with limited experience in AI and without formal training in prompt engineering. It suggests that even a basic proficiency in generative AI tools can enable researchers to produce high-quality proposals efficiently. This democratization of the grant writing process may level the playing field, particularly for junior faculty and researchers from less represented demographics, potentially mitigating longstanding biases in funding allocations.

The implications of these findings extend beyond mere operational efficiencies. They invite a re-evaluation of grant application standards and the criteria for assessment by funding bodies. With generative AI capable of commoditizing sections of grant applications, there's a call for these organizations to differentiate between contributions that require human expertise and those amenable to automation. This bifurcation not only streamlines the evaluation process but also redirects the focus towards the innovative and substantive merits of proposed research projects.

Moreover, the strategic use of generative AI in grant writing posits a dual challenge and opportunity: maintaining the integrity and originality of research proposals while embracing the efficiencies AI offers. Recommendations for funding bodies to guide the ethical use of AI in grant writing, including transparent disclosures of AI assistance, reflect a balanced approach to integrating these technologies. This guidance ensures that while AI can assist in drafting and refining proposals, the core ideas and methodologies remain the product of human intellect and creativity.

The evolution of AI in grant writing also signals a shift in skill requirements for future researchers and grant writers. A commitment to continuous learning, adaptability, and an understanding of the ethical implications of AI use become paramount. Training programs will need to address these competencies, ensuring that professionals can effectively leverage AI tools in a manner that enhances, rather than undermines, the research funding landscape.

The integration of generative AI into the grant writing process represents a significant leap forward in efficiency and accessibility. By reducing the time and effort required to prepare competitive proposals, AI has the potential to democratize research funding, making it more accessible to a broader range of investigators. However, this technological advancement also necessitates a re-evaluation of application standards, ethical considerations, and the skills required for effective collaboration between humans and AI. As we move forward, the challenge will be to harness the potential of AI in a way that preserves the integrity of the scientific inquiry while opening up new avenues for innovation and discovery.

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## RISK CULTURE IN A FAMILY BUSINESS – MOVING TOWARDS SUSTAINABILITY?

Joanna SADKOWSKA<sup>1\*</sup>, Joanna M. MOCZYDŁOWSKA<sup>2</sup>, Krystyna LESZCZEWSKA<sup>3</sup>,  
Ewa STAWICKA<sup>4</sup>

<sup>1</sup> University of Gdansk; joanna.sadkowska@ug.edu.pl, ORCID: 0000-0002-6275-7071

<sup>2</sup> Bialystok University of Technology; j.moczydlowska@pb.edu.pl, ORCID: 0000-0003-1123-2555

<sup>3</sup> University of Lomza; kleszczewska@al.edu.pl, ORCID: 0000-0001-7302-647X

<sup>4</sup> Warsaw University of Life Sciences; ewa\_stawicka@sggw.edu.pl, ORCID: 0000-0003-0314-4942

\* Correspondence author

**Purpose:** The objective of the paper is to diagnose the features of risk culture in the studied family-owned enterprise.

**Design/methodology/approach:** The theoretical part employs the method of Systematic Literature Review (SLR) while in the empirical part, qualitative research was used. The case study method was employed as it is particularly suited to answering the questions of why and how.

**Findings:** The conducted research allows for the formulation of the following conclusions. The overarching factor which influences risk culture in the studied family business. is the risk approach of the owners. The other factor to be taken into consideration is the approach towards risk of external stakeholders. The dominant influence of the owners' risk approach is related to their accumulation of institutional knowledge and their role in taking decisions and resolving strategic issues within the family. The influence of these factors results in caution in decision-making and a conservative approach to risk.

**Research limitations/implications:** A limitation of the conducted empirical research is certainly the fact that it was carried out on a single family enterprise. However, considering the lack of empirical research on sustainable risk culture in family businesses so far, the conducted case study can be treated as a pilot study aiming to create a basis for future research.

**Practical implications:** Given the limited empirical research on risk culture in family businesses in Poland, this case study can be considered a pilot study, laying the groundwork for future research in this area. Additionally. The findings aim to encourage family owners and managers to pay greater attention to understanding this aspect in the operations of family-controlled enterprises.

**Originality/value:** The paper is based on own surveys.

**Keywords:** Family business, cultural context, risk culture, Poland.

**Category of the paper:** research paper.

## Introduction

To The intensification of research in the field of family entrepreneurship over the past three decades (cf. Li et al., 2024; Combs et al., 2020, pp. 38-63) objectively reflects the fascinating complexity and uniqueness of entities owned and controlled by families (cf. Aparicio et al., 2021, pp. 33-44; Astrachan et al., 2020, pp. 1-68; Bargoni et al., 2023). This topic is significant among others in the context of environmental changes that force family entities to seek new sources of competitive advantage. The development strategies employed by family businesses often serve as valuable sources of information not only for other family entrepreneurs but also for entities not controlled by families. Despite the intensification of researchers' interest in family entrepreneurship and its cultural determinants (cf. Song et al., 2022; Chrisman, Chua, Sharma, 2003; Dyer, 1988; Zahra et al., 2008), the cultural context of this group of enterprises remains not fully recognized. This issue is interesting, among other things, in the context of risk culture the core of which 'lies' in a set of shared values, views, beliefs, and expectations. The risk culture is linked to the processes of interpreting and making sense of events within the enterprise and its environment. This influence is closely related to the understanding of risk, reactions, and actions towards those risks that materialize in the business activities. Although the research problem of risk culture is gaining increasing interest, it should be emphasized that the conducted research has primarily focused on the financial sector (Kunz, Heitz, 2021; Ghafoori et al., 2023). Although there are studies on the relationship between risk culture and pro-environmental behaviors (Zeng et al., 2020) or the impact of risk culture on human behavior during catastrophic events (Lanza et al., 2023), there is still a noticeable lack of research dedicated to the specific group of entities that are family businesses. Similarly, there are no studies in the literature devoted to sustainable risk culture. This paper aiming to diagnose the features of risk culture in the studied family-owned enterprise asks the question whether risk culture can be a sustainable one.

In the theoretical part, the method of analysis and critique of literature was used. A systematic literature review was applied (Snyder, 2019, pp. 333-339; Ćwiklicki, 2020). The empirical layer was based on qualitative research. It was assumed that qualitative research, including the case study method, is a valuable tool for describing the variability and subjectivity of phenomena identified by the researcher in the studied entity (Glinka, Czakon, 2021, p. 9). Citing Trincherro, Melodi (2004) and Guraziu (2023), the case study was applied to "describe and evaluate the effects (both visible and less visible) of specific educational interventions in real contexts, and study the situations in which a specific educational intervention does or does not produce the desired effects".

In the first part of the paper, the cultural context of the family business is presented, with particular emphasis on the factors affecting it. The next section analyzes the phenomenon of risk culture and outlines what a sustainable risk culture is. Following the presentation of the research methods, the results of the study on risk culture in the family business, based on an original research model, are presented. The paper concludes with findings and

recommendations for further research. The contribution of this paper is threefold. From an academic perspective it broadens the literature on risk culture seen through the lens of family ownership and engagement. By providing a preliminary, exploratory work it broadens the perspective of family firm owner and managers in the area of risk culture.

## **Literature review**

### **Family Business – Cultural Context**

The analysis of literature dedicated to the area of culture within the specific group of entities that are family businesses reveals an existing need for intensified research in this direction. For example, in studies conducted over the past two years, researchers have addressed issues such as the impact of cultural patterns on the organizational culture of family businesses (Sindakis et al., 2022, pp. 994-1016), collectivist cultures and the specifics of their influence (Fan et al., 2022, pp. S293-S325), and the impact of organizational culture on innovation in family entities (Baykal, 2022, pp. 1082-1102). At this point, it is also worth noting an interesting phenomenon related to the significant difficulties, if not the impossibility, of non-family entities “copying” certain characteristics and actions undertaken by family entrepreneurs (cf. Carrigan, Buckley, 2008, pp. 656-666; Chaudhary et al., 2021, pp. 143-161). S. Zahra (2005, p. 364) referring to the organizational cultures of family businesses, emphasize that these cultures are distinct and difficult to imitate. Although the cited authors referred to the cultural context, the conducted studies clearly indicate that the phenomenon of difficulty in “copying” patterns developed by family businesses applies not only to the cultural area (cf. Ge et al., 2022, pp. 223-251).

Studying the cultural context of a business has posed difficulties for researchers since the beginning of this research trend (cf. Rovellii et al., 2022). This difficulty is related to the influence of two main groups of factors. The first group of conditions is associated with the indeterminacy of the concept of culture. It is worth quoting M. Hatch (2002, p. 206) here, who stated that organizational culture is one of the most difficult concepts to define in organizational theory. At the same time, however, the ability of science to explain the specifics of the cultural area in family businesses may prove helpful in understanding other areas of functioning of this group of entities. This is valuable, among other things, in the context of understanding the mechanisms shaping consumer engagement and their purchasing decisions (cf. Rajan et al., 2023; Rauschendorfer et al., 2022, pp. 239-279). Andreini et al. (2020, pp. 18-37), in their studies analyzing 83 papers on the meanings consumers attribute to family businesses, showed the key importance of the family nature of the studied group of entities from three perspectives. One of them, in addition to the perceptual and social perspectives, was the cultural perspective.

The second group of factors is related to the paradigmatic embedding of the conducted analyses. Although research on cultural threads is often placed by researchers within the assumptions of the interpretive-symbolic paradigm, which results in the selection of appropriate methods, techniques, and research tools, it is also worth noting the possibility of conducting research according to the assumptions of other paradigms. This issue is highlighted by S. Ainsworth and J. Cox (2003, p. 1481), who point out the necessity of including more diverse paradigms in research. This is to allow for a better understanding of the complexity associated with the influence of owners and their families. The element of complexity is of key importance in cultural research, according to the authors of this paper, because it is the cultural context of family businesses that determines the difficulty for other entities in “copying” the sources of success of family-owned and controlled entities. The consequence of the influence of the above conditions in the area of family entrepreneurship is a specific “shape” of organizational culture, which is one of the most commonly used indicators of the cultural area. An attempt to synthetically capture the factors shaping the cultural context of family entities is presented in the figure below (Figure 1).

<b>Family business</b> – <b>cultural areas</b>	Position of the family vis-à-vis the company: family in, family out, balanced
	Family strategy in relation to socio-emotional health
	Relationship of the family person to non-family employees
	Influence of family members not involved in the company
	Influence of family members involved in the company
	Influence of the founder
	Specificity of family intangible assets
	National culture
	Regional culture
	Succession stage
	Family history and experience
	Family values

**Figure 1.** Family Business - Outline of Factors Influencing the Cultural Area.

Source: Own elaboration.

Among the various factors shaping the cultural context of family businesses, the dominant factor seems to be the presence of an additional stakeholder, absent in other entities, namely the family, and the consequences that this presence entails. These include, above all: the long-term influence on organizational culture (cf. Zahra et al., 2004, pp. 368), the transfer to successive generations of management (Cruz, Hamilton, Jack, 2012, pp. 147-161), the values upheld by the family (cf. P. Sharma, 2004), with particular emphasis on the influence exerted on the entity by its founder (cf. Zahra, 2005; Gersick et al., 1997; Schein, 1995). One must also not overlook the factor of the family's intention to maintain, protect, and increase its socioemotional wealth (SEW) (Berrone et al., 2012; Cennamo et al., 2012). Underestimating the role of cultural context, the influence of organizational culture, and its subcultures carries significant consequences related to the risk of overly superficial interpretation of processes and phenomena occurring in family organizations. In similar the scope of potential influence of cultural factors is worth pointing out (Figure 2).



**Figure 2.** Cultural Area in a Family Business - Scope of Influence.

Source: Based on own elaboration.

The influence of cultural factors is indisputable, as confirmed by numerous studies (cf. Zahra, 2005; Dyer, 1988; Peters, Waterman, 1982). At the same time, however, the “cultural area” in a business often remains unrecognized until the risk associated with cultural aspects materializes. This factor is crucial because, from the perspective of entrepreneurs, not only family ones. This is due to the fact that that early recognition of the strengths and weaknesses of the organizational culture and its subcultures can significantly increase the ability to identify potential threats early on. As Zahra indicates (2005, p. 25) additional risk may be generated in the case of family entities by the idiosyncratic nature of their cultures. The results of other studies (Astrachan, Klein, Smyrnios, 2002) which have proven that the presence of strong family values favors the development of a distinct organizational culture, are also worth citing. In relation to the above research thread, S. Zahra et al. (2008) distinguish a type of organizational culture, which they call the culture of family commitment. The authors, who studied 248 family businesses, concluded that an organizational culture characterized by family commitment is positively correlated with the strategic flexibility of the entity, understood as the ability to seek new opportunities and the ability to cope with threats generated by the competitive environment (Zahra et al., 2008, pp. 1035-1054).

## **Risk Culture in the Perspective of Family Businesses**

The analysis of literature (cf. Financial Stability Board, 2014; Hilson, 2013; IRM, 2012a, 2012b) clearly indicates that although the research problem of risk culture has attracted researchers’ attention relatively recently, the importance of this concept in organizational activities cannot be overlooked. For example, as early as 2015, the significance of risk culture in organizations was emphasized (Gorzeń-Mitka, 2015, p. 60), indicating that empirical research in this area is still lacking. Even at the beginning of 2022, researchers (Raab, 2022, p. 17) pointed out the small number of studies dedicated to risk culture. At the same time Streicher and his team (2023) emphasize that the concept of risk culture has the potential to integrate various research streams and provide practically significant insights. From this perspective, risk culture can be a valuable “solution” both for researchers in understanding organizations and for practitioners in improving organizational efficiency.

In the initial phase of development, research was primarily dedicated to the financial sector. Risk culture attracted researchers’ interest mainly in the context of its “relationship” to risk management processes, and consequently, to risk appetite (Jackson, 2014). As research progressed, the inquiries of authors (Bockius, Gatzert, 2023; Ghafoori et al., 2023; Lanza et al., 2023) expanded towards research areas related, among others, to the public sector, environmental protection (Zeng et al., 2020), and innovative activities (Ho et al., 2024).

The authors emphasized the importance of this construct in shaping group, organizational, social, and individual ways of perceiving risk, and consequently, specific behaviors towards risk (Streicher et al., 2023). In the conducted research on risk culture, aspects related to the essence of risk culture and its dimensions (Bockius, Gatzert, 2023) and measurement (Ghafoori et al., 2023) are highlighted. The role of risk culture in the banking sector (Sheedy, Canestrari-Soh, 2023) and during catastrophic events (Lanza et al., 2023, p. 11063) was also analyzed. The cited authors (Lanza et al., 2023, p. 11063) attempted to investigate the potential role of risk culture in shaping collective behaviors in the context of controlled behaviors or collective panic. Risk culture is defined in the literature somewhat depending on the cognitive area on which the authors focus their attention. An attempt to systematize the definitions identified in foreign and domestic literature is shown in Table 1.

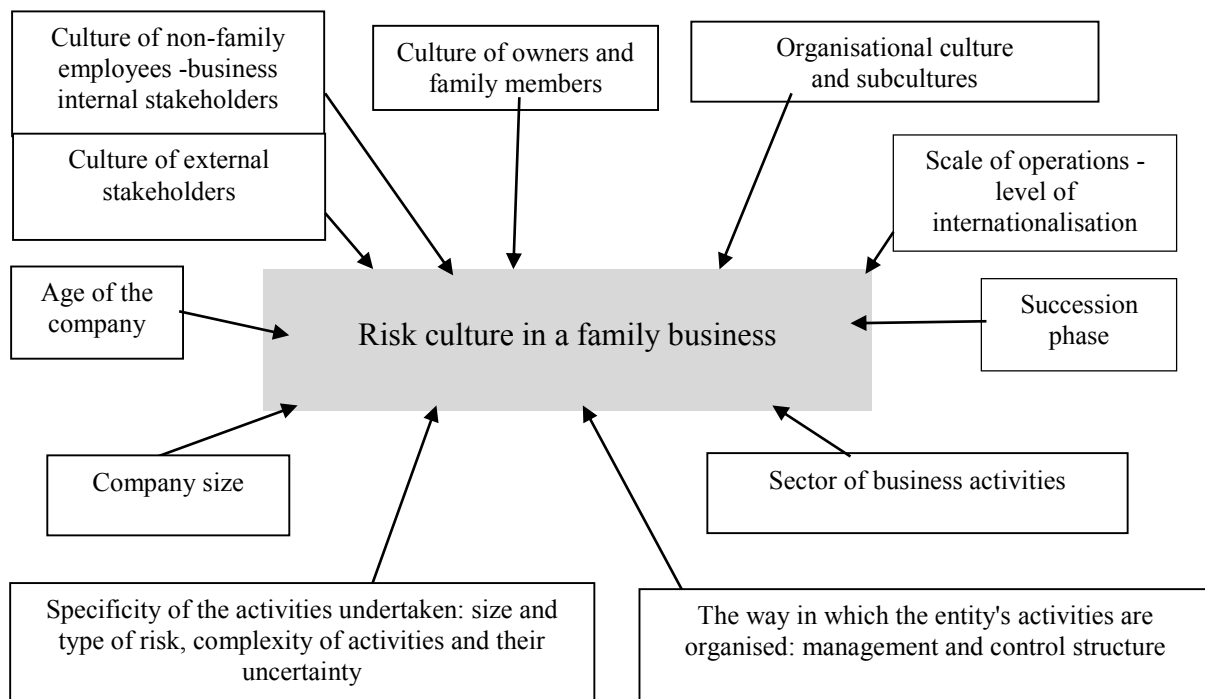
**Table 1.**  
*Risk Culture in the Literature*

Author	Reference - Emphasis on the Importance of Risk Culture to a Selected Element/Area in the Enterprise
(Sheedy et al., 2017)	Risk culture as a multidimensional construct potentially identifiable in most organizations
(Previati, 2017)	Risk culture as a construct combining two areas: risk and culture
(Sheedy, Canestrari-Soh, 2023)	Risk management; in the case of a proactive risk culture, all decision-making processes are characterized by risk consideration
(Lanza et al., 2023)	Risk culture as a determinant of collective behaviors (context of control/panic)
(Streicher et al., 2023)	Risk culture as a construct/approach related to the way/specificity of understanding risk by a social unit
(Ring et al., 2016)	Risk culture perceived as a shared understanding of risk, shared values, knowledge, and beliefs
(Sinha, Arena, 2020), (Hilson, 2013), (PriceWaterhouseCoopers, 2011), (Protiviti, 2012), (IIF, 2009)	Management
(Ring et al., 2016), (IRM, 2012b), (Kasiewicz, Kurkliński, 2019)	Organizational culture: including values, beliefs, knowledge, and the way of understanding risk shared by a group of people with a common goal, especially employees of the organization or groups within the organization
(Cornia et al., 2016), (Korombel, 2013)	People management
(IRM, 2012b), (Ashby et al., 2012), (Deloitte, 2012)	Attitudes and behaviors of people
(Ashby et al., 2012)	Relationships

Source: Based on the literature cited in the table.

The analysis of the understanding and consequently the definition of the concept of risk culture in the literature draws attention to two important elements. First, researchers must accept the fact that the multitude of approaches to defining risk culture remains a reality. This is related to the multifaceted, complex, and comprehensive ‘character’ of risk culture. What is particularly important is the fact that risk culture, influencing the processes of broadly

understood risk management, remains, regardless of the sector to which the research pertains, very strongly linked to the employees of a given enterprise and relationships among them. Ashby et al. (2012, p. 19) expressed the opinion that “risk culture refers to the behaviors of people in an organization concerning risk management”. However, it encompasses “something more” than just behaviors. Regardless of the adopted approach, just as in the banking sector, risk culture can be one of the factors influencing the success or failure of undertaken actions (cf. Sinha, Arena, 2020, pp. 81-102), so too in family businesses, this factor should not be overlooked. In this context, it is important to identify the conditions shaping the risk culture in a family entity (Figure 3).



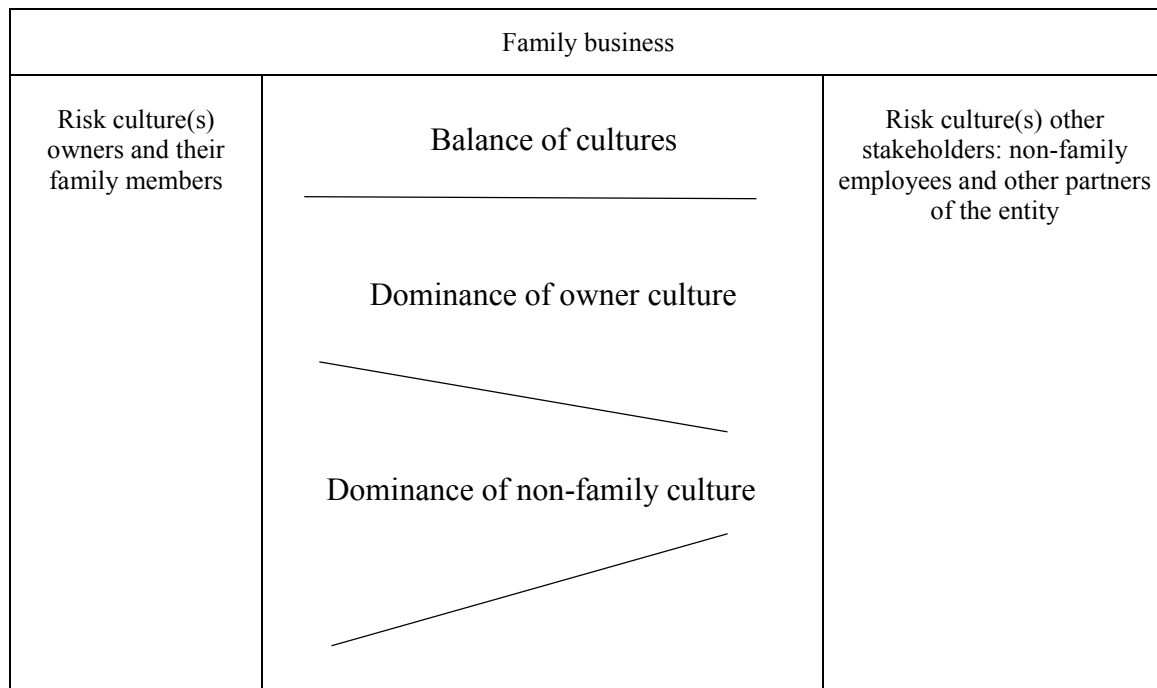
**Figure 3.** Selected Conditions of Risk Culture in a Family Business.

Source: Own elaboration.

In the analysis of risk culture in family businesses, to maintain the highest possible research objectivity, it is worth paying attention to the relationship that may manifest as a kind of “power play” between the risk culture of the owners (and possibly their family members) and the risk culture of non-family members: employees in managerial and non-managerial positions. An attempt to illustrate this relationship is made in the Figure 4.

When attempting to study the culture of a given family business, it is important to pay attention to the elements presented in Table 2.





**Figure 4.** Family Business – Context of Cultural Relationships.

Source: Own elaboration.

**Table 2.**

*Risk Culture in a Family Business – Context of Cultural Balance*

Possible Scenarios	Specificity - Created Threats
<b>Examined Element: Balance of Cultures</b>	
Dominance of Owners' Culture	The dominance of the owners' culture seems to be a characteristic phenomenon of the "formula" of a family business. This particularly applies to cultures described by Dyer (1988) as paternalistic, typical for "mom and pop family firms" and clan family firms (Dyer, 2006).
Dominance of Non-Family Culture	Relatively rare in the area of family entrepreneurship. It seems that such a scenario is not possible in small and medium-sized enterprises, where management and control functions are concentrated in the hands of the family. Therefore, such a situation may occur in large entities with a professional culture (Dyer, 1988), which are managed by external managers.
Balance of Cultures	Although this is the most desirable situation from the perspective of the impact of cultural factors on the effectiveness of actions, it seems that achieving such a situation may be relatively difficult in family businesses. This is primarily related to the family's constant pursuit of maintaining and increasing the element of SEW (socioemotional wealth). The key influence of this factor is indicated by numerous authors in their research (cf. Berrone et al., 2012; Cennamo et al., 2012; Labelle et al., 2018). This phenomenon occurs regardless of the geographical and sociodemographic context.
<b>Examined Element: Relationship Between Cultures</b>	
Symbiosis of Cultures	The most desirable situation, where individual cultures, through the convergence of values and basic assumptions, "support each other", resulting in generally high effectiveness of actions taken.
Orthogonality of Cultures	In the case of orthogonality of culture, individual cultures coexist "side by side" but do not support each other. In this situation, the enterprise may not achieve the maximum effectiveness of initiatives taken, as could be the case with symbiotic culture.
Conflict/Antagonism of Cultures	The least desirable situation, where there is mutual "combat" between cultures. This can occur, for example, in the case of professional cultures coexisting within an entity. In many cases, this is the result of different values and basic assumptions "represented" by individual cultures. For the enterprise, such a situation poses a threat of reduced effectiveness of actions taken, both in the short and long term.

Source: Own elaboration.

In the area of family entrepreneurship, the relationship between the risk culture of the owners and the risk culture of employees and involved individuals who are not family members might play a significant role. Analyses of the functioning of family businesses indicate that the personality of the owner (founder of the company) has the greatest influence on businesses operating in the first generation, which are usually small entities. Family businesses that have been operating longer, have undergone the succession process, and operate on a larger scale, tend to professionalize their activities. So it can be assumed that the dominance of the owners' culture might be evident in particular in small family entities run by the founding generation.

## Research Methods

This paper uses a literature review as a research methodology (Snyder, 2019). Understanding similarities and differences among the literature review, theoretical framework, and conceptual framework can help novice and experienced researchers in organizing, conceptualizing, and conducting their research, whether qualitative, quantitative, or mixed-methods (Rocco, Plakhotnik, 2009). Conceptual papers do not have data, because their focus is on integration and proposing new relationships among constructs. Thus, the onus is on developing logical and complete arguments for associations rather than testing them empirically (Gilson, Goldberg, 2015).

In conducting the research, qualitative studies were employed as they are well-suited for describing and reflecting the variability and subjectivity of phenomena identified in the enterprise (Glinka, Czakon, 2021, p. 9). The choice of research method was based on the criterion of the method's suitability for the research problem, the object of analysis, and research limitations. Qualitative research focuses on understanding the opinions of research participants regarding the research problems, rather than determining how typical or marginal these opinions are within a given group of entities (Kuc, 2012, p. 156). Qualitative research aims to understand the uniqueness of the situation and the nature of the studied phenomenon (Merriam, 2002, p. 5). The case study method was used, with particular emphasis on the technique of in-depth individual free-form interviews.

Qualitative research that employs the case study method is characterized, as emphasized by W. Czakon (2006, pp. 9-12), by its usefulness in the occurrence of symbolic black swans of Popper. This choice of research tools is dictated by the fact that the researcher's intention is not to reduce the complexity present in the organization. Such an approach, as W. Czakon (2016, p. 47) writes, is typical for quantitative research. A single case study is justified when there is no existing theory on the topic or it exists in a specific context; in such cases, a single case study can be treated as a pilot study aiming to create a "preliminary" theory and prepare a foundation for future, broader research (Yin, 2009, p. 8).

Due to the specific nature of the activities conducted by entities owned and controlled by families, purposive sampling was used. The study included a business founded and currently managed by second-generation family members. The entity provides long-term and short-term hotel services as well as catering services (Table 3).

**Table 3.**

*Characteristics of the Studied Business - Business and Family Context*

Examined Element	Specification
<b>Characteristics of Conducted Activities</b>	
Profile of Activities	Services
Duration of Entity's Operation in the Market	Over 20 years
Scope of Activities	Global
Size of Enterprise Measured by Employment Level	50-249 people
<b>Ownership Characteristics</b>	
Type of Ownership	Private
Type of Ownership	Family-owned entity
Specificity of Ownership	Ownership by one family
Organizational and Legal Form	Business activity
Number of Founders	More than 1
Management of the Enterprise by Founder(s)	Yes
Employment Structure	Dominance of non-family employees
Current Family Involvement in Management	100%
<b>Family Characteristics</b>	
Total Family Size	4-6
Generation Currently Managing the Enterprise	II
Presence of Family Members Who Can Take Over Management in the Future	Yes

Source: Own elaboration.

In the cognitive area of family entrepreneurship, succession is a “factor” that can explain the complex and difficult-to-“copy” organizational reality by other entities. For example, van Gils et al. (2019) in their research focused on the relationship between family involvement and the company’s image, discovering that it is conditioned, among other things, by the intention of intergenerational succession and non-economic goals that are “family-centered” (family-centered non-economic goals).

Similarly, studies conducted in Poland (Popczyk, 2018; Sobiecki, 2018; Hadryś-Nowak, Więcek-Janka, 2016) show that succession is one of the most significant challenges faced by family businesses. Conducting succession often results in significant changes in the entity’s management—both positive and negative (cf. Dudek, Pawłowska, 2022; Więcek-Janka et al., 2016). Therefore, including an entity in the “development phase - post-succession” in the study may be helpful in identifying research threads worth further in-depth analysis. The risk culture framework proposed by B. Streicher and M. Bielefeld (2023) was used to examine the risk culture in the enterprise. This model was modified for the analysis to account for the specifics of family entities. In particular, it addressed the relationship between the family and the business present in these entities. The research model is presented in the table below (Table 4).

**Table 4.**  
*Risk Culture – Research Model*

<b>Research Context</b>	<b>Examined Element</b>
Source of Risk	Type of risk Entity/event causing the risk Time of event Potential effects
Reactions and Actions Towards Risk - Balance of Influence of Owners and Non-Family Employees	Perception of risk Reaction to risk from the family Reaction to risk from employees Decisions and actions taken towards risk Risk assessment and specificity of learning
Conditions from Owners and Non-Family Employees	Values Beliefs Experience Knowledge Competencies

Source: Own elaboration based on (Streicher, Bielefeld, 2023, p. 5).

In the case of the group of entities that are owned and controlled by families, the factors with a decisive impact on risk culture will be those related to the influence of the family and its culture, where the family is perceived as a social unit.

## Research Results

The starting point for initiating research on risk culture should always be the identification of risks present in the activities of the given entity. The key risk identified in the studied enterprise during the conducted research was related to the specificity of activities carried out in a project format. For the purposes of the study, a project was defined as a unique, temporary, multidisciplinary, and organized endeavor aimed at producing a specific, unique product, service, or result (Haaskjold et al., 2023, pp. 117-138; Project Management Institute, 2017, p. 4). Its goal was to design and implement a communication system between facilities. The results of the conducted research are summarized in Table 5.

**Table 5.**  
*Risk Culture – Context of Risk-Generating Event*

<b>Source of Risk</b>	<b>Response of Surveyed Individuals</b>
Stakeholders - contractors and subcontractors	<i>During the project, the most stressful moments were those involving contact with our suppliers, contractors, and receiving information from them that they were unable to perform or complete something. That was when we were most stressed</i>
Lack of interest from specialized entities in providing services for SMEs	<i>Now we have such problems in the labor market, there are no specialists. Because specialists are not interested in working in such small facilities</i>

Source: Own elaboration based on conducted research.

The key risks identified by the surveyed individuals included: the risk of overinvestment, bureaucracy, and problems with contractors and suppliers. It is worth noting the aforementioned risk related to contractors and suppliers. During the conducted interviews, a very clear theme was identified, pointed out by respondents both from within the family and outside it, concerning contact with suppliers and contractors. Another highlighted element was the lack of interest from specialized entities in providing services for SMEs.

This identified risk factor is significant not only from the perspective of research on culture in the context of risk but also for family entrepreneurship as a whole. It indicates a potential threat related to contractors ignoring the demand for services reported by family entrepreneurs, who mostly constitute entities from the SME sector. This is a somewhat “false” picture, as these entities, despite having a small number of employees, dynamically apply for funds from centrally financed programs, which they allocate to the implementation of various projects. In the adopted research model of risk culture, the factor related to reactions to risk from the family and employees, and consequently behaviors towards risk, plays a significant role. These are the two basic indicators of the studied phenomenon at the observable level (Table 6).

**Table 6.**

*Risk Culture – The Context of Risk Perception and Risk Actions*

<b>Examined Element</b>	<b>Response of Surveyed Individuals</b>
Perception of risk – perspective of non-family employees	<p><i>To be honest, during this project we didn't have such events that stopped certain activities. If such an event occurred, the boss immediately managed to find someone as a replacement and we didn't have such long downtimes.</i></p> <p><i>There was no such thing that due to the illness of some employee or some other unavailability we just stood still. The boss immediately tried to react, find someone else to keep it going.</i></p> <p><i>With experience, my approach to risk is definitely related to experience. I positively perceive the family's approach to risk because I know that the family is focused on success. There are certainly some concerns because every investment is associated with some risk, but the experience that the boss has (...) also gave her the strength and ability to build something bigger, primarily by expanding the business.</i></p> <p><i>To sum up, it was all balanced.</i></p>
Behaviors towards risk – perspective of non-family employees	<p><i>It is known that there are also issues that unfortunately cannot wait, as I mentioned here I will think about it tomorrow. Because there are things, problems that need to be solved immediately. So for example, we had a situation where one company let us down, delayed, so we were forced to give up and quickly find a replacement. Because delaying the work of this company would unfortunately cause serious problems. Because the entry of the next companies depended on the completion of this part of the project.</i></p>
Risk assessment and learning	<p><i>Because it is also known, we are in such an industry that we pay attention to what is happening with others, go, observe, some other solutions.</i></p> <p><i>There are many such restrictions when certain activities must be performed within specific deadlines, not a day earlier, not a day later so it also creates such a nervous atmosphere in these most intense periods to perform, do, so that nothing is done because then one mistake and we lose everything”, as well as that cooperation on the project with partners offers the opportunity to gain knowledge that the company does not have.</i></p>

Source: Own elaboration based on conducted research.

In the examined enterprise, the approach to risk is characterized on the one hand by the acceptance of the fact that risk accompanies the implementation of every single action and undertaking, and on the other hand by a flexible and active approach to it. A key role in the approach to risk is played by the approach of one of the owners. It is a cautious approach, possessing certain conservative features, but also a flexible and open approach, in which the owners consciously decide to take on a certain type of risk. The owners themselves engage in tasks that are associated with risk. A very important identified element, whose significance needs to be emphasized, are the processes related to environmental scanning identified in the examined entity. Before making decisions regarding risk, the enterprise actively scans its environment. This process aims to gather as much information as possible to help make the optimal decision. This indicates a mature approach to risk, as well as the implementation of an active risk management strategy aimed at minimizing it. The implementation of environmental scanning processes allows the enterprise to find risk solutions that are beneficial to it. The fact of systematic environmental scanning is also a factor that facilitates ongoing response in the event of specific risks materializing.

The conditions of risk culture in the examined entity can be classified into three main groups. The factors in the first group are related to the specifics of the activities carried out. These include the budget of a given project and the client's requirements. The factors in the second group are related to beliefs built on the experience gained by the people involved in the projects. As one of the surveyed managers put it:

*I do not participate in these strictly private conversations.*

*This stress, as I mentioned earlier, these concerns, some kind of fear that certainly accompanies some of the undertaken projects, is not conveyed here at work, here to the employees. So it doesn't accompany me on a daily basis.*

Particularly interesting from a cognitive perspective are the factors in the third group, which are related to the influence of the values "held" by the owners of the enterprise. These include primarily caution, reluctance to expose the enterprise to too high a risk, and the associated need to ensure safety and protection for the family and employees. As emphasized earlier, the influence of the co-owner is particularly prominent here. This approach is perceived positively by non-family employees. One of the surveyed individuals expressed it as follows.

*What seems particularly interesting from a cognitive perspective is the fact that strategic issues related to risk are decided within the family without the presence of managers and employees who are not family members.*

This indicates that the family, despite having trust in their collaborators, clearly separates these individuals from the most strategic issues related to the projects being carried out. On the one hand, the co-owners discuss selected issues related to risk-laden activities with the managers, but on the other hand, these individuals are not provided with strategic knowledge. This aspect is significant as it points to a certain specificity of the family and the values they hold, where non-family employees are not "admitted" to the most important aspects related to

project implementation. Referring to the works of domestic and foreign authors, this confirms the results of research conducted so far, in which researchers have pointed out the problems that arise in family businesses when it becomes necessary to transfer part of the power to non-family members, a situation that arises, for example, from the development of the enterprise, when it is no longer possible to manage it solely by the owners (Morck, Yeung, 2003; Perez-Gonzalez, 2006).

Addressing the issue of cultural conditions in the context of risk, it is also worth noting that the approach to risk implemented by the owners often involves strong emotions for them. Non-family employees agreed that even in the event of a serious threat or other crisis situations in the project, the owners never “transferred” their problems to the employees. This indicates the maturity of the owner family, as well as their awareness of the responsibility borne by the family for the decisions made.

Addressing the issue of cultural conditions as determinants of business operations, it is also worth pointing out the knowledge factor. The conducted research showed that knowledge has not been formalized in the examined enterprise, for example, in the form of risk journals or other forms of collecting lessons learned. It remains concentrated in the owners, who continue to build it based on previously acquired experience. It is developed informally, as mentioned earlier - without formalization. This situation creates a specific risk associated with the occurrence of a random event affecting one or more co-owners, where, in the event of the need to take over tasks, non-family employees may not have sufficient information. It should be emphasized once again that these employees have not been provided with knowledge by the family regarding the most important aspects of the operation in which they participate, in this case, the budget. During the interviews, it was also not confirmed that individual owners exchange knowledge on an ongoing basis so that each of them has a full range of it. Similarly, processes have been implemented and developed to the extent that allows for ongoing risk control. However, as with knowledge, the dominant role of one of the co-owners, which in turn reflects the values held by this person, also comes to the forefront here. What seems interesting is how learning processes occur in the examined entity.

Although communication processes function correctly, albeit intuitively, informal communication dominates. Non-family members are additionally rewarded for an active approach to risk, resulting in “protecting the enterprise” from the consequences of bad decisions. The recruitment process is carried out by the owners, with non-family employees not always being informed about the sources of certain decisions. This remains rather in the realm of their assumptions and positive assessment of the owners.

An interesting discovery during the conducted research was made in relation to the training process. One of the surveyed individuals, who is not a family member, clearly avoided answering the question of whether employees can develop knowledge and competencies related to risk during training, finally concluding:

*Well, they do happen (trainings - researcher's note), let's say it that way, they do happen.*

This indicates, on the one hand, that employees most likely do not participate in training, but on the other hand, these individuals are highly loyal to the owners and did not want to inform the researcher about situations that would not reflect well on the family.

## Conclusions and recommendations

In the examined enterprise, the foundation of the risk culture lies in the values held by the owners. Consequently, it is a culture that is cautious in taking risks but also open. Risk is predominantly perceived as a threat and associated with the uncertainty that accompanies the implementation of individual actions. Despite the somewhat conservative attitude of the surveyed individuals towards risk, the examined enterprise scans the environment before making decisions to gather sufficient reliable information to take on the risk. The process of analyzing events and processes in the environment is accompanied by openness to cooperation and a willingness to engage in it. The enterprise carefully selects partners for cooperation. Competent stakeholders with specialized knowledge are chosen. This selection of partners is also a strategy to mitigate the risk associated with the fact that they possess the type of knowledge that the enterprise itself does not have. It should also be emphasized that the processes of environmental scanning indicate not only openness and awareness but also the high maturity of the management team. The importance of environmental scanning to seek desired information is identified in the literature as a strength of the organization. For example, R. Daft and K. Weick (1984, pp. 284-295) divide the environment into four categories based on the ability to analyze and the attitude (active, passive), and then propose four strategies for environmental scanning and information interpretation processes.

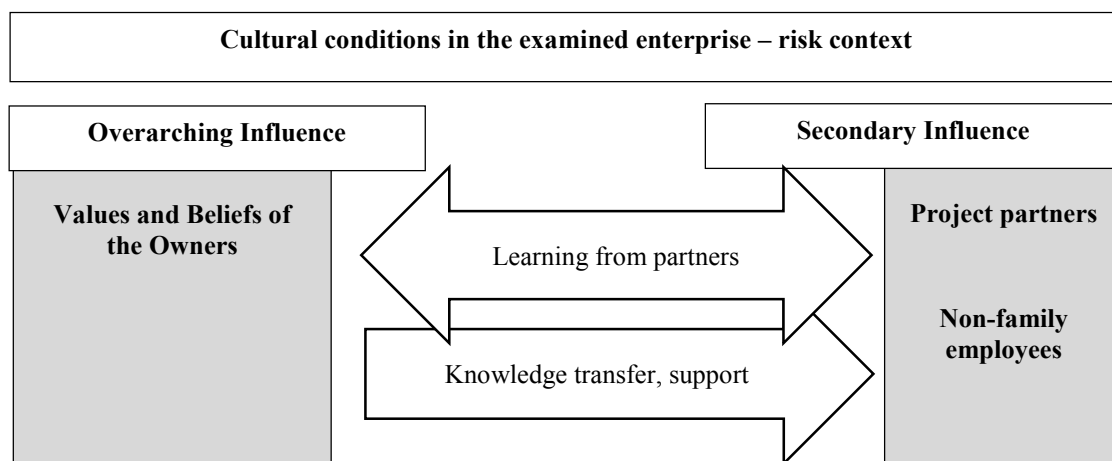
Knowledge about risk has not been formalized, and its primary source is the owners, with employees contributing to a lesser extent. This situation, despite the sharing of knowledge among family members, poses a risk due to the lack of documentation of knowledge and experiences, for example, in the form of lessons learned. Similarly, the dimension of processes and structure is “strongly rooted” in the owners, who, although they consult risk-related issues with managers, ultimately make decisions within their own circle. The most notable example of this is the lack of knowledge of a non-family manager who led a project without knowing its budget.

The dominant influence of the owners’ risk culture is related to the fact that these individuals have accumulated institutional knowledge and make decisions and resolve strategic issues within the family. As one of the surveyed non-family managers put it:

*I don't remember that moment and I don't know, that decision about this project probably came up at their home, it was some vision they had, they wanted.*



Another factor is the key influence of the risk culture of the partners supporting the examined entity in the implementation of the project. This is related to the fact that, as emphasized earlier, the examined enterprise, representing on the one hand a cautious culture, but on the other hand open to taking risks, sought knowledge it did not possess among external stakeholders who could support it in the implementation of a given undertaking. It is therefore worth noting the empirical nature of the learning processes and the specific benchmarking process associated with these processes.



**Figure 5.** Family Business as a “Collection of Stakeholder Cultures”.

Source: Own elaboration.

The conducted research indicated the existence of two key conditions influencing the risk culture. The first, overarching one, is the risk approach of the owners, resulting and expressed in the values they hold regarding risk. The second is the risk approach of the external stakeholders, in this case, the partners supporting the examined enterprise (Figure 5). In the examined entity, two main processes were identified that occurred between the parties. From the external stakeholders, it was support and knowledge transfer, while from the owners, it was intensive learning processes.

This study is not free from limitations. The primary limitation of the empirical research conducted is that it was carried out on a single family enterprise. Another limitation is using qualitative research not supported by quantitative research. However, given the limited number of empirical research on risk culture in family businesses in Poland, this research can be considered a pilot study, laying the groundwork for future scientific investigations in this area. Additionally, the results of this study underscore the importance of risk culture in family businesses. These findings aim to encourage family owners and managers to pay greater attention to understanding this aspect in the operations of family-controlled enterprises.

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## THE ROLE OF CHAMBERS OF COMMERCE IN STIMULATING ECONOMIC GROWTH: AN ACADEMIC PERSPECTIVE

Roman TYLŻANOWSKI

University of Szczecin, Department of Enterprise Management, Institute of Management, Faculty of Economy, Finance and Management; roman.tylzanowski@usz.edu.pl, ORCID: 0000-0003-3644-1935

**Purpose:** The article aims to assess the knowledge and interest in the offer of chambers of commerce by students of faculties offering theoretical and practical knowledge about starting and running a business.

**Design/methodology/approach:** A questionnaire plus the Pearson correlation coefficient and the T-Czuprow dependence coefficient were used to examine the relationship between the study variables. The research sample consisted of students from the Faculty of Economics, Finance and Management. The sample was selected to represent a diverse group of individuals based on several criteria, including gender, field of study, degree of study and mode of study.

**Findings:** Students are moderately familiar with the services offered by chambers of commerce. They are also not sufficiently aware that these entities can provide them with support at the stage of setting up or developing their business.

**Practical implications:** The results indicated a need for increased information and promotional activities on the part of the chambers of commerce to communicate more effectively the support opportunities for future entrepreneurs.

**Originality/value:** The article highlights the important role of chambers of commerce in supporting young entrepreneurs, which makes it a valuable source of information for those interested in starting their own businesses. The originality of this study lies in its targeted approach, which not only assesses students' awareness of services of chambers of commerce but also identifies their preferred areas of support.

**Keywords:** chambers of commerce, entrepreneurship, business, students, academic entrepreneurship.

**Category of the paper:** research paper.

### 1. Introduction

Chambers of commerce are organisations that help their members in many different ways. They offer access to information and resources and strengthen social connections. They act as intermediaries connecting local businesses with stakeholders, positively influencing the local economy, defending business interests and supporting networking. They play a key role in

economic development, making a significant contribution to the local economy. It would therefore be useful to verify the interest in the services of these institutions among young people who are about to start their own business. The survey took into account the opinions of students of courses in which theoretical and practical knowledge of starting and running a business is acquired. The aim of the study was to assess familiarity with and interest in the offer of the chambers of commerce.

## 2. Literature review

Various business environment institutions take part in shaping the image of the regions, including organisations bringing together entities engaged in similar business activities. These may include, for example, entities bringing together freelancers, as well as organisations bringing together entrepreneurs based on sectoral or territorial criteria (Przeszło, 2019, p. 592). By exercising the right of association, entrepreneurs can obtain a number of benefits from belonging to different types of organisations.

Chambers of commerce are an example of an economic self-government organisation. These institutions bring together individuals (sole traders) and entities (companies) that carry out business activities. Like regional development agencies, chambers of commerce carry out their activities on a non-profit basis. The institutions are characterised by their regional or sectoral scope of action, and participation in them is voluntary (Markiewicz, 2007). Chambers of commerce function as multi-faceted business organisations. In the sphere of public policy formation and implementation, chambers of commerce, which defend the interests of business owners, have the potential for significant and influential involvement. The activities undertaken by representatives of chambers of commerce can contribute to the shaping and implementation of public initiatives in a constructive manner (Dąbrowski et al., 2023).

An effective chamber of commerce, serving as a facilitator for the business sector, can produce beneficial results, such as cultivating community ties, providing educational opportunities, organising workshops, offering scholarships, providing financial assistance, disseminating relevant information for the betterment of society, optimising the use of resources, improving the quality of the business environment, minimising transaction costs, improving the efficiency of public spending, increasing investment attractiveness, promoting the inflow of national and international capital, supporting job creation, fostering innovation, and promoting economic growth (Dąbrowski et al., 2023; Özsungur, Karadal, 2020). The primary function of chambers of commerce is to meet the collective needs and interests of their members, to enable them to carry out their operational activities, to promote the development of the profession in line with wider interests and to maintain integrity and trust among members both internally and in their dealings with the public (Özsungur, Karadal, 2020).

These institutions serve as an important pressure group, working to promote a favourable business environment that helps support the growth and success of businesses, advocating for better service delivery by local government units (Meyer, Meyer, 2017). In a nutshell, it can be said that chambers of commerce assist businesses in meeting the challenges of the 21st century economy (Marciniak, 2023).

In Poland, chambers of commerce operate as voluntary associations of entrepreneurs at various levels, including sectoral, national, regional, local and bilateral (Dąbrowski et al., 2023). They operate on the basis of the Act of 30 May 1989 on Chambers of Commerce (Dz.U. z 2019 r., poz. 579) and regulations issued pursuant thereto. These regulations don't imply any restrictions related to the membership of individual enterprises. Therefore, entrepreneurs belonging to professional self-governments, craft entrepreneurs, as well as entrepreneurs forming associations and other organisations qualified to the so-called professional self-government of certain entrepreneurs may belong to the chamber. The basic tasks of the chambers of commerce include (Przeszło, 2019, p. 596; Gródek-Szostak, Szelaż-Sikora, 2016, p. 56):

- representing the interests of the business members of the chamber of commerce, especially before state authorities,
- creation and dissemination of principles of ethics related to business activity,
- preparation of draft legislation,
- opinion on draft solutions concerning the functioning of the economy,
- critical assessment of the formulation and implementation of legislation relating to the operation of business,
- removing all barriers to business development (e.g. burdensome bureaucracy),
- creation of solutions influencing the activation of the economy,
- supporting the business initiatives of chamber members,
- intensifying cooperation with the scientific sector and local governments,
- participation in the work of advisory and consultative institutions,
- settling disputes and representing chamber members in court proceedings in connection with their business activities,
- expressing opinions on the state of economic development in the chamber's area.

Companies sign up to chambers of commerce to raise their profile in the business sector, expand their professional contacts and build a trustworthy reputation with customers (Özsungur, Karadal, 2020). In order to establish a chamber of commerce, initiating actions by at least 50 business entities conducting their activities in the area of the province in which the chamber is to operate are required. In the case of activities carried out on a territory larger than the area of the province, at least 100 founders are required. In order for the chamber to commence its activities, it is also necessary to adopt its statutes and make an entry in the National Court Register (Dz.U. z 2019 r., poz. 579).

The individual chambers of commerce on a voluntary basis are affiliated to the National Chamber of Commerce, whose main priority is to represent micro, small and medium-sized enterprises, including family businesses (Arendarski, 2014). In total, nearly 160 regional, sectoral and bilateral chambers can be distinguished (Krajowa Izba Gospodarcza, 2024).

The largest chamber of commerce in Poland is the Northern Chamber of Commerce (NCC), established in 1997 (2021). It is an independent organisation set up to protect and represent the interests of its member businesses. Businesses' membership is voluntary. Its primary objective is to create conditions for the development and modernisation of economic life, to support the initiatives of its members and to promote the development of interregional and international economic contacts. In pursuing this goal, the institution has a significant impact on entrepreneurs in Western Pomerania and the whole of Poland. Since its inception, the Chamber has cooperated with more than 150 organisations (Polish and European) with a similar business profile. Its dynamic development has enabled it to acquire new members year by year, increasing the number of associated enterprises from 60 to nearly 1500, the vast majority of which are micro and small enterprises from West Pomerania and Germany.

A current undertaking by NCC worth mentioning is the 'My Company My Success' project, which aims to increase the number of micro-enterprises in the region. This project supports young people (aged 18-29), who are unemployed, in setting up and running their own business. A non-refundable grant (PLN 23,050) is provided for the creation of the enterprise. In addition, the chamber also provides bridging support (PLN 2800 per month for 6 months), as well as a series of training courses (e.g. on labour law, bookkeeping, contact with clients, business marketing), thanks to which young people can acquire knowledge and skills necessary to start a business (Fundusz Pomerania, 2021).

The existing literature on entrepreneurship and business support services often emphasizes the role of chambers of commerce in fostering economic growth and supporting established businesses. However, there is a notable lack of empirical research focusing specifically on the awareness and perceptions of students - particularly those studying fields related to business and entrepreneurship - regarding the services offered by these institutions. This gap is significant because students represent a critical demographic group that can benefit from the resources and support provided by chambers of commerce as they transition into the entrepreneurial landscape. Moreover, while previous studies have explored the general impact of chambers of commerce on businesses, few have investigated how effectively these organizations communicate their services to potential young entrepreneurs. This lack of targeted research leaves a void in understanding how chambers can tailor their outreach and support mechanisms to better serve the needs of students who are interested in starting their own businesses.

### 3. Methods

The survey was conducted among students of the Faculty of Economics, Finance and Management at the University of Szczecin. The survey involved 335 students from two fields of study, i.e. management (285) and entrepreneurship and investment (50 students), 62.4% of whom were considering setting up their own business. These faculties were selected for the study because their profile is partly related to setting up and running a business.

Entrepreneurship and investment is a practical field of study. The content of education in the field of study includes issues in the field of management and quality sciences, economics and finance as well as related disciplines. Students have the opportunity to develop practical skills in the area of setting up and running their own enterprise, developing a family business or pursuing a career as a local leader - creator of economic ventures and initiatives in the local community. The practical profile makes it possible to educate according to the expectations of employers and with the participation of practitioners - entrepreneurs, managers and specialists. Graduates of the field of study are prepared to: setting up and developing their own enterprise, taking over a family business, working in managerial and specialist positions in small and medium-sized enterprises, in consulting companies and other organisations such as institutions supporting entrepreneurship, acting as a leader of local entrepreneurship.

The aim of study in the field of management is to acquire specialist knowledge in the field of management sciences, economics and related disciplines; shaping a critical understanding of phenomena as well as economic and organizational processes, as well as developing the ability to use methods and techniques necessary to solve problems and make decisions within the organisation. In addition, the studies are aimed at preparing graduates for the implementation of their own entrepreneurship, career development of specialists and managers in management structures. In the area of social competences, the studies are aimed at shaping ethical and social sensitivity, commitment and a sense of responsibility in the work environment and beyond, awareness of the need and development of personal development and lifelong learning skills.

The degree of studies is the criterion that divided the research group into two groups, which are almost equal in terms of quantity - 52.5% were first-cycle students and 47.5% were second-cycle students. In addition, 72.5% of the respondents are full-time students, and the remaining 27.5% are part-time students. 69.3% of respondents were female, while 30.7% were male. The aim of the study was to assess the familiarity with and interest in the offer of chambers of commerce. It was also verified which areas of activity of business support institutions were indicated by students who are interested in using the services of the surveyed institutions. Students could choose from the areas of support most often offered by business environment institutions, namely: training and workshops, consultancy and individual consultations, promotion and advertising, obtaining grants for starting a business, assistance in applying for EU funds, access to current economic information, as well as various meetings and business and integration trips.

The survey questionnaire was directed to students electronically (students received a link that took them to the survey form). In the questionnaire form, mainly closed and semi-closed questions were used, as it limited the percentage of people resigned from answering the question. In addition, these types of questions made it easier to classify and analyse the data.

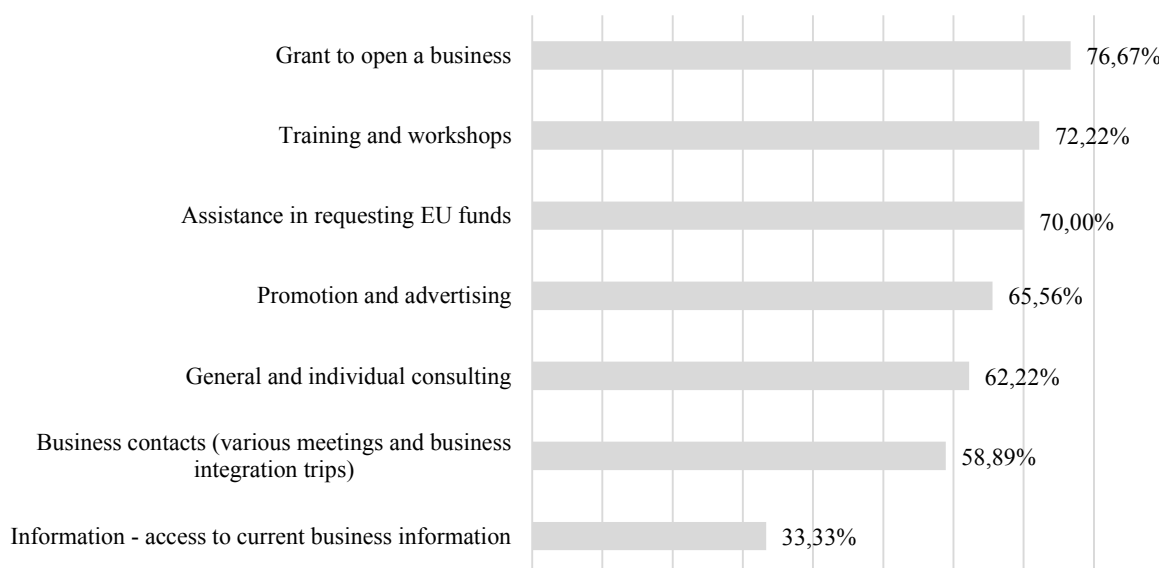
Pearson's correlation coefficient and T-Czuprow dependence coefficient were used to examine the relationships between the data being processed. The Pearson coefficient ( $r_{xy}$ ) is a linear correlation coefficient that indicates the level of linear relationship between random variables. Its value falls within the closed interval  $[-1, 1]$ . The greater the absolute value of this coefficient, the stronger the linear relationship between the variables. 1 indicates a positive relationship, -1 in turn indicates a negative relationship between the characteristics. 0 indicates the absence of a linear relationship (Zeliaś, 2002). The T-Czuprow coefficient ( $T_{xy}$ ), on the other hand, is a dependency ratio that is used to measure the strength of the relationship between two nominal variables. It assumes values from the closed range  $[0, 1]$ . The closer the value of this coefficient is to one, the stronger the relationship between the examined characteristics (Domański, 2001).

The analysis contained in this article is part of a more extensive study on business environment institutions (Leoński, Tylżanowski, 2022; Tylżanowski, 2023; Tylżanowski, Salwin, 2023; Tylżanowski, Szarek, 2023).

## 4. Results

The surveyed group of students was asked to answer the question whether they would like to make use of the offer of chambers of commerce if they were planning to set up a business or running one. Students had the opportunity to express interest (or disinterest). Only 45.67% of students are familiar with the offer of chambers of commerce, and only 26.87% of respondents are interested in benefiting from it. Students (in particular those pursuing studies in economics) should be familiar with the offer of entities that at some point may become one of their strategic partners facilitating the start or continuation of their own business.

The survey also asked which areas of operation pursued by business environment institutions the students would most like to benefit from when planning to run a business. The figure below details the percentage of these institutions' areas of support indicated by students who expressed an interest in using the services of chambers of commerce.



**Figure 1.** Areas of activity of business support institutions in the opinion of students who are interested in using the services of chambers of commerce.

Source: Own study based on own research.

The area of activity that was considered key by students interested in using chambers of commerce was obtaining funding, including, inter alia, grants, indicated by 76.67% of respondents. This result indicates a prevailing demand for financial support among would-be entrepreneurs, suggesting that access to finance is a key determinant of their development and ability to implement business ideas. The next most important area for respondents is trainings and workshops (72,22% of responses). Such a high percentage of students indicating the need for trainings and workshops underlines the importance of developing practical competences and acquiring up-to-date business knowledge. Training and workshops are a key element in preparing young people to successfully navigate the labour market and enhance their competitiveness and adaptability to rapidly changing business requirements. Further areas of business environment institutions indicated as important are assistance in requestion EU funds (70% of responses) as well as promotion and advertising (65,56% studentów). The identification of these areas underlines that students perceive great opportunities for development and support from EU funds, which can significantly accelerate the implementation of their projects. It also demonstrates the need for support in terms of orientation in the complex procedures of obtaining EU funds and applying effectively for such funds. Furthermore, the high percentage of students interested in promotion and advertising indicates their awareness that effective marketing strategies are indispensable for the market success of their projects. An understanding of the importance of promotion and advertising in branding and reaching customers suggests that future entrepreneurs are aware of the need for a proactive and strategic approach to developing and positioning their products or services on the market. General and individual consulting was important to 62,22% of students, and assistance in

obtaining business contacts for 58.89% of students. Direct and concrete advice received from business environment institutions can significantly influence the development of entrepreneurship. Networking and building business relationships are fundamental to creating effective partnerships and opening up new market opportunities. Access to information turned out to be the least significant area of business environment institutions' operations for the surveyed group of students (this area was indicated by only one in three students). The relatively lower interest in accessing information may be due to easy access to data in the digital age, where students can independently search and analyse the information they need via the internet, focusing their needs on more interactive forms of support.

The study carried out on a group of students from the Faculty of Economics, Finance and Management also examined whether the independent variables (gender, field of study, degree of study and mode of study) had an impact on the dependent variable (desired areas of support among those interested in using the services of chambers of commerce). The table below shows the percentage of students' answers to the question concerning the dependent variable. Four criteria were taken into account: gender, field of study, degree of study and mode of study. In addition, the following table presents the values of correlation coefficients between the independent variables as well as between the independent and dependent variables.

**Table 1.**

*Percentage of students who answered the question regarding the desired areas of support by gender, field of study, degree of study and mode of study*

Criterion		Desirable areas of activity of business support institutions by students who are interested in using the services of chambers of commerce [in%]						
		Grant to open a business	Training and workshops	Assistance in requesting EU funds	Promotion and advertising	General and individual consulting	Various meetings and business integration trips	Information - access to current business information
Gender	Female	84,13	73,02	71,43	68,25	65,08	57,14	31,75
	Male	59,26	70,37	66,67	59,26	55,56	62,96	37,04
Field of study	Management	75,36	76,81	66,67	68,12	56,52	57,97	31,88
	Entrepreneurship and investments	80,95	57,14	80,95	57,14	80,95	61,90	38,10
Degree of study	I	81,13	71,70	71,70	69,81	66,04	62,26	33,96
	II	70,27	72,97	67,57	59,46	56,75	54,05	32,43
Mode of study	Full-time	86,67	66,67	76,67	70,00	60,00	56,67	36,67
	Part-time studies	56,67	83,33	56,67	56,67	66,67	63,33	26,67

Source: Own study based on own research.



**Table 2.**

*Values of Pearson's correlation coefficients between independent variables and values of T-Czuprow dependence coefficients between independent variables and the dependent variable*

Criterion		The value of the Pearson correlation coefficient $r_{xy}$ between the individual variants of the criteria (independent variables) when answering the question regarding the indication of the desired areas of business environment institutions by students who are interested in using the services of chambers of commerce	The value of the T-Czuprow $T_{xy}$ relationship between the criteria (independent variable) and the indications of desired areas of activity of business environment institutions by students who are interested in using the services of chambers of commerce (dependent variable)
Gender	Female	0,7874	0,0476
	Male		
Field of study	Management	0,5681	0,0671
	Entrepreneurship and investments		
Degree of study	I	0,9493	0,0208
	II		
Mode of study	Full-time	0,4869	0,0775
	Part-time studies		

Source: Own study based on own research.

The above summaries indicate that for the 'degree of study' criterion there is a very strong linear relationship, for the 'gender' criterion there is a strong relationship, and for the 'field of study' and 'mode of study' criteria there is a moderate relationship between the independent variables in response to the questions on indicating the desired areas of business environment institutions among students interested in using the services of chambers of commerce. This means that undergraduate and postgraduate students, as well as women and men, answered very similarly. Larger differences appeared between the responses of Management and Entrepreneurship and investment students, and between the responses of full-time and part-time students. At the same time, the very low values of the T-Czuprow index indicate that gender, field, degree and mode of study have no influence on the answers given by students. Such areas of activity of business environment entities as obtaining grants for opening a business, assistance in applying for EU funds, as well as counselling and individual consultations, are more desired by students of the Entrepreneurship and investment field of study. This may be due to the practical profile of the studies in this field of study. Students very often have the opportunity to learn about the offer of the discussed institutions thanks to field classes (e.g. as part of the following subjects: basics of business economics, entrepreneurship, setting up and functioning of a small company, business problems in practice), during which visits of students to enterprises and business environment entities take place.

## 5. Discussion

The results of the survey indicate that students are moderately familiar with the services offered by chambers of commerce. They are also not sufficiently aware that these entities can provide them with support at the stage of setting up (e.g. the 'My Company My Success' project implemented by the Northern Chamber of Commerce) or developing their business activities. This highlights the need for increased information and promotional activities on the part of chambers of commerce to effectively communicate the support opportunities they offer to prospective entrepreneurs. There seems to be a lack of effective communication channels to reach students and highlight the practical benefits of working with these institutions. Academic staff also need to intensify their activities aimed at increasing student interest in the offer of the chambers of commerce to a greater extent. Increasing awareness of the programmes these institutions provide could encourage more students to use professional advisory services, which could ultimately lead to more successful start-ups and new business development. Improving this communication could bridge knowledge gaps and make it easier for students to access valuable resources and experts. Integrating practical experiences, such as internships or workshops with chambers of commerce, into the curriculum could enhance students' understanding of the support available and foster a culture of entrepreneurship.

## 6. Summary

Chambers of commerce are institutions that bring together entrepreneurs. They represent their interests and support all economic initiatives of their members. Their activities play an important role in shaping economic policy, which manifests itself in lobbying for favourable regulations, advising in the rule-making process and organising public consultation and dialogue between the public and private sectors. In this way, they contribute to creating a more dynamic, competitive and resilient economy. Chambers of commerce can also play an important role in supporting entrepreneurial development among students. The study conducted focused on assessing students' perceptions towards chambers of commerce as potential business partners. The results indicated the need to increase students' awareness of the support services offered by chambers to future entrepreneurs. It is also important to intensify information and promotion activities on the part of the chambers of commerce in order to reach young people more effectively and encourage them to use professional advisory services. Their support can take place, for example, through educational initiatives and training programmes that provide the practical knowledge and skills necessary in today's labour market. The workshops, training courses and conferences they organise can enable students to gain

up-to-date industry knowledge and learn about modern tools and technologies. An important role of chambers of commerce is also to facilitate access to the labour market through internship and apprenticeship programmes. By cooperating with local companies, chambers of commerce help students to gain their first work experience, which is invaluable for building a career. The chambers of commerce also organise networks (networking) that enable students to establish relationships with professionals and potential employers. Thanks to the wide range of services offered by the chambers of commerce, students can better prepare themselves for the challenges of the labour market and acquire the necessary skills and knowledge that contribute to their professional success.

The research results are limited by a potentially small and homogeneous sample size, which may not accurately represent the broader student population. The study opens avenues for future research, particularly in exploring the effectiveness of specific programs offered by chambers of commerce and their impact on student entrepreneurship. Future research should aim to include a larger and more diverse sample of students from various institutions to enhance the generalizability of the findings.

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Ministry of Science and Higher Education  
Republic of Poland

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## GREENWASHING IN CORPORATE SOCIAL RESPONSIBILITY: BIBLIOMETRIC ANALYSIS

Monika WODNICKA<sup>1\*</sup>, Azeta TARTARAJ<sup>2</sup>

<sup>1</sup> University of Lodz, Faculty of Economics and Socjology, Department of Business Analysis and Strategy;  
monika.wodnicka@uni.lodz.pl, ORCID: 0000-0002-9656-5713

<sup>2</sup> Aleksandër Moisiu University, Durrës, Albania, Faculty of Business; azetatartaraj@uamd.edu.al,  
ORCID: 0000-0002-7276-0565

\* Correspondence author

**Purpose:** The aim of the research conducted was to identify the main research areas in scientific articles addressing greenwashing in corporate social responsibility and to present the most current areas of research in this area.

**Design/methodology/approach:** The study was conducted between August and December 2024. Scientific articles from the Scopus database were submitted for analysis. They were selected according to bibliometric query Q1. Based on the established criteria, 149 scientific articles were identified. These articles were analysed according to author keywords using the VOSviewer software, which was helpful to generate bibliometric maps. The study also conducted a systematic literature review of scientific publications that addressed the issue of greenwashing in corporate social responsibility.

**Findings:** We identified 11 author keywords most frequently used in the analysed publications. The analysis allowed us to see that the most topical areas of research in greenwashing in corporate social responsibility are ESG and corporate governance.

**Research limitations/implications:** Among the limitations of the study conducted, two factors can be mentioned. The first factor limiting the present study is the choice of a single database, which is the Scopus database. The bibliometric query Q1 constructed in the first stage of the research considerations undertaken can be considered the second limiting factor of the study. However, the analyses carried out in this article confirmed the validity of the choice of the Scopus database, as the articles selected for the study did not include studies prepared on the basis of the Scopus database alone. Constructed in this way, the study allows for expert planning of future research, with a focus on replicating this study in the future to verify new research areas.

**Originality/value:** The study carried out in this article is unique from those conducted to date, as confirmed by the Q1 bibliometric query constructed. The analysis identified the most up-to-date areas of research linking greenwashing and corporate social responsibility, as well as important future research directions, such as addressing the issue of green blockchain. In the authors' opinion, the article can be an inspiration for other researchers and those interested in the issues of greenwashing and corporate social responsibility.

**Keywords:** greenwashing, corporate social responsibility, green blockchain, green organization, sustainable development.

**Category of the paper:** Literature review.

## 1. Introduction

The rise in popularity of corporate social responsibility (CSR) means that companies often use CSR as a marketing ploy (Wu et al., 2020) using sometimes unsubstantiated or misleading claims about environmental and social attributes to create themselves as an environmentally friendly company (Aggarwal, Kadyan, 2011). This practice occurs both in the regulated commercial sphere and in the unregulated non-commercial sphere i.e. governments, NGO partnerships, or international declarations and commitments (Nemes et al., 2022). The practice described is referred to as greenwashing, and organisations that link poor environmental performance to positive communication about their environmental performance are greenwashing organisations (Delmas, Burbano, 2011).

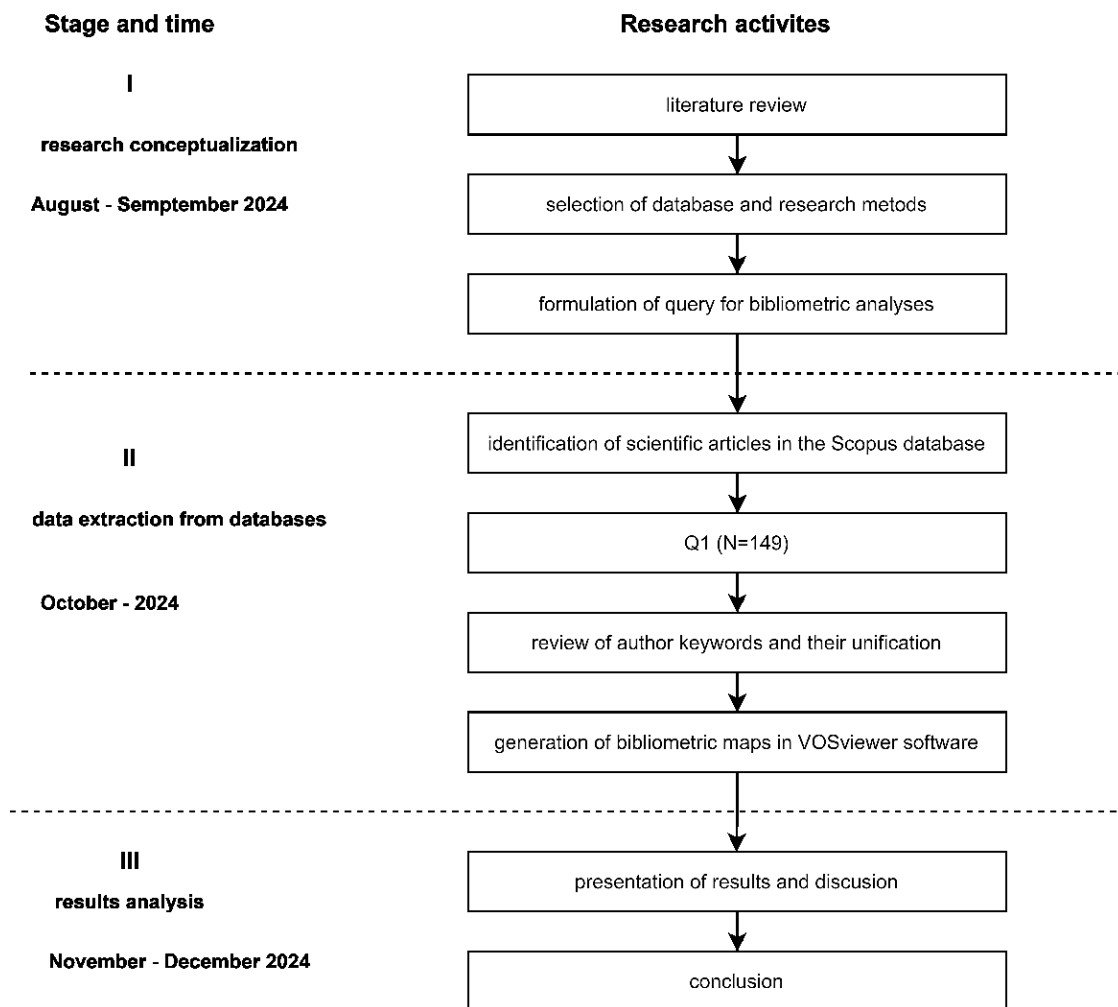
The phenomenon of greenwashing is discussed by researchers in a wide range of areas. Although the problem is discussed in the context of, for example, promoting an organisation's social status, building relationships with consumers and employees or achieving short-term profits. Greenwashing, however, leads to the deliberate avoidance of changes to reduce negative environmental impacts (Nemes et al., 2022). The systematic adoption of greenwashing practices increases customer scepticism and reduces trust in a company's corporate social responsibility intentions (Santos, Coelho, Cancela, 2024) at the same time as preventing consumers from making informed purchasing decisions. This aspect is already recognised in various studies on the issue of consumers operating in an economy that is undergoing a green transition (Poduszyńska, Kozar, 2024).

This article undertook two research objectives. One objective referred to the presentation of the main research areas addressing greenwashing and corporate social responsibility simultaneously. The second objective concerned the identification of future research directions in the field of the addressed issues. To fully realise the objectives set, a systematic literature review (SLR) was conducted in this study. The Scopus database was selected for analysis. Articles were selected according to the constructed bibliometric query Q1. The VOSviewer software (version 1.6.20) was used to present the results graphically. This programme is used by numerous researchers to map bibliometric data (Kozar, Bolimowski, 2024b; Kozar, Wodnicka, 2024; Nuraisiah et al., 2024).

The article contains four parts: introduction, material and method, result and discussion, conclusion. The introduction of this paper justifies the choice of topic and presents the purpose of the research and the research methods. Using the literature on the subject, the issue of greenwashing and its importance in corporate social responsibility is presented. The timeline of the research work carried out is described in the second section on research material and methods. The Q1 bibliometric query, according to which articles were selected for analysis, was also presented and the VOSviewer software, which was used to generate bibliometric maps, was described. The next section provides a discussion based on the results obtained. The final section of this article provides conclusions.

## 2. Material and Method

The research described in this article was carried out in the period August - December 2024. Three research stages were adopted, which served the research objective outlined in the introduction. Each stage was assigned specific research activities and a time period for their implementation (Figure 1).



**Figure 1.** Research procedure stages and timeline.

Source: authors' elaboration.

The research considerations started with the conceptualisation of the study. This stage was oriented towards a general literature review on the issue of greenwashing in corporate social responsibility. The sources analysed were mainly from the Scopus database and Google Scholar. The analysis of selected publications made it possible to perceive an increased interest among researchers in the topic of greenwashing (Kozar, Bolimowski, 2024a; Santos, Coelho, Marques, 2024; Wodnicka, 2023). Accordingly, a research objective has been set for this article, which is to identify the key research areas undertaken by researchers in the field of the issues covered in the title of this paper. At this stage, research methods and tools were also identified

(bibliometric analysis, SLR method, VOSviewer software were selected). The next step was to select the database and define the variables for the bibliometric query Q1, which are presented in Table 1. The choice of the Scopus database was intentional, as it is considered by researchers to be a reliable source of scientific information for bibliometric analyses (Ben Youssef, Mejri, 2023; Kozar, 2024; Wodnicka, 2024).

**Table 1.**  
*Search Query syntax details*

Symbol	Query syntax	No. Results in the Scopus
Q1	TITLE-ABS-KEY ( greenwashing AND ( "Corporate Social Responsibility" OR csr ) ) AND PUBYEAR > 2002 AND PUBYEAR < 2024 AND ( LIMIT-TO ( SRCTYPE , "j" ) OR LIMIT-TO ( SRCTYPE , "p" ) ) AND ( LIMIT-TO ( PUBSTAGE , "final" ) ) AND ( LIMIT-TO ( DOCTYPE , "re" ) OR LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "cp" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )	149

Source: Authors' elaboration.

The review of the Scopus database according to bibliometric query Q1 used covered articles in English published between 2003 and the end of 2023. The review consisted of verifying titles, abstracts and keywords in all identified articles that referred to greenwashing and corporate social responsiveness. Criteria for extracting scientific publications from the Scopus database presented table 2. Based on the criteria adopted, 149 scientific articles were identified and further analysed using the VOSviewer software. The functionality of this software allows bibliometric maps to be graphically represented in an easily interpretable way (van Eck, Waltman, 2010).

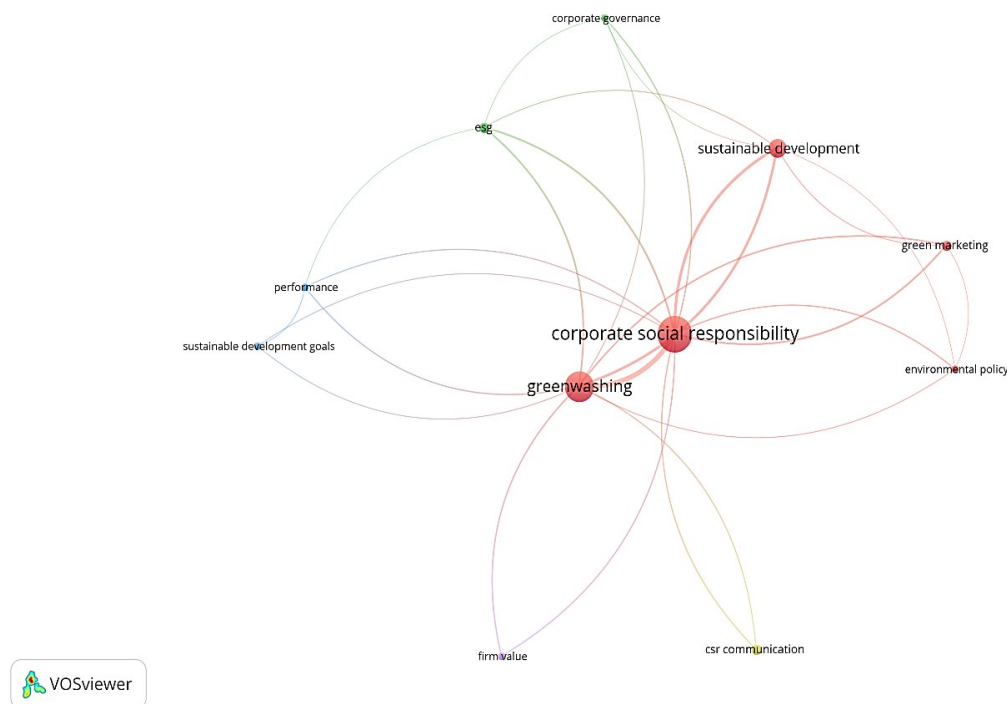
These analyses were carried out in the next stage of the research. As a result, 470 author keywords were obtained. The resulting words were subjected to a unification procedure due to their different spelling forms. Spelling unification was carried out for the author keywords by selecting one variety of English. For keywords that occurred in both the plural and singular number, one of the numbers (plural or singular for the author word) was used. When identifying author keywords, the full name of the author word in question was used for some of them or linguistic errors were eliminated.

Further analyses were conducted on the basis of 124 author keywords, as alignment was done for 25 keywords. The generated new keywords in csv format were used to create bibliometric maps, which were generated using software VOSviewer (1.6.20 version). The co-occurrence, author keywords and full counting options were used when generating the maps. They were also re-checked at the verity selected keywords step, which did not exclude any author keywords. In the third stage of the research, the results were analysed on the basis of the obtained results.



### 3. Results and discussion

In this part of the article, three bibliometric maps were generated according to the research steps presented above and the assumed criteria. Their visualisations are graphically presented in Figure 2, Figure 3 and Figure 4. In the choose threshold panel, the minimum number of co-occurrences of author keywords proposed by software VOSviewer was set at 5. This criterion was met by 11 author keywords. Their visualisation on the bibliometric map is presented in Figure 2, where each keyword is indicated by the colour of the cluster to which it was assigned.



**Figure 2.** Author keywords co-occurrences in full counting method of Q1 results.

Source: authors' elaboration in VOSviewer software (1.6.20 version).

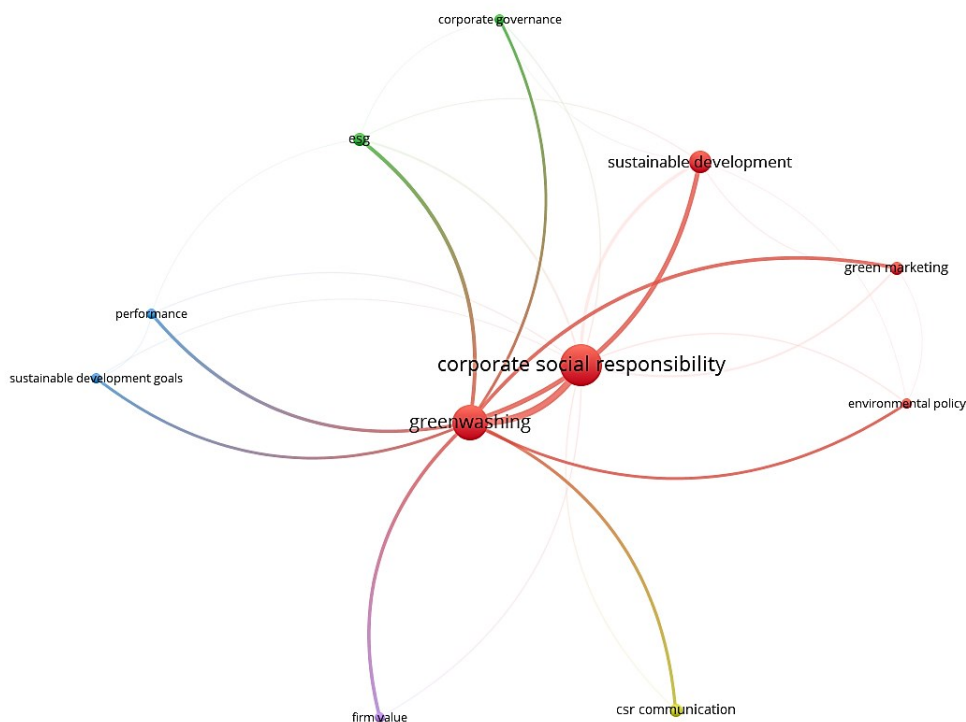
The co-occurrence analysis of the identified author keywords most frequently used in the analysed publications is also presented as quantitative bibliometric data (Table 2). In the analysed articles, the most frequent author keywords are those contained in the red cluster and include corporate social responsibility ( $O = 101$ ), greenwashing ( $O = 74$ ), sustainable development ( $O = 27$ ).

**Table 2.**  
Cluster of author's keywords visible in Figure 2

Cluster	Composition of keyword clusters by links, total link strength, co-occurrences			
	Author's Keywords	Links (L)	Total Link strength (TLS)	Co-occurrences (O)
Red	corporate social responsibility	10	110	101
	environmental policy	4	8	5
	green marketing	4	17	8
	greenwashing	10	100	74
	sustainable development	6	42	27
Green	corporate governance	4	8	5
	ESG	5	19	8
Blue	performance	4	10	5
	sustainable development goals	3	6	5
Yellow	CSR communication	2	7	8
Purple	firm value	2	9	5

Source: Authors' elaboration.

Another bibliometric map was generated to highlight the author keyword greenwashing (Figure 3). The analysis allowed us to see that this word co-occurred with other listed author keywords.



**Figure 3.** Keyword “greenwashing” relations with other keywords.

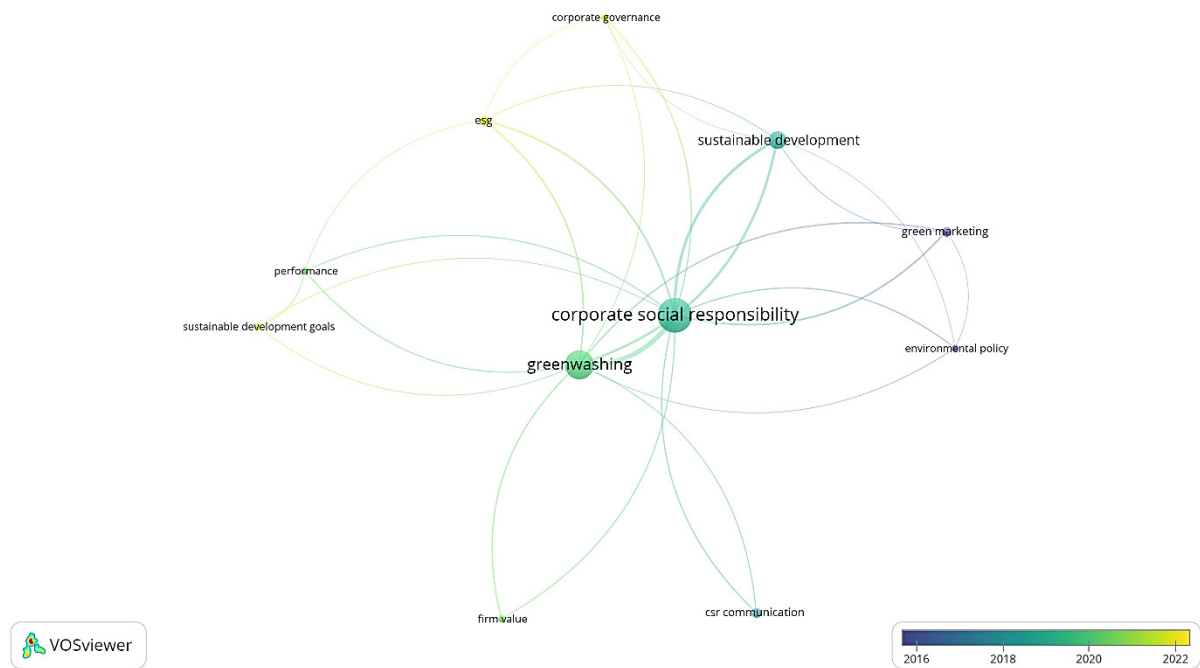
Source: authors' elaboration in VOSviewer software (1.6.20 version).

A further bibliometric map (Figure 4) was generated to complement the analysis and to show the changes over time in the research undertaken on the topic under discussion. This action was taken to indicate the most recent areas of research. These areas are marked in light colour.

As can be seen from the presented bibliometric overlay map generated using VOSviewer, one of the new areas of research linking greenwashing and corporate social responsibility is corporate governance. This research targets corporate governance and its relevance in terms of creating stakeholder value through improved environmental practices (Velte, 2023) and engaging in community projects (Choi, Hong, 2022). Researchers emphasise that different corporate governance mechanisms such as, for example, board of directors, ownership structure, and shareholders should be analysed to examine their impact on companies' environmental disclosure and prevention of greenwashing (Pinheiro et al., 2023).

Another new issue raised in the articles analysed is ESG. The attention of researchers to this area is due to several arguments. One is the growing interest in Environmental, Social and Corporate Governance (ESG) in business, mainly in ESG-based investments (Kim, Lee, 2023). In addition to this, the academic research undertaken in this area and the results obtained are expected to allow all those interested in this topic to better understand the complexity of corporate ESG aspects particularly in terms of the complexity of ESG measurement (Jámbor, Zanócz, 2023). As highlighted by researchers, ESG risks are more challenging than traditional risks known and established in risk management (Frank et al., 2021) hence the need to identify them.

The last most recent area of research identified in the bibliometric map is sustainable development goals. This area addresses the development of environmental reporting and corporate social responsibility highlighting the measurement and provision of information to support the achievement of sustainability (Wilson, 2021). It raises issues of greenwashing and the need for transparency across value chains (Thakker, Sun, 2023). According to the researchers, this is an area that requires research and the development of a model for assessing corporate social responsibility with sustainable development goals in mind (Lu et al., 2021). According to the researchers, the rationale for conducting research in this area is the existence of a large number of methodologies and indicators for environmental reporting and corporate social responsibility used by companies. This results in a lack of full transparency and gives difficulties in comparing companies and the inability to compare corporate social responsibility between industries or countries (Lu et al., 2021), and sometimes supports and gives positive results in greenwashing (Wilson, 2021).



**Figure 4.** Overlay map of the author's keywords co-occurrences.

Source: authors' elaboration in VOSviewer software (1.6.20 version).

An analysis of the articles shown in this bibliometric study showed that some of them presented results from bibliometric studies. These studies were conducted using data from the Web of Science database (Montero-Navarro et al., 2021; Nyantakyi et al., 2023; Wang, Ma et al., 2023) or from a combination of this database and the Scopus database (Jámbor, Zanócz, 2023; Vangeli et al., 2023; Ziabina, Dzwigol-Barosz, 2022). A study was also identified, which was a literature review based on articles published in a number of databases, i.e. ScienceDirect, Emerald Insight, SpringerLink and Web of Science (Yang et al., 2020). To demonstrate the research differences between this article and the articles taken for the study, the content of the bibliometric queries prepared by the researchers in their research articles was analysed. In some of the research papers, it can be observed that the researchers omitted the word corporate social responsibility in their bibliometric queries using only the word greenwashing itself (Vangeli et al., 2023; Yang et al., 2020) or in addition to the word greenwashing they used various other forms of it (Montero-Navarro et al., 2021; Wang, Ma et al., 2023). An article was also identified where the biliterate query omitted the word greenwashing and used the word corporate social responsibility combining it with the word green brand (Ziabina, Dzwigol-Barosz, 2022). Among the articles analysed were also those where the authors did not use the words greenwashing and corporate social responsibility in the bibliometric query (Jámbor, Zanócz, 2023; Nyantakyi et al., 2023). Hence, the presented study is distinguished not only by the choice of database, which is the Scopus database, but also by the content of the bibliometric query. This allowed for a new quality of data presented in the bibliometric maps.

Corporate social responsibility and greenwashing have been an area of interest among researchers for several decades. Mainly, research on greenwashing is widespread in developed countries (Ioannou et al., 2023). Initial studies highlighted public and political concerns about the environment, which have raised the profile of corporate social responsibility (CSR) among companies (Watson, Mackay, 2003), and the prevailing lack of an agreed international system of environmental accounting reporting, which may consequently encourage greenwashing (Delmas, Burbano, 2011). Despite the passage of many years, this problem is still relevant.

In their studies, the authors undertake analyses of this issue from different perspectives. They consider the phenomenon of greenwashing, for example, from the point of view of consumers (Delmas, Burbano, 2011), employees (Mu, Lee, 2023; Robertson et al., 2023), the role of management in the relationship between greenwashing and firm value (Chen, Dagestani, 2023), financial management (Gregory, 2023) or investment decisions (Gregory, 2023). It is also possible to note analyses on the 'collaborative management of greenwashing' where researchers emphasise its non-existence (Wang, Ma et al., 2023; Wang, Sun et al., 2023). They acknowledged the validity of collaboration among multiple stakeholders participating in the market i.e. government, businesses, media, non-profit organisations and citizens to share information on corporate social responsibility. They highlighted that many actors participate in the management of greenwashing individually without information sharing and collaboration, which translates into ineffective management of the phenomenon in question (Wang, Sun et al., 2023). Encouraging actors to participate in the management of greenwashing at both macro and micro levels will create a good culture of honest and trustworthy low-carbon consumption throughout society (Wang, Ma et al., 2023).

According to the analysis, transnational corporations could use their finances, manpower, production infrastructure or logistical expertise to play a key role in corporate social responsibility and sustainability, but greater rigour, consistency, transparency in their disclosure of data related to environmental performance is required (Lamont et al., 2023). Also, sustainability indicators that would support the market's function of embracing corporate social responsibility as part of corporate performance are currently unavailable in a form that would be credible and could hold companies accountable for poor performance or use of greenwashing (Tsagas, 2020).

#### **4. Conclusion**

This article demonstrates that the stated aim of the research, which was to identify the main research areas undertaken by researchers in the issues identified in the title of this study and to identify the most topical issues emerging in recent studies, has been achieved. Eleven research

areas most frequently addressed in scholarly articles were identified, including the three most recent (corporate governance, ESG, sustainability development goals).

Nowadays, more and more companies are prioritising CSR by embedding it in their operational strategies, but due to two factors, i.e. corporate legitimacy and stakeholder pressure to be green, they are taking steps towards using greenwashing (Mu, Lee, 2023). Researchers have concluded that multinational corporations tend to disregard corporate social responsibility when it is convenient for them and then use greenwashing for their strategic benefit (Reza, Du Plessis, 2022). Despite this, greenwashing is perceived as a phenomenon that harms society, even when it benefits various stakeholder groups (Yang et al., 2020).

Undoubtedly, the study carried out shows that the problem of greenwashing in the context of social responsibility requires constant attention and ongoing research to find long-term and effective solutions to reduce or eliminate this phenomenon at both the macro and micro level. In this context, new technologies, including green blockchain, allowing for reliable reporting of information related to pro-environmental activities, are an interesting direction for future research and scientific considerations in the field of greenwashing and corporate social responsibility, particularly in the area of reliability of presented data.

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## THE IMPORTANCE OF THE ENERGY SECTOR IN BUILDING SOCIAL WELL-BEING: CHALLENGES OF SUSTAINABLE DEVELOPMENT AND THE POLISH PERSPECTIVE

Grażyna WOLSKA<sup>1</sup>, Joanna KIZIELEWICZ<sup>2\*</sup>

<sup>1</sup> Faculty of Economic Sciences and Management, Nicolaus Copernicus University in Toruń;  
grazyna.wolska@umk.pl, ORCID: 0000-0002-7289-5179

<sup>2</sup> Faculty of Management and Quality Science, Gdynia Maritime University; j.kizielewicz@wznm.umg.edu.pl,  
ORCID: 0000-0001-7415-9928

\* Correspondence author

**Purpose:** The main objective of the article is to demonstrate that the currently adopted path of economic development in the Polish energy sector is accelerating ecological crisis and failing to ensure the ecological and economic security essential for long-term sustainability. By highlighting the negative consequences of present-day energy policies, it emphasizes the need for a more holistic approach that incorporates economic, social, and environmental considerations.

**Design/methodology/approach:** This article employs a triangulation of methods, including a critical literature review, hermeneutic analysis, logical-semantic analysis, and conceptualization of key terms, guided by the principle of Occam's razor for clarity and precision. It examines the implications of Poland's energy sector policies on ecological sustainability, economic security, and social well-being. The approach provides a multifaceted perspective on energy transition within the framework of sustainable development.

**Findings:** A crucial focus has been placed on the energy sector, given its substantial contribution to CO<sub>2</sub> emissions. The argument presented here is that only by integrating environmental objectives with economic and social goals could Poland—and indeed other nations—achieve relevant level of the sustainable development. The key point is that such integration requires rethinking current policy and energy strategies, prioritizing investments in low-carbon technologies, and strengthening public participation mechanisms to foster greater awareness and engagement.

**Research limitations/implications:** The Polish energy sector operates within a unique socio-political and economic context, influenced by historical dependence on coal, current policy structures, and public sentiment. These factors may reduce the generalizability of research findings to other countries with different energy mixes and policy frameworks. While this research emphasizes the importance of public participation, it does not extensively analyze the perspectives of all stakeholder groups e.g., local communities, private sector, or non-governmental organizations. A broader range of viewpoints could further enrich the findings.

**Practical implications:** The findings of this research could serve as a valuable resource for researchers and experts in sustainable development, energy policy, and environmental studies, as well as policymakers and local government representatives responsible for implementing environmental and energy strategies.

**Social implications:** Additionally, non-governmental organizations, scientific research institutions who are engaged in the future of the energy sector should also find the results of the study valuable for the public debate and policy decisions.

**Originality/value:** The study calls for policy changes, investments in low-carbon technologies, and greater public involvement to support sustainable energy transitions. These recommendations are tailored to Poland's specific social and economic context, offering practical insights for improving sustainability.

**Keywords:** natural environment, sustainable development, energy policy.

**Category of the paper:** Case study, literature review.

## 1. Introduction

The concept of sustainable development is based on the correlation of the economy, natural environment, and society, forming its three fundamental systems. The environment is one of the important pillars of sustainable development, as it provides the economy and society with information on external costs, the standing of institutions, social capital, and the level of social participation. Therefore, it is so important to recognise the role of the natural environment in building social wellness and well-being. The issues covered in this article include primarily issues related to the energy sector, which is one of the largest emitters of CO<sub>2</sub>. The study aims to prove that the currently adopted path of economic development in the energy sector in Poland leads to the ecological catastrophe, and that the current activities within the energy policy do not ensure the ecological and economic security.

The socio-economic development and growing environmental problems related thereto, as well as the growing interest in the quality of natural environment in the 1970s, have become particularly important in recent years. In addition to the concept of "nature conservation", the term "environmental protection" emerged and became dominant. Nowadays, the environmental protection is defined as a set of activities including the protection and rational management of natural resources in accordance with the principle of sustainable development, protection of particularly treasured values of the natural environment (Knoepfel, Nahrath, 2005), restoration of natural elements, prevention of pollution, protection of the human living environment against any burdens and nuisances (CSO 1993, p. 41). The environmental protection can also be defined as protection against the wrong directions of civilization development, which contributes to the degradation of environment and disruption of the conditions of human existence on Earth.

From the economic point of view, it is worth quoting the opinion of H. Rogall (2010), who believes that many representatives of the ecological economics want to maintain the traditional neoclassical economics as a foundation, reforming only some of its aspects. Some economists, however, propose to develop a "theory of modern economy", which would be a creative development of classical thought (Rogall, 2010, p. 8). Upon examining these issues, A.T. Kowalewski (2006) proposes to verify these attitudes for at least two reasons:

- obsolescence of many theories that were developed in a decidedly different reality than the current one,
- necessity of confronting the economic theories with the ideas of balancing the development and the areas of natural and social sciences (Kowalewski, 2006, p. 154, as cited in: Pondel, 2013).

In the opinion of S. Czaja and B. Fiedor (2010), the necessity to verify the neoclassical economics results from its failure to take into account the laws of nature, which are very important for the sustainable development. Therefore, these authors present two approaches (paradigms) related to the review of economic theories: ecological paradigm of economics (greening of economics and economic activity) and paradigm of economization of the natural environment (in terms of its protection and economic use) (Czaja, Fiedor, 2010, pp. 30-50).

The complexities between the economics and sustainable development, presented in a concise way, indicate that the evolution of traditional economics towards the sustainable economics is underway. Nowadays, the assumptions supporting the sustainable development are defined by the economics of sustainable development. According to H. Rogall (2010), this is "an economic theory that takes into account transdisciplinary foundations (...), pursuing to define such conditions of management that would ensure sufficiently high economic, socio-cultural and ecological standards within the nature tolerance limits, implementing the principle of intra- and intergenerational justice" (Kowalewski, 2006, p. 154; Pondel, 2013, p. 24). In the theory of sustainable development economics, the implementation of its assumptions in the economic practice is particularly important (by virtue of the importance of practical consequences) (Barnett, 2019).

As emphasized above, the concept of sustainable development is based on the correlation of the economy, natural environment, and society, forming its three fundamental systems and it's associated also with environmental management systems (ISO, 2020). Therefore, the environment is one of the important pillars of sustainable development. While the economic and social issues have long been of interest to theoreticians, economic practitioners and politicians, the ecological considerations have struggled to make their way into the decision-making processes (Wolska, 2021).

A low level of environmental awareness has led to disastrous climate consequences, and the environmental crisis has become a fact. It should be emphasised that in the public awareness the concepts of climate and weather are often considered equivalent. Meanwhile, weather is a short current system of atmospheric and temperature conditions, i.e., a temporary atmospheric

situation in a given place, usually within a small area of the Earth. Whereas long-term, usually thirty-year-old observations of these weather conditions, carried out regularly with the use of objectively verifiable and correct methods, allow us to determine the process of climate creation. Human research on climate is conducted on a large scale by means of instrumental studies, e.g., precipitation, temperature level and wind velocity, and through the paleoclimatic reconstructions, i.e., the possibility to study temperatures that existed on Earth a very long time ago within several hundred thousand years. These studies indicate that the current change in the Earth's atmosphere over a period of approximately 150 years is unprecedented in the geological history of the Earth known to us. It mainly refers to the speed and intensity of changes in the geological history of the Earth, studied quite thoroughly over a period of five hundred million years. The furthest reconstructions of temperature and atmospheric components on the Earth indicate that apart from natural climate processes, people added to them the aspect of economic activity related to the emission of carbon dioxide, methane and nitrogen compounds. When these substances enter our atmosphere, they destabilize the climate. The loss of climate equilibrium is obvious all over the world. The record levels regarding the latest measurements include, for example, the first days of January 2023, when the temperature in many places in Poland reached 19 degrees C. According to the indications of the Institute of Meteorology and Water Management (IMGW Obserwator, 2023), in many places in Poland we observed the thermal summer. Whereas on the other side of the Atlantic Ocean, in the USA and Canada, we observed a very strong and violent hit of winter. Paradoxically, this is also a consequence of climate change, involving e.g., global warming, i.e., an increase in average global temperatures, and the accumulation of more energy in our atmosphere, caused by the effects of greenhouse gases (CEN, 2012).

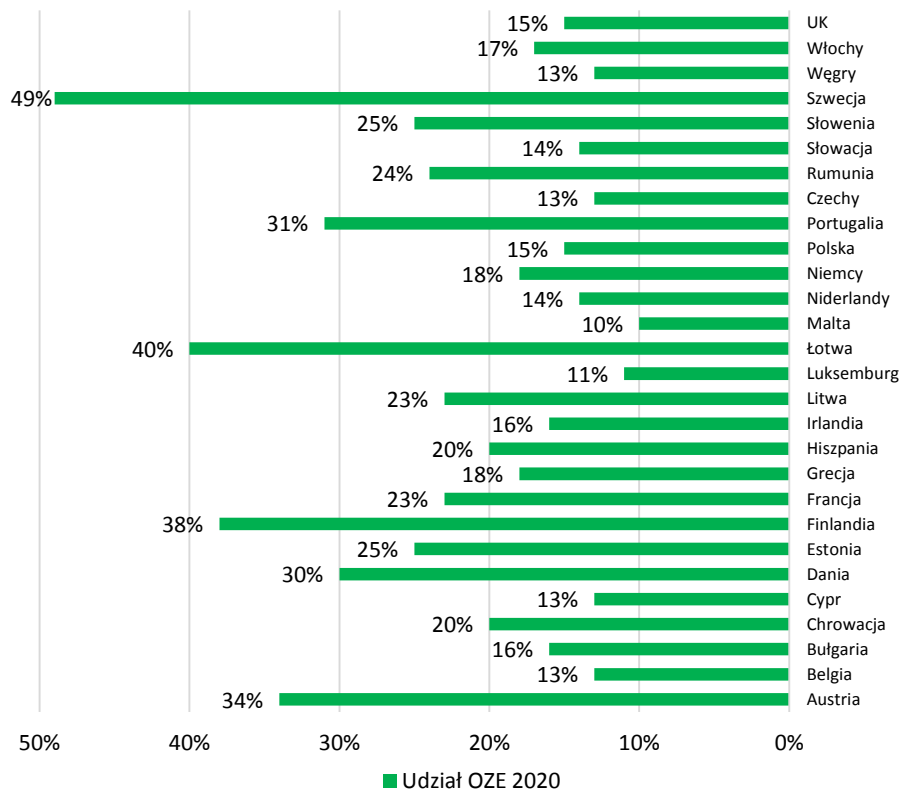
The accumulation of energy slowly disturbs the climate system and causes, e.g., the disruption of the so-called polar vortex, i.e., cold air masses circulating over the North Pole. As a result, they get out in the southern areas and enter the areas where harsh winter did not occur. In recent years, we observed this phenomenon e.g., in Texas and New Mexico (Attack of Winter in the USA, 2023). In 2021, winter hit Canada with a great force and then the southern regions, covering a large area of the United States. Snowfall and cold temperatures were also observed in the state of Texas. There have been numerous collisions and accidents, and many sections of the road were impassable. The temperature was lower than the long-term standard for this time of year, even by 14-17 degrees Celsius. Snowfall, frost, and stronger wind gusts forced Americans to close many stores and cancel thousands of flights. There have been many failures of power grids. In addition, the frost with snowfall from Canada also reached the Gulf of Mexico and Florida. Most of the problems occurred on the roads in the state of Texas near the border with Mexico, where people are not prepared for extreme winter weather.

Climate change is a process that has been observed over decades. The Organization of United Nations issued a document "Transforming our world: the 2030 Agenda for Sustainable Development" (UN, 2015, pp. 5-38)." where 17 Sustainable Development Goals (SDGS) were established and the European Commission developed the program called the European Green Deal (EC, 2019) **which also set out the main goals that should be achieved by 2030, i.e. a reduction in net greenhouse gas emissions by at least 55% and** the second target set by 2050, i.e. net-zero greenhouse gas emissions (Kizielewicz, 2022). However, this is now becoming more and more dangerous as gradually more greenhouse gases are emitted. The annual global emissions reach approximately 35-36 billion tonnes of gases. These gases decompose in the atmosphere and over 150 years have caused a 40% increase in the concentration of carbon dioxide (IMGW Obserwator, 2023). The process of increasing the carbon dioxide concentration has been ongoing ever since. Such a rapid increase in the amount of gas in the atmosphere has never occurred in the geological history of the Earth.

## 2. Energy in the Context of Natural Environment – Literature Review

The energy sector is one of the largest CO<sub>2</sub> emitters. At the same time, it allows to maintain and develop the civilizational progress. Nevertheless, it is difficult to refute the argument (put forward by scientists and the enlightened part of society) that it is necessary to reduce CO<sub>2</sub> emissions from the energy sector and other areas of human economic activity. This does not mean that they demand to abandon energy production, on the contrary, they recommend a wider use of the latest technologies that allow for the production of green energy (turbines, photovoltaics, biomass, nuclear power), which, despite many imperfections, is safer for people than coal-based energy.

Despite numerous measures taken and noticeable downward trends (EEA Report, 2023), CO<sub>2</sub> emission rates are too high in most EU countries. This points to the need for more effective measures to protect the environment. In accordance with the Energy and Climate Package, called the 3x20 Package, which is a collection of documents concerning the areas of energy, climate and synergies between them, the EU has committed to reducing the emissions of hot gases by 20% as early as in 2020, increasing the share of energy from renewable energy sources (RES) to 20% and increasing energy efficiency by 20%. Moreover, the increase in the share of biofuels in transport to 10% was planned as well as the increase in the EU energy security and independence. (Ziębik, Gładysz, 2015). The EU detailed targets and objectives are presented in Figure 1.

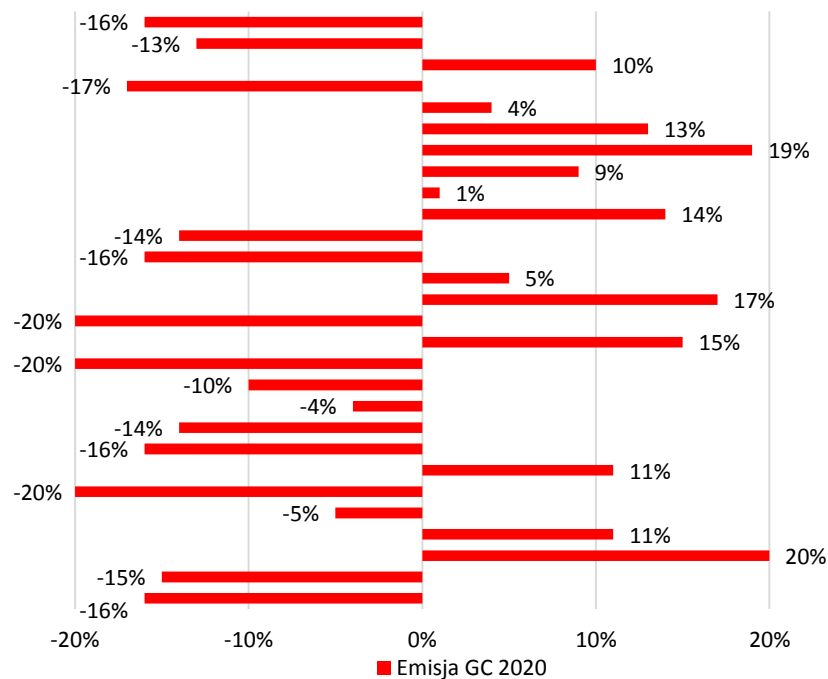


**Figure 1.** The share of RES in the structure of energy generation in a given country in 2020 compared to 2005 in the EU according to PEK.

Source: own elaboration on the base of (EEA Report, 2019; EEA Report, 2020).

The objectives presented in Figure 1 and Figure 2 were divided amongst Member States. Each of them was given an individual goal, conditioned by historical factors, raw material deposits and the level of the country development. One of the key tools for achieving the above-mentioned objectives referred to the Emissions Trading Scheme (ETS) (Bednorz, 2010, p. 47; Directive 2003/87/EC, 2023). The system introduces predetermined, total limits of CO<sub>2</sub> emissions into the atmosphere each year. Over the years, this limit is reduced by 1.74% per year, which is designed to reduce the emissions in the EU in proportion to the decrease in the number of allowances. Moreover, this ETS trading system covers countries outside the Community, such as: Iceland, Liechtenstein, and Norway.





**Figure 2.** Change in the amount of GC (Greenhouse Gases) emissions in a given country in 2020 compared to 2005 in the EU according to PEK.

Source: own elaboration on the base of (EEA Report, 2019; EEA Report 2020).

A single allowance means that the holder can emit one tonne of CO<sub>2</sub>. Allowances are allocated amongst Member States according to their needs. Each country distributes them as per the national plan throughout installations and appraises the volume thereof at the end of the year. If not all allowances are used, it is possible to sell them in auction or leave them for the next term. Otherwise, it is necessary to incur the cost of purchasing an additional number of allowances. This system covered only approx. 45% of all gas emissions, did not apply to all facilities and sectors (non-ETS). It excluded small entities with a capacity not exceeding 3 MW or emitting no more than 25 thousand tonnes per year. The remaining 55% (e.g., transport, aviation, agriculture) has been covered by another document, which assumes a 10% emission reduction in this period at the Community level (Decision 2009/406/E, 2009).

When considering the issue of greenhouse gas emissions into the atmosphere, it is worth noting that in 2020 there were 276 coal-fired power plants operating in the EU, including 110 lignite-fired and 166 coal-fired power plants. 63% of all facilities were located in three countries: Germany, Poland, and the Czech Republic. The largest power plants in terms of installed capacity include: lignite-fired plant in Bełchatów (5030 MW), Grevenbroich-Neutrach (Germany, 4424 MW), Niederaussem (Germany, 3676 MW), and Jaenschwalde (Germany, 3210 MW), coal-fired plant in Kozienice (3994 MW) and lignite- and coal-fired plant in Opole (3332 MW). Among the twenty largest installations, there were also another six in Germany and one in Poland (Bąk et al., 2022).

In 2020, under construction or in the commissioning process there were three facilities, including two coal-fired facilities in Poland and Germany and one lignite-fired plant in Greece. This state of affairs is very unsatisfactory; therefore, we have high hopes of modern coal-based technologies. In the EU, the NER300 programme has been established, involving the selection, by the European Investment Bank, of several dozen projects implementing innovative technologies, e.g., CCS (Carbon Capture and Storage), involves capturing carbon dioxide and financing half of the cost. In the first phase of this programme, none of the CCS projects was granted support from the national government, and no CCS facility was built (Hinc, 2011, p. 53). Such an approach raised concerns, especially since both the EU and independent organizations perceive in their analyses the use of CCS technology as one of the most important activities aimed to reduce greenhouse gas emissions (International Energy Agency, 2013; COM, 2011). Europe is lagging behind other regions of the world as regards this technology, as in 2015, in Europe there were only two advanced facilities (both in Norway, i.e., outside the EU) (Global CCS Institute, 2019). In 2019, the situation improved slightly, and eight facilities began to operate within the EU: six in the UK (then part of the EU) and one in Ireland and in the Netherlands (table 1).

**Table 1.**  
*Carbon Capture and Storage Technology in Europe*

Name of the state	Carbon Capture and Storage Technology
Norway	2
Ireland	1
The Netherlands	1
United Kingdom	6

Source: (International Energy Agency, 2013; Global CCS Institute, 2019).

However, the European Commission and the European Court of Auditors have independently concluded that the pace of investment is not satisfactory, both technically and economically, and that the EU's actions unfortunately failed to deploy the CCS technology on a larger scale (Strzępka, 2018; Directive 2009/31/EC, 2009). In order to speed up this process, the European Commission has established a fund for "economically weaker" countries, i.e., those with GDP below 60% of the average level in the EU. The resources from this fund are used for investments in the energy sector. Funds from the sale of ETS allowances from the reserve pool are indicated as a source of financing. According to the existing algorithm, in 2019 approx. 90% of the auction pool, the remaining 10% was distributed to countries with a GDP per capita up to 90% of the EU average. The EU has also approved the possibility to allocate free allowances to the energy sector, up to 40% of the auction pool, in countries with a GDP per capita up to 60% of the EU average. The allocation process is controlled by the EU institutions. Restrictions regarding energy markets have also been introduced (EU/CO 169/14, 2014; COM, 2019).

### 3. Research methodology

This article uses a triangulation of research methods, comprising a critical literature review, the hermeneutic approach, logical-semantic analysis, and the conceptualization of key terms. The principle of Occam's razor was also adopted, ensuring conciseness and precision in argumentation. It presents an original analysis of the implications of solutions adopted in the Polish energy sector for ecological policy, economic security, and social well-being. The hermeneutic approach took into account the intentions of the authors of the examined sources, while the critical literature review highlighted both historical conditions and current development trends. Logical-semantic analysis and consistent conceptualization of terms maintained coherence and prevented terminological ambiguities. As a result, a multifaceted perspective on the issue of energy transition in the context of sustainable development was developed, serving as a key to evaluating and designing future solutions.

### 4. Results and Discussion: Poland's Energy Solutions and Ecological Implications

In Poland, one of the most important current issues involves the slow implementation of the environmental requirements delegated by the EU and the comprehensive stability of the legal environment in terms of sustainable development. This indicates the need to reorient the position and role of the state in the area of sustainable development, which should come down to supervision, mainly arbitration activities towards the economic entities and the EU. Despite the fact that Poland is an EU member state, many EU environmental arrangements are not respected. This was clearly demonstrated by the events at the turn of 2023, related to maintaining the current model of coal use in households. At the time, the government in Poland argued that heating with coal was a good alternative and that the state would take care of the coal-based well-being of its citizens. As a result, 19.4 million tonnes of coal were imported in 2022 (Grzeszczak, 2023, pp. 42-71), compared to 12.9 million tonnes in 2020. In this context, it is worth mentioning that the extraction from the coalmines in Poland will have to gradually decrease, especially after bringing into effect the EU regulations on the reduction of methane emissions, which is a very weak point of the Silesian mines. *Polska Grupa Górnicza S.A.* (PGG) warns that the new standards will threaten its seven mines already in 2027, and two more by 2031. More affluent EU countries, influenced by the war in Ukraine and the need to cut off Russian energy resources, have undertaken austerity programs and energy transition acceleration. Meanwhile, since 2015, the Polish government has been successively blocking wind energy generation. In addition, contrary to the government's frequent praise of coal-fired

energy, a photovoltaic revolution has been initiated on the Polish Renewable Green Energy (RES) market. By installing PV panels, Poles have become the electricity prosumers. In 2022, the number of PV panels was estimated at about 1.26 million, while the installation capacity was estimated at 9.5 thousand MW. The number of solar power plants has also been gradually increasing. In 2022, they provided 55% of renewable energy. Micro-installations, together with larger photovoltaic farms, had a total capacity of 13.5 thousand MW. It should be noted that a PV installation with a capacity of 1 MW produces about 1.1 thousand MWh of energy per year. In a coal-fired power plant, this amount of electricity requires burning 500 tons of coal (Grzeszak, 2023, p. 41). It should be mentioned that power grids operate in two areas: commercial and physical. One area refers to contracts, settlements with producers and consumers, and the other to the laws of physics that determine the flow of energy in the network. This causes serious challenges, especially for distribution grids where the renewable photovoltaic sources are connected. Grids have to operate both directions, transmitting and receiving energy, although they were developed as Energy supplying systems only. At the same time, a large proportion of renewable energy is not produced where it is most needed. As a result, without large investments in power grids, the energy transition will not be possible. The draft Polish Energy Policy PEP2040 assumes that PLN 500 billion will be allocated for grid expansion by 2040. However, experts doubt whether such an amount will be possible to generate and whether there will be contractors able to carry out such large investments.

According to the assumptions of the European Commission, Poland (like other EU Member States) should move away from coal by 2040 in order to achieve climate neutrality in 2050. True climate neutrality means no carbon dioxide emissions into the atmosphere. However, it is difficult to measure the amount of carbon dioxide reaching the atmosphere versus a given entity responsible therefor. There are several types of definitions; the narrowest of them indicate that only emissions caused directly by an entity during the production process matter. Those who apply more broad definitions indicate that the electricity consumed by a company, when it comes from the combustion of coal, oil, or gas, should also be taken into account. The most comprehensive definitions also include the effects of sale, use and recycling of goods launched by a company.

The energy and fuel companies are currently strongly referring to the future climate neutrality. The problem is that they also most frequently use greenwashing, in Polish referred to as "green whitewash", "ecological baloney" or "eco-crap". In Poland, the state-owned energy company Polska Grupa Energetyczna (PGE), producing electricity mainly from coal is an example of greenwashing. The company declares reaching energy neutrality by 2050. However, it is not shutting down coal-fired power plants but wants to sell them. The Council on Foreign Relations (ECFR) best describes these and similar actions, indicating in their report that the existing ignorance towards climate becomes an area for practicing politics and playing interests that are not always headed in the right direction. By protecting their interests related to sectors threatened by transformation, the economic lobby is often resistant, providing

numerous analyses indicating that too rapid a transformation means a loss of competitiveness and is economically dangerous. The economic losses from the transition to greener energy production are probably inevitable, at the national level, in the regions and within companies. However, we should be aware that if the critical point in the climate system is exceeded (the moment thereof is difficult to precisely determine), feedback will be triggered, making human life difficult or even impossible. And it does not matter where the excess CO<sub>2</sub> emission occurs: in China, Africa, the United States, Australia, or Poland.

Another economic issue related to sustainable development and neglected by the Polish government is the thermal modernization of buildings. This is part of the EU's REP Power EU plan, which imposes an obligation on Member States to fight the "energy vampires". This name refers to buildings with the lowest thermal standard, requiring the highest expenditure on heating. There are about a million such residential buildings in Poland. It is estimated that they account for ca. 15% and that they consume about a third of the energy used in residential buildings. The EU's plan aims to introduce energy efficiency classes for buildings, similar to household appliances. According to the EU's proposal, buildings will be assessed as per classes from A+ to G. Class A+ refers to buildings with positive value as for energy efficiency relative to non-renewable primary energy, class A – emission-free buildings, while the worst class G will cover 15 per cent of buildings with the lowest energy performance. The class will also include information on the level of air pollution, including CO<sub>2</sub> emissions. Information on energy demand and emissions will also be provided in advertisements for the sale and rental of real estate. It is estimated that the modernization of the most energy-intensive buildings of class F and G, upgrading them to class B or C, could reduce their final energy consumption by 90 per cent, while upgrading them to class E would reduce the consumption of gas and heating oil by 31 per cent. In the European energy fragmentation, in buildings with the worst energy performance the consumption of energy from gas accounts for 47%, from heating oil 13% and 4% from coal. All countries will be required to identify the 15% most energy-intensive buildings (class G - "energy vampires") and upgrade them to at least class F (Buildings in Poland..., 2023). Unfortunately, Poland is currently the last EU country where energy classes of buildings do not apply.

Another problem to be solved refers to issues related to the ETS-2 system, i.e., the parallel emissions trading system, which the industry and energy sector must now take into account in their calculations (European Emissions Trading System (EU ETS)). It covers buildings and road transport and involves charges for CO<sub>2</sub> emissions caused by residential buildings and cars. In the ETS, emission fees should be transferred to the national budgets and allocated for energy transition, thermal insulation of buildings and moving away from fossil fuels. Currently in Poland, revenues from emission fees are transferred mainly to subsidize coal-fired power generation and imports of coal.

There is also the issue of introducing a deposit for plastic bottles, the improper disposal of which results in the increased CO<sub>2</sub> emissions into the atmosphere. No recycling system involves paying fines (65% of packaging is to be recycled by 2025, 2023, according to the EU targets). In order to prevent establishing new landfills, the EU Directive on Packaging and Packaging Waste has been introduced. It sets targets for particular types of raw materials from packaging by 2025. As much as 50% of plastics, 25% of wood, 70% of ferrous metals are to be recycled; 50% aluminium; 70% glass and 75% paper and cardboard. The Polish government transfers EUR 0.8 per 1 kg of plastic from the national budget to the EU budget for every tonne of new plastic packaging that is not recycled. By 2023, Poland has paid in about PLN 2 billion to the EU budget for insufficiently performer recycling. According to the Statistics Poland (GUS), in 2019 each Pole produced 332 kg of rubbish. In 2020, 334 kg (tabel 2) and in 2021, 360 kg. Meanwhile, about 27% of waste is recycled, and we observe no signs for the rate upward trend in recent years (Kowanda, 2023, p. 43).

**Table 2.**

*Rubbish left by an average Pole in 2019-2021 according to the Central Statistical Office (GUS)*

Name of the state	Carbon Capture and Storage Technology
2019	332 kg
2020	334 kg
2021	360 kg
United Kingdom	6

Source: (Kowanda, 2023, p. 43.)

According to the European Commission, the number and significance of negligence is significant, and proves that e.g., the management of Natura 2000 areas in Poland is an example nature protection on paper. In the call, the European Commission also refers to the Biodiversity Strategy 2030 programme. The European Green Deal and the EU Biodiversity Strategy for 2030 underline how important it is for the EU to stop the loss of biodiversity by protecting natural areas and restoring degraded ecosystems to their good ecological condition. The European Commission also indicated that there is also serious negligence in climate policy. Not only does Poland have one of the least ambitious CO<sub>2</sub> emission reduction targets in the EU, but it also has insufficient climate programmes. This proves that the dysfunctions in the Polish economy require developing the economic policy strategy in the area of natural environment. Fundamental importance should refer to the intensification of efforts towards the implementation of common objectives set by the EU.

The pace of civilizational changes, the development of production, and, as a result, the growth and pollution of the Earth have made the ecological aspect one of the most frequently discussed issues today. However, it can be noted that in Poland it is very difficult to build real environmental awareness and cause the same ecological attitudes in the household and in the workplace. Meanwhile, management is primarily a dependent system. It is subject not only to economic, but also to non-economic influences in the form of socially sanctioned norms and

rules, defining culturally important goals and permitted ways of achieving them. Social understanding is therefore the main tool for achieving the assumptions of Polish's sustainable development. In fact, there are no areas of the economy in which significant progress is possible without strengthened mechanisms for cooperation between society, institutions and sectors. It is worth noting, however, that in Polish society, climate denialists are a marginal party for the benefit of society as a whole, as only about 2 percent of respondents said that there was no climate change, 9 percent that it was only natural change (Kaczorowska, 2023). It is worth mentioning that greater differences are noticed between age groups than between rural and urban areas. Nevertheless, the countryside is changing more slowly, primarily because it is inhabited by older people who are reluctant to use digital tools and the internet. Lower proficiency in the use of these tools limits access to information, which means that the degree of development of the information society is of great importance in understanding the degradation of the natural environment.

## 5. Conclusions

In Poland, the principle of sustainable development has been included in the *Constitution of the Republic of Poland on 2 April 1997*. However, despite the fact that in 2003 the Polish government adopted the document "Obligations of Poland resulting from provisions included in the "Action Plan" of the Earth Summit in Johannesburg – "Implementation Programme", activities for sustainable development in Poland have been neglected for years. The priority obligations from Johannesburg included: changing the production and consumption models, rational use of natural resources and ensuring the protection of biodiversity, increased use of renewable energy, minimising the chemicals adverse impact on human health, fulfilling obligations to help the poorest countries, and developing the institutional framework for sustainable development.

As it has been repeatedly emphasized, the energy sector is one of the largest emitters of CO<sub>2</sub>. Although the energy sector allows to develop the civilizational progress, it is necessary to modernize it as soon as possible for climate security reasons. Increasing the energy efficiency and reducing emissions can be achieved by increasing financial expenditure in the area of R&D and training of modern human resources. The development of a "green" economy is also conditioned by measures taken for the efficient use of resources. This means decoupling the economic growth from the increasing use of resources, especially the primary ones, shifting towards a low-emission, low-carbon economy, increased use of renewable energy sources, promoting energy efficiency (Burchard-Dziubińska et al., 2014, p. 32), and developing and implementing eco-innovation and eco-technology.

To sum up, the technological progress should be perceived primarily as a means applied to reduce the number of resources needed to produce goods and services, greenhouse gas emissions, noise, to stop pollution of seas and oceans, forests, and the process of biodegradation. The effectiveness of technical progress is mainly determined by the synergy of science and business, openness to new ideas, and human capital. A significant importance is attached to a country, which, through its institutions and economic entities, should provide conditions for pro-environmental activities.

## 6. Limitations and recommendations

The Polish energy sector operates within a unique socio-political and economic context, influenced by historical dependence on coal, current policy structures, and public sentiment. These factors may reduce the generalizability of research findings to other countries with different energy mixes and policy frameworks. While this research emphasizes the importance of public participation, it does not extensively analyze the perspectives of all stakeholder groups e.g., local communities, private sector, or non-governmental organizations. A broader range of viewpoints could further enrich the findings.

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## SILVER GENERATION RUNNERS: SELECTED MOTIVATIONS AND RUNNING EVENT ENGAGEMENT

Patrycja WYCISZKIEWICZ<sup>1\*</sup>, Natalia GLUZA<sup>2</sup>

<sup>1</sup> Uniwersytet Ekonomiczny w Poznaniu; patrycja.wyciszkievicz@ue.poznan.pl, ORCID: 0000-0001-9368-2845

<sup>2</sup> Uniwersytet Ekonomiczny w Poznaniu; natalia.gluza@ue.poznan.pl, ORCID: 0000-0002-9864-4116

\* Correspondence author

**Purpose:** The Silver generation is becoming increasingly active and aware of the benefits of physical activity, particularly running, as a way to improve their health and well-being. This study aims to explore the key factors motivating older people to engage in physical activity and how these factors influence their participation in running events.

**Design/methodology/approach:** The research method involved surveying a sample of 400 respondents, all representatives of the silver generation. These individuals declared regular engagement in physical activity, including running.

**Findings:** Motivations for running among the Silver generation differ based on running experience. Individuals with 5+ years of experience are more driven by health and social factors than those with less experience. Additionally, longer running experience increases participation in events. To encourage less experienced runners to participate, age-specific rewards are recommended.

**Research limitations/implications:** The study's limitations include a sample that may not represent the silver generation due to reliance on online questionnaires, potentially excluding those less comfortable with technology. Future research should use alternative data collection methods and ensure a more representative sample to better understand the motivations and barriers to running in this population.

**Practical implications:** The article presents the most important motivational factors for the silver generation regarding running and participating in mass running events. This allows organizations within this market to utilize statistically tested solutions to create value for silver generation runners.

**Originality/value:** This study fills a gap in the literature by identifying the motivations for running among older people, a topic not previously explored. It highlights how running experience shapes these motivations and influences participation in running events.

**Keywords:** silver generation, running market, mass running events, customer motivations.

**Category of the paper:** Research paper, conceptual paper.

## 1. Introduction

Demographic changes in the global economy indicate an ongoing process of societal aging. Data and forecasts from the Central Statistical Office in 2023 show that, by 2060, the 65+ age group in Poland will increase by over 2.5 million people compared to 2022 (GUS, 2023), constituting a 34.2% increase.

Age and aging are key factors influencing individual activity across various life domains. Life stages are marked by biological, psychological, social, and professional transformations (Panasiuk, Panasiuk, 2021). Typically, the final years of professional activity and the phase of preparation for retirement—alongside changes in lifestyle and physical activity levels—occur between ages 55 and 64. In literature, individuals aged 50+ nearing the end of their careers and making lifestyle adjustments are often referred to as the Silver Generation.

Defining the exact age range for the Silver Generation is challenging. This generational group differs significantly from younger groups and is also internally diverse (GUS, 2020; Karani, Fraccastoro, 2010; Kohijoki, Marjanen, 2013; Lesáková, 2016a; Najdený et al., 2019; Kovács, 2019). Members of this group vary in terms of gender, place of residence, and education level (Panasiuk, Panasiuk, 2021). Additionally, they exhibit unique lifestyles, shopping habits, travel preferences, and levels of sports activity. Contemporary market trends empower people aged 50+ to remain active, pursue passions, expand their knowledge, and travel. This shift has led to a change in how the Silver Generation consumer segment is perceived; as one of the fastest-growing segments, it warrants increasing attention (Eusébio et al., 2015; Lesáková, 2016b; Najdený et al., 2019).

The Silver Generation redefines traditional perceptions of older age. Consumers within this generation, even post-retirement, generally maintain purchasing power and are less impacted by the cessation of professional duties (Zalega, 2015; Kovács, 2019; Trembošová, Kramoliš, Dubcová, Nagyová, Forgáč, 2022). Moreover, this generation emphasizes social engagement, contrasting with the passive lifestyles of previous generations (Człapiński, 2017; Kim, 2017).

A 2018 study by CBOS, involving a representative random sample of 1,066 Polish adults, revealed that nearly 50% of respondents aged 55+ engage in physical activity. Additionally, this study showed that one of the most common activities among Poles is running or jogging, with over 55% of participants reporting regular practice. These findings suggest that this generation may choose running as a means of maintaining mental and physical health, as well as fulfilling emerging social needs. Taking the above into consideration, it can be concluded that the growing interest in physical activity among the discussed generation, combined with the purchasing power of the silver generation driven by their professional activity, will contribute to an increase in expenditures on sports-related goods. These may include sports equipment, recreational trips, sports classes, or participation in sports competitions.

The specific objectives of this study were:

- To identify motivating factors for engaging in physical activity (specifically running) among the Silver Generation.
- To examine conditions influencing older consumers participation in running events.

## 2. An overview of the literature

Running is a sport that almost anyone can practice. It does not require formal training, as it is a natural form of movement (Grabus, Szymański, 2017). The rise in the popularity of running began in the mid-1960s, when a training method based on long, slow runs—jogging—gained widespread appeal (Galloway, 2011, p. 13). Since then, the popularity of running has continued to grow, and the sport has developed in economic, managerial, and social dimensions. This inclusivity of running contributes to the internal diversity of the social group that runners comprise. Runners vary in terms of sports skills, duration of physical activity, knowledge of sports brands, interest in running, training methods, and sociodemographic factors such as age, gender, residence, and income. This diversity influences the visible differentiation in the needs and preferences of these consumers (Jasiulewicz, Waśkowski, 2017; Zawadzki, 2015) as well as their motivations for running (Schwarz, Hunter, 2008).

Given this diversity, it can be assumed that conclusions drawn from research into runner motivation will differ depending on age, particularly for the Silver Generation, i.e., runners aged 50+. The heterogeneity of runners may indeed be a factor influencing motivations to begin running. One of the most important factors determining people's decisions to start running, as described in the literature, is increasing societal awareness of the benefits of regular sports activity. Research by Parzonko and Szuba (2017, p. 67) found that the most frequently cited reason for starting to run was the desire to improve physical condition (34%). About 26% of respondents indicated weight loss as their primary goal, and 16% noted that they chose running because it was the most accessible sport when they were seeking a form of physical activity. Factors such as persuasion from friends and fashion trends were selected by 7% and 3% of respondents, respectively, indicating these were minor motivations. Thus, internal motivation is a key determinant for deciding to run, with a focus on achieving physical and mental health and deriving enjoyment from the activity.

Running experience also influences changes in a runner's motivation. Therefore, the authors developed the following hypothesis, stating that running experience determines the primary motivation for running among the Silver Generation. The first hypothesis is:

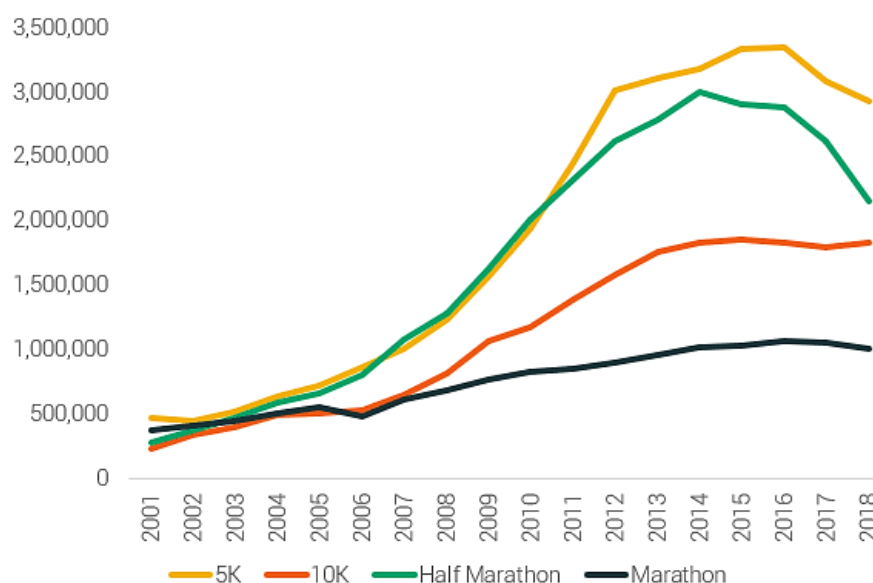
**H1:** Among the Silver Generation, motivations to run vary depending on the length of running experience.

- H1a: For people who have been running longer, a key motivator is the possibility of socialization, including gaining social recognition through running.
- H1b: For people who have been running for a shorter period, a primary motivator is taking care of their health.

A running event is an event aimed not only at runners but also fans and supporters of the sport. In 2019, a report titled "The State of Running 2019" was published by RunRepeat.com and the International Association of Athletics Federations (2019). This study provides a comprehensive analysis of a database covering 96% of races held in the USA and 91% of races in Europe, Asia, Africa, and South America from 1986 to 2018. The report reveals that, between 2008 and 2019, participation in mass races increased by as much as 49.43%.

In 2016, a global decline in the number of runners participating in events was recorded, with a 13% drop over a three-year period. At the peak of participation in global running events, 9.1 million runners crossed the finish line, but by 2018, this number had fallen to 7.9 million. A marked decline was observed in the number of people participating in street races in the US and Europe, the primary markets for running worldwide. The global running market reflects trends not only in participant numbers but also in preferred race distances. It is apparent that runners are increasingly opting out of half-marathons and 5 km races, as shown in figure 1.

Training experience, even at the amateur level, is strongly correlated with one's endurance over time. With longer training, individuals gain confidence in their physical condition and mental endurance in facing temporary discomfort associated with physical exertion. Through consistent training, runners have the opportunity to build self-confidence based on a long-term, planned process of implementing training units.



**Figure 1.** Number of participants in mass running events by distance worldwide.

Source: The State of Running, 2019.



Taking the above into account, the authors decided to develop a second hypothesis, which is as follows:

**H2:** Among the silver generation, a person with longer running training experience is more likely to participate in a running event than someone with less experience.

The motivations for beginning running training or later deciding to participate in a mass event may vary. There is no single, universal factor that motivates all runners to participate in a running event. Each participant has unique preferences and needs that running competitions aim to fulfill. Recognizing the determinants that motivate runners to enter an event should be among the strategies that, if effectively implemented, could positively impact runner participation in such events. Although valuable insights regarding runners' motivations for participating in events have been studied and identified over the years, there is currently a lack of up-to-date research on the reasons for participation in organized sports (Koper et al., 2014; Malchrowicz-Moško, Fadigas, 2018; Stempień, 2015).

The previously cited research conducted by Parzonko and Szuba (2017) also examined motivations for participating in running events in addition to motivations for running. In their study, 42% of respondents indicated that the atmosphere of the event, the opportunity to meet new people, and the chance to have fun were key motivators for participation. Another 26% cited the opportunity to compete and set personal records as their main motivation. For 21% of respondents, the primary motivator was the desire to assess their training progress, while 11% viewed running events as a way to travel. These findings indicate that, beyond entertainment and enjoyment, competition and self-assessment are important motivators for runners.

The above data align with Dybała's research (2013, pp. 119-124), which found that runners participating in events are driven by motivators related to physical health, as well as social, psychological, and achievement factors. The latter includes competition, with a desire to compete against others to secure the best possible place. Similarly, Romanowska-Tołłoczko and Marciniuk (2012) indicated that the need to achieve a sports result motivates runners to take part in competitions. This suggests that the motivation to compete is also present among silver generation runners.

Taking the above into account, the motivation to participate in sports competitions should be analyzed on two levels: intrinsic motivation, which stems from an individual's internal desire to engage in sports, and extrinsic motivation, which is driven by external factors. Extrinsic motivation arises when engagement in an activity—whether sports-related, professional, or social—is influenced by external factors, enabling the individual to achieve specific social outcomes (Kozioł, 2002, p. 59).

The influence of extrinsic motivational factors on an individual, in this case a runner, may directly or indirectly affect their decision-making processes. Recognition of a sports achievement, emphasis on the ranking or placement in a competition, and the opportunity to compete with peers in age-specific categories can serve as significant motivators for participating in sports events. The introduction of age categories facilitates competition within a diverse community of runners by allowing for the categorization of results and recognition of achievements across different age groups.

Considering the interplay between these intrinsic and extrinsic motivational factors, the authors formulated a third hypothesis, which was subsequently tested in their research:

**H3:** It is important to offer prizes for individual age categories among runners participating in running events.

### 3. Research methods

For the survey, authors created a closed-ended questionnaire to explore the respondents' physical activity (silver generation), particularly their running frequency and form. Respondents were also asked about the determinants and barriers to taking up running, as well as their participation in running events. They rated every statements on a five-point Likert scale, where 1 indicated "strongly disagree" and 5 indicated "strongly agree". The authors of the article developed the survey and then commissioned the research agency Biostat, which is well acquainted with research methodology. The study was conducted in 2-21.08.2024.

To achieve the research objectives, a nationwide study was carried out using the Computer-Assisted Web Interviewing (CAWI) method on a representative sample of 400 respondents, all aged 55 and above (the silver generation), who engage in physical activity.

The cluster analysis aimed to identify distinct groups of runners based on the length of time they had been running, with the variable "How many years have you been running?". This analysis allowed for the division of respondents into two main clusters: those who had been running for a relatively short period (up to 5 years;  $n = 198$ ) and those who had been running for a longer time (more than 5 years;  $n = 202$ ). The structure of the research sample is presented in Table 1.

**Table 1.**  
*Socio-demographic characteristics of respondents*

Variables	Respondents who have been running for a short period (up to 5 years; up5) n = 202		Respondents who have been running for a longer time (more than 5 years; more5) n = 198	
	Number	%	Number	%
<b>Gender</b>				
Man	78	38.6	109	55.1
Woman	124	61.4	89	44.9
<b>Age</b>				
Between 55 and 60. y.o.	78	38.6	58	29.3
Between 61 and 65 y.o.	47	23.3	58	29.3
Between 66 and 70 y.o.	52	25.7	43	21.7
Under 70 y.o.	25	12.4	39	19.7
<b>Place of residence</b>				
The country	29	14.4	28	14.1
City below 50 thousand citizens	52	25.7	40	20.2
City between 50 thousand and 250 thousand citizens	59	29.2	66	33.3
City between 250 thousand and 500 thousand citizens	26	12.9	31	15.7
City over 500 thousand citizens	36	17.8	33	16.7
<b>Education</b>				
Elementary	0	0.0	4	2.0
Vocational	13	6.4	14	7.1
Secondary	81	40.1	76	38.4
Higher	108	53.5	104	52.5

Source: author's work.

Basic descriptive statistics (mean, standard deviation) were calculated to compare the results for each group, considering the criterion of motivation, determinants and barriers to taking up running or respondents' participation in running events. To analyse the data from the questionnaire survey and compare the answers of up5 and more 5 respondents, a test  $\chi^2$  was used. Appropriate statistical tests were conducted to verify of the research hypotheses: the non-parametric Mann-Whitney U test for data without a normal distribution. The significance level of 0.05 was adopted as the criterion for hypothesis testing, and hypotheses were accepted or rejected based on this threshold. SPSS Statistics was employed to prepare the analyses.

#### 4. Results of the research

##### **Length of Running Experience and Motivations for Running**

According to the adopted assumptions, a person with longer running experience is defined as a respondent who has declared running for at least five years. Those with less than five years of running experience are classified as having a shorter period of engagement.

The first motivators for running analyzed are "social factors, including the possibility of gaining social recognition". This variable was created based on responses to questions about the possibility of sharing achievements on social media and running apps (Z1); making new friends (Z2) and connections through sports apps (Z3); running because "friends run" (Z4); perceiving running to express social status (Z5); and showing family that running contributes to maintaining physical and mental health (Z6).

To verify Hypothesis 1a, the Mann-Whitney U test was conducted. The results showed a significant difference between the groups. For runners with longer experience, important motivators for running include social factors, such as the possibility of gaining social recognition through running ( $U = 16866.00$ ,  $Z = -2.715$ ,  $p = .007$ ) (table 2). Therefore, Hypothesis 1a should be accepted.

**Table 2.**  
*Motivations for running (social factors)*

Variables	Respondents who have been running for a short period (up to 5 years; up5) n = 202		Respondents who have been running for a longer time (more than 5 years; more5) n = 198	
	x	$\sigma$	x	$\sigma$
Z1	1.87	1.325	2.13	1.357
Z2	2.19	1.420	2.56	1.427
Z3	1.96	1.311	2.21	1.346
Z4	2.40	1.372	2.65	1.420
Z5	2.02	1.377	2.21	1.346
Z6	2.92	1.401	3.27	1.376

The second analyzed group of motivators relates to the health benefits gained from running. This variable reflects responses to questions regarding maintaining mental health (U1), physical health (U2), physical condition (U3), coping with daily stress (U4), and alleviating negative emotions (U5).

For respondents with longer running experience, health maintenance through running is a significant motivator.

The Mann-Whitney U test was conducted, and the results showed a significant difference between the groups ( $U = 16846.00$ ,  $Z = -2.743$ ,  $p = .006$ ). However, respondents with longer running experience demonstrated greater motivation to run in the form of taking care of their own health (more5:  $x = 19.49$ ,  $\sigma = 3.25$ ; up5:  $x = 18.57$ ,  $\sigma = 13.49$ , respectively) (Table 3). Therefore, Hypothesis 1b should be rejected.

**Table 3.**  
*Motivations for running (health factors)*

Variables	Respondents who have been running for a short period (up to 5 years; up5) n = 202		Respondents who have been running for a longer time (more than 5 years; more5) n = 198	
	x	$\sigma$	x	$\sigma$
U1	4.12	1.046	4.25	0.995
U2	4.02	1.117	4.31	1.048
U3	4.34	0.980	4.44	0.942
U4	2.29	1.434	2.41	1.396
U5	3.80	1.271	4.08	1.027

### Length of Running Experience and Participation in Running Events

Among the silver generation, most respondents do not participate in running events, with 166 respondents in the "up to 5 years" group and 132 respondents in the "more than 5 years" group. It is worth noting, however, that those who report participating in organized runs are almost twice as likely to have longer running experience (up to 5 years: 36 respondents; more than 5 years: 66 respondents).

**Table 2.**  
*Descriptive statistics (H2)*

Variables	Respondents who have been running for a short period (up to 5 years; up5) n = 202		Respondents who have been running for a longer time (more than 5 years; more5) n = 198	
	Number	%	Number	%
Respondents who participate in running events	36	17.8	66	33.3
Respondents who do not participate in running events	166	82.2	132	66.7

Source: author's research work.

To verify Hypothesis 2 about the connection between running experience and a consumer's willingness to participate in running events, the  $\chi^2$  test was conducted. The analysis confirmed ( $\chi^2 = 12.664$ ;  $df = 1$ ;  $p < .001$ ) this connection: the longer the training experience of a runner, the more frequently they are willing to take part in a running event. Hypothesis 2 should be accepted.

At the same time, it is worth noting that among the most common barriers/reasons for participating in running events, the respondents indicated that they train for running "only for their own health" (up to 5 years:  $x = 4.15$ ,  $\sigma = 1.310$ ; more than 5 years:  $x = 4.27$ ,  $\sigma = 1.132$ , respectively) and "for their own satisfaction" (up to 5 years:  $x = 4.31$ ,  $\sigma = 1.116$ ; more than 5 years:  $x = 4.39$ ,  $\sigma = 0.963$ , respectively).

### Length of Running Experience, Participation in Running Events, and Awards for Age Categories

In the next step, the analysis of the conditions for participation in running events was conducted in depth. A motivating factor was considered that did not refer to running "in general", but to the motivation to participate in a specific running event. The examined determinant was the existence of age categories and the possibility of receiving an award for individual categories included in the competition regulations set by the organizer of the mass running event.

**Table 3.**

*Descriptive statistics (H3)*

Variables	Respondents who have been running for short period (up to 5 years; up5) n = 202		Respondents who have been running for a longer time (more than 5 years; more5) n = 198	
	x	$\sigma$	x	$\sigma$
The presence of age categories and prizes for individual categories in the competition rules	3.56	1.319	3.00	1.324

Source: author's research work.

The Mann-Whitney U test was conducted. The results showed a significant difference between the groups ( $U = 1466.00$ ,  $Z = 1.993$ ,  $p = .046$ ), indicating that for runners with shorter experience, the presence of age categories and awards for individual categories included in the rules of the running event ( $x = 3.56$ ,  $\sigma = 1.319$ ) serves as an additional motivation.

## 5. Conclusions

The research conducted by the authors and the analysis of existing data indicate that, according to the report titled "Profile of the Polish Runner," carried out at the Poznań University of Economics (PPB, 2014), senior runners (the silver generation) constitute less than 10% of all runners in the running market. Specifically, 5.45% are aged 51-60, and 1.34% are over 61 years of age. Nevertheless, the aging of society, increased awareness of the positive impact of physical activity on maintaining quality of life, and the growing popularity of running as a mass sport allow us to assume that the population of runners over 50 years old will increase. The WHO recommendations (2021) indicate that adults aged up to 64, as well as those over 65, should engage in regular moderate-intensity aerobic physical activity, amounting to 150 to 300 minutes per week. Physical activity should align with individual preferences, capabilities, and age-related limitations. Based on the above review of literature and existing data, it can be concluded that this generation may choose running as one of many ways to care for their mental and physical health while meeting emerging social needs.

Additionally, statistical analysis of the conducted research indicates that runners who have been running for over 10 years are more willing to participate in running events and continue their running activity into their silver years. However, it should be noted that a significant portion of the 50+ generation who declare engaging in running have been doing so for less than 5 years. According to the authors, an important action that should be taken in aging economies is to encourage individuals in the last years of working age (45-50 years) to take up physical activity. Started running training earlier may result in a greater desire to continue it later in life, as the barriers to entering the running community tend to increase with age.

## **6. Limitation and future research**

The limitations of this study primarily stem from the characteristics of the research sample combined with the chosen research method. Specifically, the respondents' age and reliance on computer use for completing online questionnaires (CAWI) may have influenced the results. It is important to consider that some members of the silver generation may not be as comfortable or proficient with digital technologies, which could have impacted their participation in research study. In future research, it may be beneficial to explore alternative data collection methods better suited to this age group, such as in-depth individual interviews, which could provide more nuanced insights.

Another limitation arises from the lack of representativeness of the research sample concerning certain sociodemographic factors, such as gender and education levels within the silver generation. This limitation also suggests a valuable direction for future studies. Ensuring a more representative sample would allow for a more thorough examination of the relationships between the variables studied and sociodemographic factors, such as gender or education, which could offer deeper insights into the motivations and barriers related to running in this population.

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## STRENGTHENING ORGANIZATIONAL RESILIENCE – TOWARD A PRACTICAL FRAMEWORK

Sławomir ZAPŁATA<sup>1\*</sup>, Ewa MATYJASZCZYK<sup>2</sup>

<sup>1</sup> Poznań University of Economics and Business, Institute of Management, Department of Quality Management; slawomir.zaplata@ue.poznan.pl, ORCID: 0000-0001-6134-9765

<sup>2</sup> Bydgoszcz University of Science and Technology; ewa.matyjaszczyk@pbs.edu.pl, ORCID: 0000-0001-9848-8902

\* Correspondence author

**Purpose:** Organizational resilience is an individual characteristic of each organization, the strengthening of which requires a variety of measures. The myriad of articles about resilience causes problems in a practical approach hence the idea of this article is to simplify the state of the art. The purpose of this article is to summarize the literature and identify a practical framework that could be a start toward strengthening organizational resilience.

**Design/methodology/approach:** The analysis was conducted on the basis of a literature review to identify elements creating organizational resilience.

**Findings:** As a result of the literature analysis, a framework that make up organizational resilience was created.

**Research limitations/implications:** The universality of the framework facilitates a practical approach to strengthening organizational resilience in an organization, but at the same time may limit effectiveness and efficiency due to the dissimilarity of individual organizations and the changing circumstances of operations. These issues are worthy of attention in subsequent studies-both qualitative and quantitative-in organizations across industries and territories.

**Practical implications:** Application of framework in an organization makes it possible to assess what actions should be deliberately taken to strengthen organizational resilience.

**Originality/value:** The article analyses elements, factors and enablers of organizational resilience in previously unrepresented form. The research results are helpful for practitioners and researchers alike.

**Keywords:** resilience, organizational resilience, practical resilience.

**Category of the paper:** conceptual paper.

## 1. Introduction

Every organization is embedded in the business environment. Adaptation to ongoing changes in the environment in order to gain business goals but they may not be sufficient in turbulent environment, therefore organizations need to develop capabilities to be responsive to disruptions (Madani, Parast, 2023). It means to enhance organizational resilience (OR), defined as the “ability of an organization to absorb and adapt in a changing environment” (ISO 22316, 2017, point 3.4, p. 1). Resilience is equated with an employee’s ability to overcome or bounce back from adversity (Good et al., 2023), what is crucial for organizational resilience. Amidst uncertain and disruptive environments, the significance of organizational resilience cannot be overstated, as they are crucial for businesses to thrive (Mehta et al., 2024). Concept of organizational resilience is nothing revealing, however “the rise of the notion of organizational resilience reflects a fundamental shift in how organizations perceive and respond to uncertainty and adversity” (Ingram, 2024, p. 2). It stems from the fact that the organizational resilience issue grew in importance as a result of the emergence of Covid-19 (Zapłata, Kwiatek, 2023), which influenced on many aspects of businesses. Zapłata & Kwiatek (2023) were analyzing 304 articles related to organizational resilience (published in 2003-2022) and indicated that 46% of all articles were published in last three years (2020-2022). Newest literature review articles are presenting many aspects of organizational resilience like: general importance (Anand et al., 2024; Kassier, 2024), links with sustainability (Mehta et al., 2024) or with SMEs enterprises (Sirec et al., 2024, pp. 102-114). Also noticeable are attempts to concretize the concept and general metering (Pradana, Ekowati, 2024) or an area-based approach, e.g., concerning supply chain resilience (Safari et al., 2024; Stadtfeld, Gruchmann, 2024). Basically, the results of published many studies support the argument that businesses require resilience as a continuous, absolute necessity for survival, and thriving (Sethi et al., 2024). The results of individual studies contribute to the increasing exploration of the organizational resilience area. However, they are difficult to easily apply in practice, because they predominantly focus on the macro point-of-view, general description of analyzed concept and also indicate theoretical stages and management theories. Hence the idea of this article is to simplify the state of the art. “A good proposition is simple, it is easy to understand. A good research proposition moves us to change our behaviors and those of others” (Ulaga et al., 2021, p. 396). The goal of that article is to summarize the literature and identify a practical framework that could be a start toward strengthening organizational resilience.

### 1.1. Research area and procedure

A conceptual paper requires both a general look at the concept under analysis to then detail the various levels of analysis with a concretized look. In order to create the practical framework,

it is necessary to analyze in detail a variety of studies, create a theoretical framework and supplement it with real elements. Description of the research contains five elements – 3W:

1. What. Analysis of articles concerning organizational resilience focused on identification of elements, factors, enablers of that concept.
2. When. The research activities were conducted in August 2024.
3. Which way (how). The road to gain the goal contains two main stages. First is systematic literature review in area of “organizational resilience”. Second is snowballing, also known as citation chaining.

Analysis of the literature review articles provides a broad knowledge of the topic. Selecting the right database like Web of Science and/or Scopus is the first step usually for developing a review article (Paul et al., 2023). For the first step the Scopus database was chosen for identifying relevant articles. The identification of the literature was carried out using the term “organisational resilience review” only in the title, because of finding articles exactly about the topic and literature review which maximizes the saturation of knowledge in individual articles. To be included in the study strict inclusion criteria were applied – the articles had to meet five criteria: (1) published between 2021-2024 (to catch the latest items, which as literature review, contains information on many previous articles), (2) studies in English, (3) in scientific journal, (4) peer-reviewed journal, (5) full-text article. A systematic literature review was adopted as the initial method of that study, due to the thematically specific scope of the review and the relatively small number of articles, facilitating manual analysis of their content (Donthu et al., 2021, Table 1, p. 287). Using the above criteria, 25 articles (shown in Table 1) were identified in the Scopus database and analyzed in their entirety. In the course of analyzing their content through a snowballing process, another articles were selected for analysis used for the description in the “Organizational resilience – plurality of topics” section.

## **2. Analysis of the literature review articles**

“Bibliometric analysis is a popular and rigorous method for exploring and analyzing large volumes of scientific data. It enables us to unpack the evolutionary nuances of a specific field, while shedding light on the emerging areas in that field” (Donthu et al., 2021, p. 285). The enormity of the articles (inputs) means that the results for the literature review (outputs) will be a general description of the state of knowledge, at a considerable level of generality. The analysis of the collected articles focused on identification of the objectives of the study, results with a special search for practical tips for strengthening organizational resilience.

**Table 1.**  
*25 articles concerning organizational resilience review in 2021-2024*

Article	Title of the article	Brief profile
(Bento et al., 2021)	Organizational resilience in the oil and gas industry: a scoping review	Paper includes qualitative synthesis of 20 scientific articles. The resulting three elements conceptualizing resilience were identified: 1. Resilience capabilities. 2. Resilience as an outcome. 3. Resilience as a process.
(Corrales-Estrada et al., 2021)	Sustainability and resilience organizational capabilities to enhance business continuity management: a literature review	Literature review includes 60 articles. Paper presents overall organizational capabilities for sustainability and resilience and impact on business continuity management.
(Scheuch et al., 2021)	Resilience training programs in organizational contexts: a scoping review	A total of 48 studies focusing on resilience training programs in organizational contexts were included in this review. The review provides relevant insights into resilience training programs by focusing on program characteristics, target group, study design, and outcomes.
(Ali, 2022)	Analyzing the impacts of diversity on organizational resilience: analytical review and formulation	The work (general review) is presented the following fundamental requirements that define organizational resilience in a diverse environment (three elements): 1. The OR system structure. 2. Technical framework of OR. 3. OR protocol that will implement OR.
(Evenseth et al., 2022)	Building organizational resilience through organizational learning: a systematic review	Review covered 59 articles: 41 empirical, 12 conceptual and 6 literature. Conclusions indicated that organizational learning is mainly linked to adaptation capabilities.
(Khin Khin Oo, Rakthin, 2022)	Integrative review of absorptive capacity's role in fostering organizational resilience and research agenda	That study analyzes a more expansive database that includes 823 documents in bibliometric process, of which 62 documents were included in scoping review of organizational resilience. The paper highlights the significance of knowledge resources for a firm's survival.
(Zhang et al., 2022)	Organizational resilience in development: a systematic review based on bibliometric analysis and visualization	Based on 622 journal articles authors provided a comprehensive overview of the knowledge trajectory, disciplinary distribution, representative journals, research participants, key themes, hotspots, and frontiers of organizational resilience.
(Abdullahi, Mohamed, Senasi, 2023)	Exploring global trends of research on organizational resilience and sustainability: a bibliometric review	Research presents a bibliometric review of 619 publications on organizational resilience and sustainability from the period 1998-2022. Top 3 subject area: 1. Business, Management, and Accounting (299 articles). 2. Engineering (131). 3. Environmental Science (106).
(Abdullahi, Mohamed, Senasi et al., 2023)	Assessing the integration of organizational resilience and sustainability: insights from a systematic literature review	This study analyzed 53 articles on organizational resilience in relation to sustainability. The review explores various resilience factors that impact organizational sustainability.
(Akpınar, Özer-Çaylan, 2023)	Organizational resilience in maritime business: a systematic literature review	Based on an analysis of 19 articles, the authors indicated. Two main perspective/lens of research used by resilience studies in maritime literature: disaster management (8 of 19) and risk management (3 of 19).

Cont. table 1.

(Awang Ali et al., 2023)	Systematic literature review of business continuity management (BCM) practices: Integrating organisational resilience and performance in small and medium enterprises (SMEs) BCM framework	The authors, based on an analysis of 49 articles, identified two important levels of OR: planned and adaptive resilience.
(Gunawan et al., 2023)	How to link organizational resilience to transformational entrepreneurship behavior as theoretical framework gap – a systematic literature review	This study reviewed 22 articles focusing on the role and influence of organizational resilience on transformational entrepreneurship behavior. The conclusions emphasize the importance of 4 elements: 1. Psychological capital. 2. Leader-member exchange. 3. Ambidexterity. 4. Competitive advantage strategy.
(Ignatowicz et al., 2023)	Organizational resilience in healthcare: a review and descriptive narrative synthesis of approaches to resilience measurement and assessment in empirical studies	Thirty-five studies were analyzed in that paper. Authors identified a lack of consensus on how to evaluate organizational resilience in healthcare, what should be measured or assessed and when, and using what resilience characteristic and indicators.
(Ingram et al., 2023)	Organizational resilience as a response to the energy crisis: systematic literature review	In that paper authors provided a literature review (124 works) on the topic of organizational resilience, in relation to the energy crisis.
(Paeffgen, 2023)	Organisational resilience during COVID-19 times: a bibliometric literature review	That paper presents, after bibliometric literature review of 185 articles discussing organisational resilience during the COVID-19 pandemic, six main topic clusters: 1. Entrepreneurial, tourism, and emergency responses. 2. World environment, disruptions, and organisations. 3. Employees and mediation. 4. Firms and opportunities. 5. Capabilities and digitalization. 6. Leadership during uncertain times.
(Polanco-Lahoz, Cross, 2023)	Systematic literature review on organizational resilience in the context of higher education institutions	That study follows a systematic literature review method to analyze and categorize current research (16 papers) on organizational resilience applied to Higher Education Institutions. Authors indicated that only 12.5% analyzed papers presented framework proposals. They underline that 56.25% of the papers do not state any clear directions for future research on their content.
(Saeed et al., 2023)	A systematic literature review on cyber threat intelligence for organizational cybersecurity resilience	This research (based on a review of 52 articles) investigates how companies can employ cyber threat intelligence to improve their precautionary measures against security breaches.
(Shela et al., 2023)	Human capital and organisational resilience in the context of manufacturing: a systematic literature review	This paper systematically reviews 55 studies converging human capital and organisational resilience in the context of manufacturing. The analysis identified main research themes by clustering the prior studies into seven groups, which describe the direction of the literature.

Cont. table 1.

(Su, Junge, 2023)	Unlocking the recipe for organizational resilience: a review and future research directions	Authors conducted literature review of 127 publications. In conclusions they underlined that resilience has three core characteristics: 1. An adverse event as a trigger. 2. A performance setback. 3. Recovery.
(Tekletsion et al., 2023)	Organizational resilience as paradox management: a systematic review of the literature	That study aims to further understanding of the resilience literature through a systematic review of 25 articles. It aimed to glean insights from the organizational resilience literature by adopting a paradox perspective and locate a meaningful intersection of past literature.
(Weber, 2023)	The relationship between resilience and sustainability in the organizational context – a systematic review	That paper presents literature analysis of 196 articles. The author concludes that most of the ‘bridging’ studies emphasize that the two fundamental concepts are interdependent and regard organizational resilience as a component of organizational sustainability.
(Ciasullo et al., 2024)	Mastering the interplay of organizational resilience and sustainability: insights from a hybrid literature review	Drawing on a knowledge core of 51 scientific contributions, authors embedded different research streams investigating the nexus between organizational resilience and organizational sustainability: 1. Nurturing a resilient mindset. 2. Framing organizational resilience from a socio-ecological perspective. 3. Setting the stage for organizational resilience. 4. Handling organizational resilience as a dynamic capability.
(Florez-Jimenez et al., 2024)	Corporate sustainability, organizational resilience, and corporate purpose: a review of the academic traditions connecting them	Authors, on the basis of 34 documents, presented the relationship between sustainability, organizational resilience and corporate purpose.
(Pradana, Ekowati, 2024)	Future organizational resilience capability structure: a systematic review, trend and future research directions	Based on the analysis of 28 articles, the authors conceptualized organizational capability with a pyramid, which illustrates the basic framework of the six comprehensive stages of the resilience process and hierarchically forms organizational resilience: anticipation, coping, adaptation, absorptive, confronting and sustainability.
(Talab et al., 2024)	Investigating the organizational resilience of hospitals during emergencies and disasters: a comprehensive review of the components	That study investigates the components of organizational resilience of hospitals during emergencies and disasters, on the basis of the results of the analysis of 20 articles. Authors identified components and categorized them into five dimensions as follows: 1. The vulnerability of the hospital (18 components). 2. Preparedness (31 components). 3. Management and support (33 components). 4. Responsiveness and adaptability (35 components). 5. Recovery after crisis (8 components).

Source: own elaboration.

The literature review studies (shown in the Table 1) reveals general descriptions of article knowledge regarding organizational resilience, variously profiling the ranges. Based on the objectives, content and results, these (25) articles can be classified into six groups:



1. General descriptions: overview of concept (Su, Junge, 2023), focusing on development (Zhang et al., 2022), looking on capability structure (Pradana, Ekowati, 2024), linking with entrepreneurship behavior (Gunawan et al., 2023) and profiling OR during COVID-19 times (Paeffgen, 2023).
2. Aspects of management: showing organizational resilience as paradox management (Tekletsion et al., 2023), analyzing the impacts of diversity on organizational resilience (Ali, 2022), investigating absorptive capacity's role in fostering OR (Khin Khin Oo, Rakthin, 2022), linking OR with business continuity management (Awang Ali et al., 2023).
3. Industry perspective: oil and gas industry (Bento et al., 2021), maritime business (Akpınar, Özer-Çaylan, 2023), healthcare (Ignatowicz et al., 2023), hospitals (Talab et al., 2024), higher education institutions (Polanco-Lahoz, Cross, 2023).
4. Exploration of risk: energy crisis (Ingram et al., 2023), cyber threat intelligence (Saeed et al., 2023).
5. The role of people – importance of: human capital (Shela et al., 2023), organizational learning (Evenseth et al., 2022), resilience training programs (Scheuch et al., 2021).
6. Sustainability. The relationship between resilience and sustainability was highlighted in articles: (Corrales-Estrada et al., 2021; Abdullahi, Mohamed, Senasi et al., 2023; Weber, 2023; Ciasullo et al., 2024; Florez-Jimenez et al., 2024).

There are three main conclusions from the above variety of articles. Firstly, despite the various analytical approaches, the definition of OR is consistent, and it can be pointed out that the normative definition (already cited at the beginning of the article) captures the essence of the concept: “ability of an organization to absorb and adapt in a changing environment” (ISO 22316, 2017, point 3.4, p. 1). Secondly, OR can be considered from three perspectives due to the embeddedness in time and place – resilience as: capabilities, process, outcome (Bento et al., 2021). Thirdly, due to the variety of factors affecting the organizational resilience of each unit (and human and economic), it is important to include in the activities analysis that strengthen antecedents of organizational resilience identified in the literature like (Abdullahi, Mohamed, Senasi et al., 2023): absorptive capacity, adaptation, adaptive capacity, agility, anticipation, contingency planning, coping strategy, dynamic capabilities, flexibility, innovation, integrity, leadership, learning, market adaptation, organisational recoverability, redundancy, robustness, shared information, survival, technology, transformative capacity, trust, velocity.

### 3. Organizational resilience – plurality of topics

During the analysis of the 25 literature review articles, further articles were identified for detailed reading. In the process of snowballing, papers that address various aspects of organizational resilience were reviewed in detail. The goal of their exploration was to identify elements that would allow for a practical approach to strengthening OR, while at the same time enabling an analytical framework that could be applied to a single organization. It is difficult to divide the analyzed articles by content from general to specific. Topics related to organizational resilience intermingle in individual articles dealing with different aspects of it. From the perspective of the objectives of study (subjective approach), several issues can be pointed out:

1. Theoretical lens.
2. Knowledge management.
3. Prevention and reaction.
4. Plans and procedures.
5. Importance of people.
6. Immune system.
7. Resource types.
8. Organizational levels.
9. Organization size.
10. Resilient measures.
11. Case study.

“**Theoretical lens**” is a set of articles presents various types of management theories and approaches having interplay with organizational resilience, like:

- attention-based view (Weber, Kokott, 2024),
- capability-based conceptualization (Duchek, 2020),
- conservation of resources theory (Hundschell et al., 2024; Liang, Cao, 2021),
- dynamic capabilities (Stadtfeld, Gruchmann, 2024; Shafie et al., 2024),
- grounded theory (Ke et al., 2023; Jiang et al., 2023),
- hierarchy theory (De Florio, 2017),
- integrated dynamic model (Ma et al., 2018),
- integrated resource efficiency view (KWoh et al., 2023),
- multilevel dynamic process model (Napier et al., 2024),
- paradigm of complex adaptive systems (Secchi et al., 2024),
- paradox-based conceptualization (Karunaratne, Lanka, 2022) and paradox management (Tekletsion et al., 2023),
- total interpretive structural model (Sethi et al., 2024),
- transactive memory systems approach (Cotta, Salvador, 2020),

- turning crises into opportunities (Corvello et al., 2023) and crisis-opportunity framework model (Papakonstantinidis et al., 2023),
- viable system model (Cardoso Castro, 2019).

**“Knowledge management”** is a group concerning issues like:

- learning process (Lafuente et al., 2024),
- organizational learning (Mai et al., 2022; Douglas, Haley, 2024),
- resilience training programs (Scheuch et al., 2021; Ketelaars et al., 2024).

**“Prevention and reaction”** of adverse events refers to old folk wisdom “prevention is better than cure” what is visible in articles about:

- considering the anticipation/decision making pair as a continuum (November et al., 2022),
- preparing collective plans (Thürmer et al., 2020),
- proactive and reactive resilience (Zheng, Lin, 2024; Nuwan et al., 2024),
- resilience as adaptive/reactive/dynamic attribute (Conz, Magnani, 2020),
- using single and double loop learning (Tasic et al., 2020; Marcus et al., 2020).

**“Plans and procedures”** are the embodiment of a preventive approach and the preparation of reactive action plans. This is related to two issues: Work-As-Imagined (WAI) and Work-As-Done (WAD), described in two articles: (Ashraf et al., 2021; Weenink et al., 2023).

**“Importance of people”** – that group contains articles that emphasize the importance of people, employees in the process of strengthening organizational resilience and contain description of:

- dynamic managerial capabilities (Ingram, 2024) and employee attributes (Gerschberger et al., 2023) or cultural aspects (Fietz et al., 2021),
- employee engagement (Kurniawan, Rianto, 2023), especially Frontline Employees (Good et al., 2023) and stress management aspects (Sraidi Najla, El Gharbaoui Bouteïna, 2023),
- entrepreneurial orientation and aspects (Lasaksi et al., 2024; Leonelli et al., 2024; Gianiodis et al., 2022; Shafie et al., 2024),
- role of human resource management (Georgescu et al., 2024; Roumpi, 2023),
- strategic leadership (Istiqaroh et al., 2022; Schaedler et al., 2022; Sabbah, 2024).

**“Immune system”** alludes to the importance of people and comparing the functioning of an organism to the functioning of an organization: (al-Saidi, 2020; Glas et al., 2021). The origin of the organizational immune system is the theory of organizational adaptation, as organizations seek to find a means to cope with external and internal threats (Al-Badayneh, 2021). Biopsychosocial studies show that these factors help protect against the deleterious influences of stressors on physiology in general and immunity in particular (Dantzer et al., 2018). So, the immune system is something physical (a hard resource), while resilience is a broader concept (a soft resource).

**“Resource types”** – resources are very influential on organizational resilience (Kurniawan, Rianto, 2023; Shela et al., 2024) and important is their effective allocation (Dinh et al., 2024). On the one hand, it concerns the impact of people and their behavior on OR (Georgescu et al., 2024). On the other hand, it concerns physical resources (Mao et al., 2023; Stocker et al., 2022) including financial (Corvello et al., 2023). This generally refers to the division of resources into organizational hardware and software (Giovannini, Giaque, 2024) or tangible and intangible (Sethi et al., 2024), which can also be compared to the breakdown from the previously indicated area (Immune system).

**“Organizational levels”**. Studies in the literature demonstrate that employee resilience is positively associated with organizational resilience (Liang, Cao, 2021). That line can indicate three levels of organizational resilience: individual, group, and organisational (Ma et al., 2018). Moreover, the resilience of people is the basis of resilience in organization (Wilkinson, Potangaroa, 2023). Team resilience as a collective psychosocial construct (Vera et al., 2017) what is important in building organizational resilience (Hundscheil et al., 2024; Fietz et al., 2021). This influence different capabilities to manage individuals, teams and organizations (Albuquerque Pai et al., 2024).

**“Organization size”** depends on many factors such as the number of employees, customers, location, territorial scope of the business or the duration of the business and many others. These issues are relevant to enhancing organizational resilience and are reflected in the articles on:

- large organizations (Wood et al., 2019),
- small and medium enterprises (De Matteis et al., 2023; Safari et al., 2024).

**“Resilient measures”** is the name for group of articles which try to answer on question "How to measure organizational resilience?" with:

- analyzing the problems in measuring resilience (Sevilla et al., 2023),
- building a scale for assessing organizational resilience (Rahi et al., 2024),
- approach to selection of resilient measures portfolio under disruption and uncertainty (Ghezelhesar, Bozorgi-Amiri, 2022),
- general approach (Yao, Wang, 2024; Grego et al., 2024; Santos, Spers, 2023),
- measuring organizational resilience as a performance outcome (Ilseven, Puranam, 2021),
- trying to quantify resilience with the “Benchmark Resilience Tool” (Gonçalves et al., 2019),
- showing measures for technical resources (Stocker et al., 2022).

**“Case study”**. The nexus of theory with practice on the topic of organizational resilience is noticeable in the case-study articles. They concern the following issues:

- analyzing the Swedish mining industry (Monazzam, Crawford, 2024),
- conceptualizing and measuring organizational or (Chen et al., 2021),
- creating OR model of joint stock companies (Marquez-Tejon et al., 2024),
- deconstructing organizational resilience (Yilmaz Borekci et al., 2021),

- exploring family business (Leite et al., 2023),
- researching Chinese private enterprise (Jiang et al., 2023),
- selecting of resilient measures portfolio for e-payment service providers (Ghezelhesar, Bozorgi-Amiri, 2022).

The issue of organizational resilience is vast and individualized in each organization. People are at the root of organizational resilience and not to be underestimated are two aspects – their individual health resilience, both physical and mental. The employee is the essential element of the organisation and the individual resilience is the primary source of organizational resilience. There is a practical need to gain synergy between people and resources and organizational activities to assure and enhance resilience at organizations levels.

#### **4. Organizational resilience – a practical look**

From the analysis so far, it is noticeable the multiplicity and thematic diversity of articles from the OR area. The analysis of articles from the group "Resilient measures" does not clearly indicate ways to measure this concept in business – it is impossible to run them through a funnel to extract the essence and create a unified list. Taking into account state of the art and the diversity of organizations, the approach to organizational resilience (reinforcement and evaluation) is individualized – subjectively tailored to the specific organization. In practice, each company has its own characteristics (internal) and operates in a given economic environment and spatial scope. This means that the same set of factors can affect the OR level of different companies differently. The same is true of the human body. Even if we are immune to viruses in one place, this is not necessarily so in another, and then it is necessary to be vaccinated before going to a new place – a new environment. It is the same with the business environmental milieu, organizational resilience may manifest differently in various settings across different cultural and geographic contexts (Rahi et al., 2024).

A practical look at the issues of organizational resilience requires the creation of a framework designating areas for individual detailing in individual organizations. When trying to pick out such practical tips from the literature, it is necessary to look in the line from general to specific aspects. The most general issue is management theories in which two issues are noticeable: conservation of resources and dynamic capabilities. Another issue is to define the area and time frame, the beginning and end of the activities which refers to the schools of thought on organizational resilience. The earlier school considered resilience as a static and outcome variable, a second school recognized the concept as a positive adaptation to unexpected events, and a third and more recent perspective views resilience as a dynamic concept, the scope of which goes beyond bouncing back behavior (Sethi et al., 2024). As a consequence organizational resilience can be viewed as a feature and a sequential process

with three main dimensions (Matysek-Jędrych et al., 2022): (1) Pre-disruption (Preparedness, Avoidance), (2) Disruption (Agility, Adaptation, Response), (3) Post-disruption (Recovery, Transformation). Therefore organizational resilience should minimize the time between the beginning of disruption and post-disruption back to normal. From the plethora of analyzed articles the most important elements that determine the level of organizational resilience and thus those on which concentration will allow strengthening its level emerge: people, physical resources, procedures (planned and adaptive) and organizational levels (employees/workplace-teams-organization).

No organization is resilient to everything, and at the same time it is impossible to take measures to strengthen resilience to everything. The analogy is for human vaccines – they always target a specific virus. Similarly, in an organization, the preceding action to strengthen resilience is to identify the threats, assess their risks and only plan and take action targeting precisely the highest assessed risks. Table 2. shows the framework structure for practical activities, developed from the literature reviewed.

**Table 2.**

*Practical framework for starting activities to strengthen organizational resilience*

Input	Organizational levels	Focus on people	Management theories (theoretical lens)		Dimensions	Output
			Conservation of resources	Dynamic capabilities		
specific risk and the goal of minimizing of its	organization	mental and physical traits of workers and leaders	tangible and intangible	- people - physical resources - plan and procedures (planned and adaptive)	- pre-disruption (preparedness, avoidance). - disruption (agility, adaptation, response). - post-disruption (recovery, transformation).	- direct result (trained people, prepared and practiced plans) - desired outcomes (resilience to analyzed risk)
	teams					
	employees/workplace					

Source: own elaboration on the basis of analyzed articles shown in the list of references.

For each organizational level, an individual analysis can be made according to the elements in the following columns. It is also worth looking at the interactions between these levels. Individual resilience does not necessarily lead to group resilience, and similarly, group resilience does not necessarily lead to resilience at the organization level (Ma et al., 2018). The ability to respond to threats depends on the size of the companies, large firms are more resilient (Acciarini et al., 2021) in systematic way than others which based on creativity and flexibility. This also requires individualized analysis, since the availability of resources (both material and personnel, as well as knowledge and experience) is related to the size of the organization and experience (related to the period of operation in the market), but there is no “automatic” between the size of the organization and its level of organizational resilience.

## 5. Conclusions

The conceptualizations of organizational resilience address local matters and guide actions to strengthen resilience but are difficult to capture (like knowledge, resources, skills, level of preparedness) but are crucial aspects of resilience (Le Dé et al., 2021). The same set of elements may result in differential effects, depending on the external environment and intrinsic characteristics of every organization. The next aspect is interrelation between factors, it is not good to concentrate on alienated factors in resilience. Therefore, it is not an easy task to designate practical, concrete issues to be applied from a plethora of theoretical studies. Despite the various studies on organizational resilience, it is necessary to create individuated pillars of organizational resilience, for a specific organization. This necessity is noticeable in the number of scientific articles in the OR area. This is important aspects of running a business but in practice there is sparse interest. The Deloitte Global Resilience Report (2022) showed that over half of global organizations lack a common understanding of resilience. No one and no organization is immune to everything, and simply acting flexibly and on an ongoing basis in a crisis situation may not produce the desired results. It seems reasonable to take preventive measures in a systemic way, for example, by implementing a business continuity management system (BCMS). Such system can be built in organization by utilizing ISO 22301 standard and Plan-Do-Check-Act (PDCA) model results in continuous improvement and organizational resilience (Ferguson, 2019).

The results of that study and article are useful for both researchers of the issue of organizational resilience and practitioners underlying both wisdom and systemic approach. Although this study extends the discourse on organizational resilience, it is not devoid of certain limitations. Given the variety of factors influencing OR and the individualization of each organization in this matter, it is advisable in future research to analyze the interaction between the various factors, taking into account the external environment, which is best carried out in the form of qualitative research and case-study. While this narrows the universality of the results, it provides in-depth knowledge of the relationships between the variables analyzed.

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## ANALYSIS OF INTENTIONS TO USE THE DEPOSIT SYSTEM IN POLAND – PILOT STUDIES

Iwona ZDONEK<sup>1</sup>, Dariusz ZDONEK<sup>2\*</sup>, Beata HYSA<sup>3</sup>

<sup>1</sup> Silesian University of Technology; iwona.zdonek@polsl.pl, ORCID: 0000-0002-3377-0904

<sup>2</sup> Silesian University of Technology; dariusz.zdonek@polsl.pl, ORCID: 0000-0002-6190-9643

<sup>3</sup> Silesian University of Technology; beata.hysa@polsl.pl, ORCID: 0000-0003-1192-9395

\* Correspondence author

**Purpose:** The purpose of the article was to develop and validate scales that measure factors influencing intentions to use the deposit system, and then examine the determinants of these intentions. The scales were developed based on the Theory of Planned Behavior.

**Design/methodology/approach:** Scale items were developed based on the literature analysis, and then each scale was validated based on questionnaire surveys. Validation was carried out based on Confirmatory Factor Analysis. In addition, based on structural equation modelling, a pilot analysis was conducted to validate the hypotheses regarding the influence of factors derived from the Theory of Planned Behavior on intentions to use the deposit system in Poland.

**Findings:** Due to the complexity of factors resulting from the theory of rational behavior, it was necessary to develop eight measurement scales. Based on the research, six multi-item scales and two single-item scales were established that meet the criteria of convergent and discriminant validity. Pilot verification of the hypotheses allowed us to state that: 1) attitudes and social norms are significant factors determining the intention to use the deposit system, 2) ecological awareness is a significant factor determining attitudes towards the deposit system and social pressure to use this system, 3) convenience significantly affects the perceived control associated with using the deposit system.

**Research limitations/implications:** The research presented in the article should not be generalized to the entire population due to its pilot nature. The sample of respondents participating in the research is not representative of the Polish population.

**Practical implications:** The questionnaire and measurement scales proposed in the article can be used to study the factors determining the use of the deposit system in targeted studies on a larger and representative sample.

**Social implications:** The article is relevant to research on factors influencing the use of plastic packaging in the food and beverage industry consistent with the circular economy.

**Originality/value:** The article's novelty is the presentation of scales measuring the factors determining the use of the deposit system in Poland.

**Keywords:** sustainability, sustainable development, deposit system, plastic packaging, PLS-SEM.

**Category of the paper:** research paper.

## Introduction

In response to the growing environmental pollution caused by post-consumer waste, efforts are underway to mitigate these impacts. Governments worldwide are taking decisive steps to reduce plastic waste (Picuno et al., 2025), as global plastic production reached 413.8 million metric tons (Mt) in 2023 (PlasticsEurope, 2024). A particular concern is the increasing volume of beverage packaging, which poses a significant environmental challenge due to its production from fossil fuels or materials that degrade very slowly (Ma et al., 2019). One proposed solution involves implementing deposit return systems to incentivize consumers to return packaging. These systems are particularly popular in the food industry for beverage containers, which can be efficiently and easily collected, significantly reducing greenhouse gas emissions through recycling (Choudhary et al., 2019; Zhou et al., 2020). Deposit return systems for beverage containers have been widely adopted in various countries since the 1970s (Zhou et al., 2020). However, Poland remains one of the few European countries that has yet to introduce such a system.

The aim of this article was to develop and validate scales measuring factors influencing the intention to use a deposit return system and to examine the determinants of these intentions. It was hypothesized that three main factors derived from the Theory of Planned Behavior (TPB) would predict the intention to use the deposit return system: Attitudes Towards the Deposit System (ATT), Subjective Norms (SN) i.e., social pressure to use the system and Perceived Behavioral Control regarding system use (PBC). Specific factors influence each of these three predictors. It was assumed that attitudes toward the deposit return system and social pressure to use it were influenced by Ecological Awareness (EAW) and Public Information (PI) factors. Meanwhile, PBC was assumed to be affected by PI, Economic Consequences (EC), and the Convenience of using the deposit system (CON). The scales were developed based on a literature review and validated using survey data. The main analytical method employed at this stage was Confirmatory Factor Analysis (CFA), which identified latent variables for path analysis using structural equation modeling with the PLS-SEM algorithm. This approach revealed statistically significant factors influencing the intention to use the deposit return system. Research on the determinants of deposit return system adoption was essential for understanding the factors that influence the acceptance of this type of innovation in Polish society.

The article is structured as follows. The first section outlines the development of research hypotheses and the construction of the research model. The second section discusses methodological aspects, including a sample description, a presentation of the measurement tool used in the survey, and an overview of the analytical methods applied. The third section presents the research findings. Finally, the fourth section provides a discussion of the results, limitations of the study, and directions for future research.

## 1. Development of hypotheses and research model

To examine the determinants of deposit system use in Poland, the Theory of Planned Behavior (Zhang et al., 2021; Amirudin et al., 2023) was used. This theory considers behavioral intention as the primary predictor of actual behavior. In turn, intentions are influenced by three main factors: attitudes, subjective norms, and perceived behavioral control. Attitudes are understood as an individual's attitude towards a given behavior, which can be either positive or negative. Subjective norms represent the social pressure exerted on an individual to prefer a specific behavior. Perceived behavioral control refers to the degree of control an individual perceives they have over their behavior (Ajzen, 1991).

In addition to the factors derived from the Theory of Planned Behavior, this study also includes other variables that may influence the intention to use a deposit return system. These include ecological awareness, public information about the system, economic consequences associated with its implementation, and the convenience of its use. All these factors were utilized as constructs in the research model, and the relationships between them formed the basis for the development of research hypotheses. The definitions of the constructs included in the research model are presented in Table 1.

**Table 1.**  
*Construct Definitions*

Construct	Definition	Source
Ecological Awareness (EAW)	Understanding the environmental consequences of the deposit system	(Koshta et al., 2022), (Khan et al., 2019)
Public Information (PI)	Publicly available information on waste segregation and handling of waste covered by the deposit system	(Si et al., 2022), (Zhang et al., 2021)
Economic Consequences (EC)	Economic benefits of the deposit system	(Juliana et al., 2022), (Van et al., 2021), (Wang et al., 2020)
Convenience (CON)	Infrastructural support for using the deposit system	(Wang et al., 2020), (Soomro et al., 2022)
Attitude (ATT)	The extent to which using the deposit system is assessed as positive or negative.	(Khan et al., 2019), (Bosnjak et al., 2020)
Subjective Norms (SN)	Social pressure to use the deposit system	(Bosnjak et al., 2020), (Amirudin et al., 2023)
Perceived Behavioral Control (PBC)	A person's perception of their ability to use the deposit system	(Bosnjak et al., 2020), (Amirudin et al., 2023)
Intention to Use the Deposit System (INT)	Readiness of the persons to use the deposit system	(Bosnjak et al., 2020), (Amirudin et al., 2023)

Source: own study.

In their study, (Amirudin et al., 2023) showed that (Amirudin et al., 2023) environmental awareness has a significant impact on attitudes toward the deposit system and, through them, on intentions to use it. Environmental awareness, according to (Amirudin et al., 2023) also influences social pressure to use the deposit system (Amirudin et al., 2023). Both relationships stem from the fact that the knowledge gained during environmental awareness influences the

values we hold, which in turn build our positive attitudes, i.e. our positive attitudes. Assuming that this mechanism operates in any cultural context and therefore also in the Polish one, we pose the first two research hypotheses:

**H1:** Environmental awareness has a significant impact on attitudes toward the deposit system.

**H2:** Environmental awareness has a significant impact on subjective norms regarding the use of the deposit system.

The introduction of a deposit system in a country is preceded by an extensive information campaign. This information states how the deposit system will function, what waste it will cover and what environmental benefits it will generate (Zhou et al., 2023) This information through knowledge building also builds individual attitudes, social pressure and perceived behavioral control. These relationships have been demonstrated in the work of (Tian et al., 2019) and (Amirudin et al., 2023). Assuming that they are also true in the Polish cultural context, we pose the following research hypotheses:

**H3:** Public information has a significant impact on attitudes.

**H4:** Public information has a significant impact on subjective norms.

**H5:** Public information has a significant impact on perceived control over the use of the deposit system.

The individual economic benefits of a deposit system are significant factors influencing the perceived control over its use. This relationship has been demonstrated in prior studies (Amirudin et al., 2023). The higher the deposit amount, the greater the motivation for individuals to recover it, which in this case involves returning the packaging covered by the system (Amirudin et al., 2023). It is evident that the deposit amount must be appropriately calibrated to the product price and consider the financial capacity of the system's users. Convenient infrastructure is another crucial determinant of perceived control over the use of the deposit return system. This relationship has been confirmed by studies (Khan et al., 2019; Amirudin et al., 2023; Khan et al., 2019; Amirudin et al., 2023). Based on this, the following research hypotheses are proposed:

**H6:** Economic consequences have a significant impact on the perceived control over using the deposit system.

**H7:** Convenience has a significant impact on the perceived control over using the deposit system.

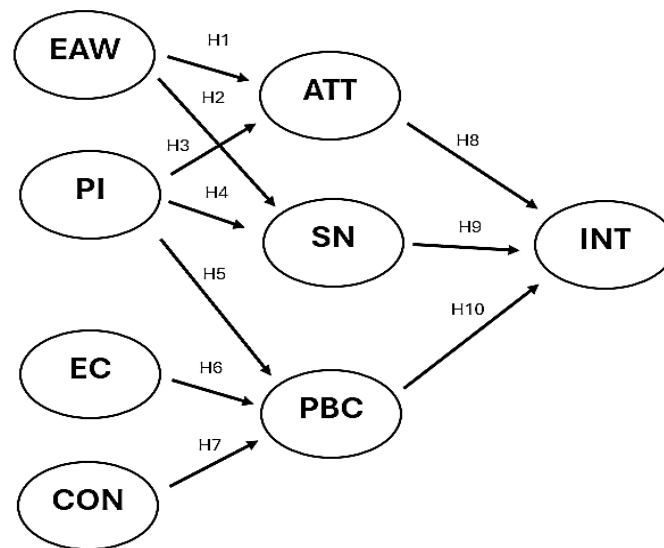
Ajzen (1991) in his work on the Theory of Planned Behavior, demonstrated that attitudes, subjective norms, and perceived behavioral control are significant predictors of behavioral intentions (Ajzen, 1991). We assume that these relationships also hold true within the Polish cultural context. Thus, on this basis, we formulate the following three research hypotheses:

**H8:** Attitudes toward the deposit system have a significant impact on the intention to use it.

**H9:** Subjective norms regarding the deposit system significantly influence the intention to use it.

**H10:** Perceived behavioral control over using the deposit system has a significant impact on the use of the system.

Based on the defined constructs and the relationships between them, a theoretical research model was developed (Fig. 1). The dependent variable in this model is the intention to use the deposit system. The study focuses on intention because a unified deposit system is not yet operational in Poland, although fragmented systems, primarily associated with the brewing industry, are in place. At this stage, it is not feasible to study actual behaviours related to the deposit system. However, given publicly available information regarding plans for the introduction of a universal deposit system, investigating the intention to use such a system is both justified and timely.



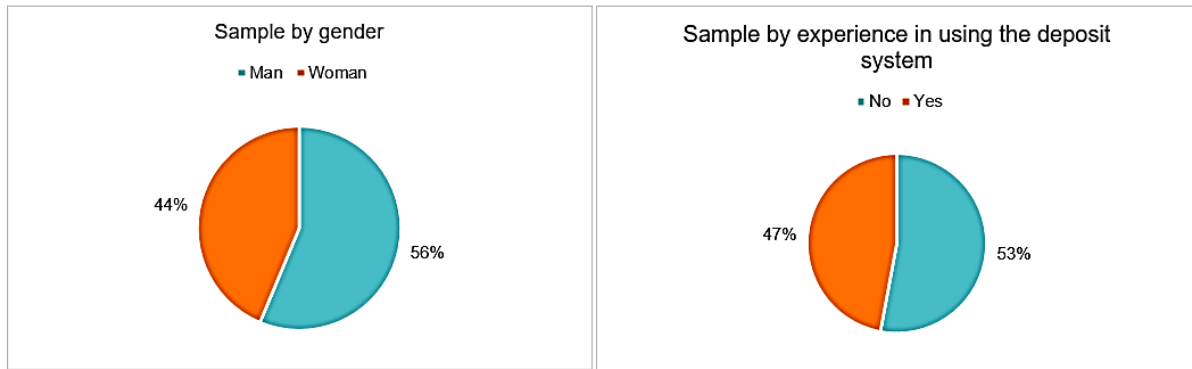
**Figure 1.** Research model.

Source: own study.

## 2. Methods

### 2.1. Research sample

Since the main purpose of the study was to validate the questionnaire, no attempt was made to select a sample representative of Polish society. The survey included 119 respondents. Since the number of items in all scales of the questionnaire was 29, the number of 119 cases is sufficient for validation of the entire questionnaire, as there are 4 observations for each variable (scale item). The sample was slightly more female (56%), and a slight majority of respondents had no experience of using the deposit system (53%) (see Figure 2).



**Figure 2.** Research sample.

Source: own study.

## 2.2. Research tool

A questionnaire was developed to achieve the goal set in the article. It consisted of eight scales measuring individual latent variables (constructs). The observable variables along with the construct membership are presented in Table 2.

**Table 2.**  
*Survey questionnaire*

Construct	Item	Observable variable
<b>Environmental Awareness (EAW)</b>	EAW1	I believe that a deposit system for beverage packaging will result in less trash in the environment.
	EAW2	I believe that a deposit system for beverage packaging will contribute to creating a better environment for future generations.
	EAW3	I believe that a deposit system for beverage packaging will have a positive effect on consumers' habits of segregating packaging.
	EAW4	I believe that a deposit system for beverage packaging will protect the environment and natural resources.
<b>Public Information (PI)</b>	PI1	I get my knowledge about beverage packaging segregation from public information (brochures, social media, etc.).
	PI2	Public information helps me understand how to segregate waste properly.
	PI3	Public information makes me aware of the importance of waste segregation.
<b>Economic Consequences (EC)</b>	EC1	I would keep the beverage containers to get the deposit back.
	EC2	I would collect discarded beverage containers to earn the deposit money.
	EC3	I believe that less affluent people would collect beverage packaging to earn extra deposit money.
<b>Convenience (CON)</b>	CON1	I have time to segregate beverage containers.
	CON2	I have the ability at home/apartment to store and segregate beverage containers before returning them to the collection point.
	CON3	I prefer to return beverage containers to a designated collection point rather than to the current yellow waste garbage.
	CON4	I am concerned that the infrastructure of the deposit system (the placement of the bottle machines) will be inconvenient.
	CON5	I am concerned about queues at collection points.
<b>Attitude (ATT)</b>	ATT1	I rate the idea of introducing a deposit system in Poland as good.
	ATT2	I rate the idea of introducing a deposit system in Poland as useful.
	ATT3	I am glad that the deposit system will be introduced in Poland.
	ATT4	I think the deposit system should be introduced in Poland.
<b>Subjective norms (SN)</b>	SN1	My family expects me to use the deposit system.
	SN2	My neighbours expect me to use the deposit system.
	SN3	My community expects me to use a deposit system.



Cont. table 2.

<b>Perceived behavioral Control (PBC)</b>	PBC1	It is only up to me to segregate beverage containers.
	PBC2	I have the confidence to segregate beverage containers if I want to.
	PBC3	I understand how the deposit system for beverage packaging will work in Poland.
<b>Intention to Use the Deposit System (INT)</b>	INT1	I am interested in initiatives under the deposit system program.
	INT2	I am ready(a) to use the deposit system regularly after its introduction.
	INT3	I am ready(a) to devote extra time to return beverage packaging.
	INT4	I am willing to participate in environmental movement programs.

Source: own study.

### 2.3. Methods of analysis

Campbell and Fiske (Campbell, Fiske, 1959) and Hair (Hair, 2014b) propose that scales measuring constructs should be validated by convergent validity and discriminant validity. Convergent validity refers to the confidence we have that a construct (i.e., a latent variable) is well measured by observable variables. Convergent validity is measured by the correlation of the observable variables of a construct. Assessment of convergent accuracy is related to such measures as factor loadings of observable variables (loadings), composite reliability (CR) of a construct and average variance extracted (AVE) of a construct. Factor loadings determine the correlations between each observable variable and each construct. The threshold value is 0.5, although it is recommended that factor loadings be higher and exceed 0.7. Composite reliability (CR) and Cronbach's alpha coefficient measure the internal consistency of scale items (internal consistency). The threshold value for these measures to be exceeded is 0.7. AVE measures the level of variance captured by a construct relative to the level due to measurement error. The acceptable level for this ratio should exceed 0.5.

Discriminant accuracy measures the degree to which indicators of different constructs are uncorrelated. It checks whether constructs show stronger relationships with their own observable variables than with the observable variables of other constructs. Discriminant accuracy is assessed using the Fornell-Larcker (FL) criterion and the heterotrait-monotrait (HTMT) criterion.

Convergent and discriminant accuracy were calculated using the data collected in the survey. After assessing convergent and discriminant accuracy, modeling was performed on latent variables (constructs) using the pls SEM algorithm available in the seminar package in RStudio.

### 3. Results

Table 3 shows the factor loadings within each construct. It shows that the vast majority of factor loadings exceed 0.7. It should be added that not all scale items assumed at the beginning remained in the constructs. Of the 29 observable variables assumed at the beginning, 22 remained. The largest variable eliminations were made for the EC (elimination of two variables), CON (elimination of three variables) and PBC (elimination of two variables) scales. The EC and PBC scales thus became scales measured with single observable variables. The remaining scales are multi-element scales. As can be seen in Table 4, the measures i.e. CR and Cronbach's alpha exceed the value of 0.7 for all multi-element constructs. In turn, the AVE values for these constructs exceed the values of 0.5. This indicates correct measures of convergent reliability.

**Table 3.**  
*Convergent reliability: loadings*

	<b>EAW</b>	<b>PI</b>	<b>EC</b>	<b>CON</b>	<b>ATT</b>	<b>SN</b>	<b>PBC</b>	<b>INT</b>
<b>EAW1</b>	<b>0.819</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>EAW2</b>	<b>0.863</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>EAW3</b>	<b>0.772</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>EAW4</b>	<b>0.794</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<b>EC1</b>	0.000	0.000	<b>1.000</b>	0.000	0.000	0.000	0.000	0.000
<b>CON1</b>	0.000	0.000	0.000	<b>0.766</b>	0.000	0.000	0.000	0.000
<b>CON2</b>	0.000	0.000	0.000	<b>0.933</b>	0.000	0.000	0.000	0.000
<b>ATT1</b>	0.000	0.000	0.000	0.000	<b>0.875</b>	0.000	0.000	0.000
<b>ATT2</b>	0.000	0.000	0.000	0.000	<b>0.900</b>	0.000	0.000	0.000
<b>ATT3</b>	0.000	0.000	0.000	0.000	<b>0.922</b>	0.000	0.000	0.000
<b>ATT4</b>	0.000	0.000	0.000	0.000	<b>0.929</b>	0.000	0.000	0.000
<b>SN1</b>	0.000	0.000	0.000	0.000	0.000	<b>0.881</b>	0.000	0.000
<b>SN2</b>	0.000	0.000	0.000	0.000	0.000	<b>0.845</b>	0.000	0.000
<b>SN3</b>	0.000	0.000	0.000	0.000	0.000	<b>0.880</b>	0.000	0.000
<b>PBC3</b>	0.000	0.000	0.000	0.000	0.000	0.000	<b>1.000</b>	0.000
<b>INT1</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	<b>0.789</b>
<b>INT2</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	<b>0.905</b>
<b>INT3</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	<b>0.887</b>
<b>INT4</b>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	<b>0.692</b>
<b>PI1</b>	0.000	<b>0.787</b>	0.000	0.000	0.000	0.000	0.000	0.000
<b>PI2</b>	0.000	<b>0.926</b>	0.000	0.000	0.000	0.000	0.000	0.000
<b>PI3</b>	0.000	<b>0.939</b>	0.000	0.000	0.000	0.000	0.000	0.000

Source: own study.

**Table 4.***Convergent reliability: Cronbach' alpha, CR and AVE*

	<b>alpha</b>	<b>rhoC</b>	<b>AVE</b>	<b>rhoA</b>
<b>EAW</b>	0.828	0.886	0.660	0.830
<b>PI</b>	0.866	0.916	0.786	0.926
<b>EC</b>	1.000	1.000	1.000	1.000
<b>CON</b>	0.652	0.842	0.729	0.803
<b>ATT</b>	0.928	0.949	0.822	0.929
<b>SN</b>	0.840	0.902	0.754	0.864
<b>PBC</b>	1.000	1.000	1.000	1.000
<b>INT</b>	0.840	0.892	0.677	0.883

Source: own study.

Two criteria were used to test discriminant validity, namely FL (Table 5) and HTMT (Table 6). Table 5 shows the correlation matrix between constructs and on the diagonal is inserted the square root of the AVE of each construct. The criterion is met when the correlations between constructs are less than the number on the diagonal. The calculations in Table 5 show that the FL criterion is satisfied.

The concept of the heterotrait-monotrait ratio (HTMT) is the ratio of the average correlation of observable variables between two different constructs (heterotrait) and the square root of the product of the average correlations between indicators of the same constructs (monotrait) (Hair, 2014a). This criterion assumes that the ratio cannot exceed a threshold value of 0.9. The calculations in Table 6 show that the HTMT criterion is also met.

**Table 5.***Discriminant validity: Fornell-Larcker criterion*

	<b>EAW</b>	<b>PI</b>	<b>EC</b>	<b>CON</b>	<b>ATT</b>	<b>SN</b>	<b>PBC</b>	<b>INT</b>
<b>EAW</b>	0.813	.	.	.	.	.	.	.
<b>PI</b>	0.272	0.887	.	.	.	.	.	.
<b>EC</b>	0.591	0.215	1.000	.	.	.	.	.
<b>CON</b>	0.398	0.270	0.551	0.854	.	.	.	.
<b>ATT</b>	0.727	0.293	0.490	0.541	0.907	.	.	.
<b>SN</b>	0.382	0.258	0.536	0.473	0.380	0.869	.	.
<b>PBC</b>	0.154	0.274	0.092	0.288	0.225	0.098	1.000	.
<b>INT</b>	0.665	0.425	0.708	0.590	0.703	0.482	0.278	0.823

Source: own study.

**Table 6.***Discriminant validity: Heterotrait-Monotrait criterion*

	<b>EAW</b>	<b>PI</b>	<b>EC</b>	<b>CON</b>	<b>ATT</b>	<b>SN</b>	<b>PBC</b>	<b>INT</b>
<b>EAW</b>	.	.	.	.	.	.	.	.
<b>PI</b>	0.308	.	.	.	.	.	.	.
<b>EC</b>	0.645	0.230	.	.	.	.	.	.
<b>CON</b>	0.515	0.339	0.651	.	.	.	.	.
<b>ATT</b>	0.827	0.316	0.509	0.672	.	.	.	.
<b>SN</b>	0.442	0.299	0.580	0.584	0.421	.	.	.
<b>PBC</b>	0.171	0.278	0.092	0.335	0.233	0.102	.	.
<b>INT</b>	0.773	0.506	0.736	0.765	0.772	0.543	0.300	.

Source: own study.

After verifying convergent and discriminant validity, path analysis was performed on the constructs to verify the hypotheses. Used bootstrapping technique on 1000 samples. The results are shown in Table 7, which shows that attitudes ( $\beta = 0.580$ ,  $t = 7.947$ ) and social norms ( $\beta = 0.249$ ,  $t = 2.745$ ) are significant predictors of intention to use the deposit system, while perceived behavioral control was found to be statistically insignificant ( $\beta = 0.124$ ,  $t = 1.900$ ). This means that for the sample of respondents studied, intentions to use the deposit system are most strongly influenced by attitudes toward the system, social norms have much less impact, and perceived behavioral control is insignificant. The insignificance of PBC can be explained by the lack of widespread experience of respondents in using this system.

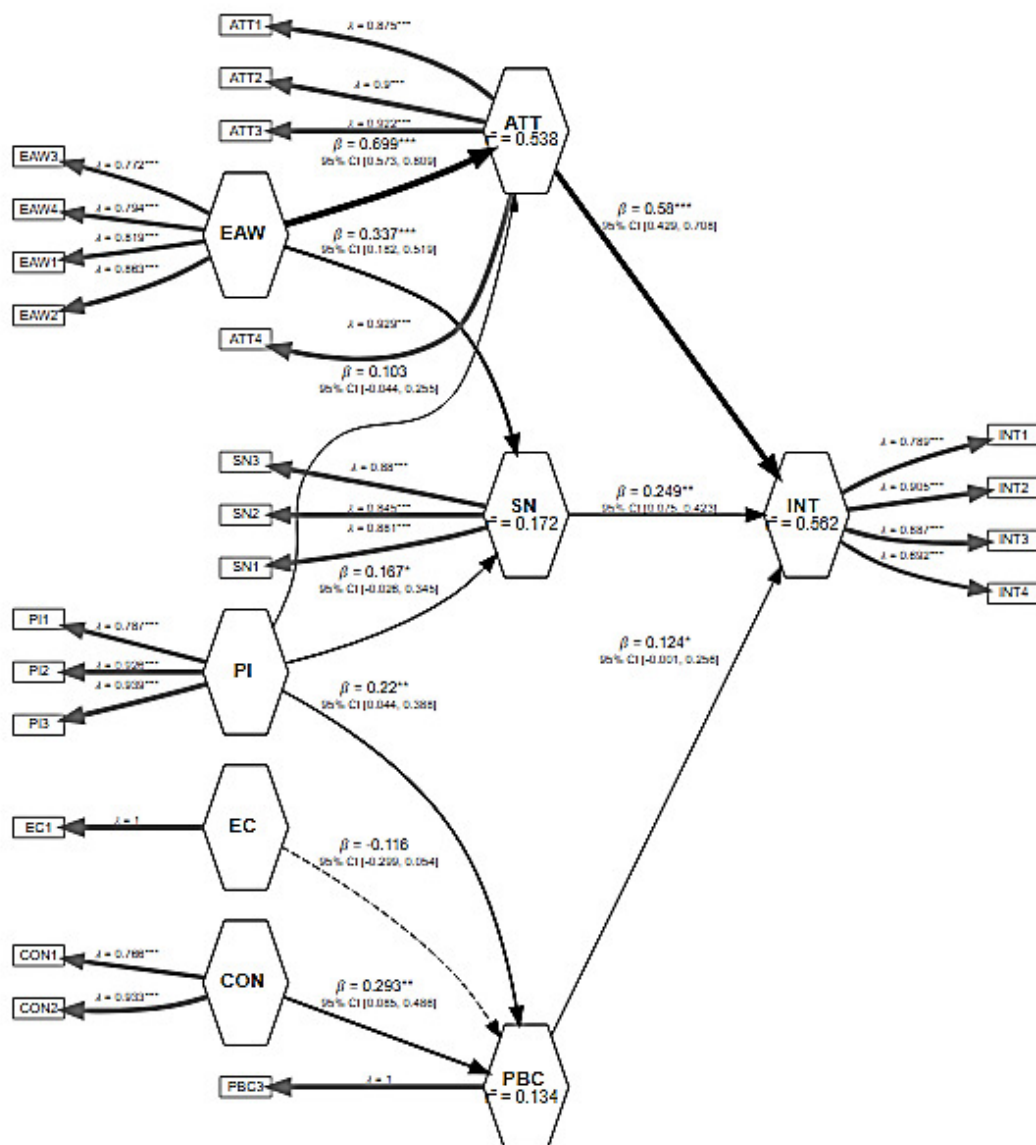
Environmental awareness (EAW) was found to be a significant predictor of attitudes toward the deposit system (ATT) ( $\beta = 0.669$ ,  $t = 11.953$ ), while public information (PI) about this system was found to be insignificant ( $\beta = 0.103$ ,  $t = 1.332$ ). A similar result was also obtained for predictors explaining social norms (SN). In this case, too, EAW proved to be a significant predictor ( $\beta = 0.337$ ,  $t = 3.929$ ), while PI was not significant ( $\beta = 0.167$ ,  $t = 1.752$ ). PBC was explained by two significant predictors. These include PI ( $\beta = 0.220$ ,  $t = 2.446$ ) and CON ( $\beta = 0.293$ ,  $t = 2.856$ ), while the predictor EC was found to be insignificant ( $\beta = -0.116$ ,  $t = -1.284$ ).

**Table 7.**  
*Bootstrapping*

Hypothesis	Original Est.	Bootstrap Mean	Bootstrap SD	T Stat	2.5% CI	97.5% CI
EAW → ATT	0.699	0.700	0.058	11.953	0.573	0.809
EAW → SN	0.337	0.349	0.086	3.929	0.182	0.519
PI → ATT	0.103	0.102	0.077	1.332	-0.044	0.255
PI → SN	0.167	0.162	0.095	1.752	-0.026	0.345
PI → PBC	0.220	0.219	0.090	2.446	0.044	0.388
EC → PBC	-0.116	-0.119	0.091	-1.284	-0.299	0.054
CON → PBC	0.293	0.302	0.103	2.856	0.085	0.486
ATT → INT	0.580	0.580	0.074	7.847	0.429	0.708
SN → INT	0.249	0.254	0.091	2.745	0.075	0.423
PBC → INT	0.124	0.120	0.065	1.900	-0.001	0.256

Source: own study.

Figure 8 also shows the  $R^2$  for each construct. Intention to use the deposit system was explained by 56%, attitudes by 54%, social norms by 17%, and perceived control by 13%. This means that there are some other factors not included in the study that explain the constructs in question. The factors are particularly important for the constructs i.e. SN and PBC.



**Figure 8.** Graphic representation of the influence of individual factors on the intention to use the deposit-refund system.

Source: own study.

#### 4. Discussion and conclusion

The goal outlined in the article was achieved: scales measuring factors determining the intention to use the deposit system were validated and a trial analysis was conducted to verify the hypotheses. Eight scales were subjected to validation. Six of these proved to be valid multi-item scales; however, for two scales (EC and PBC), our study revealed that the values for convergent and discriminant validity were not satisfactory. To conduct structural equation modeling, we were compelled to reduce these two scales to single-item scales. Therefore,

it is necessary to re-evaluate the items for these two scales and revalidate the questionnaire, which will be the focus of our forthcoming research. Another notable finding is the low coefficient of determination ( $R^2$ ) for constructs such as SN and PBC. When comparing this result to the study by (Amirudin et al., 2023), the  $R^2$  for SN was significantly higher, which can be attributed to the inclusion of the construct of religious norms in their research—something not considered in our study. Similarly, in both studies, the construct PBC was explained by EC and CON but still yielded a low  $R^2$ .

The pilot verification of hypotheses yielded unexpected results, differing significantly from those reported by (Amirudin et al., 2023). The main differences include: (1) the non-significance of the construct PI in explaining ATT and SN, (2) the non-significance of the construct EC in explaining PBC, (3) the non-significance of PBC in explaining INT. These findings highlight the minimal impact of information regarding the planned deposit system in Poland. The non-significance of PBC for intention is not surprising, as the system is still in the planning stages. It is plausible that PBC will become significant once the system is implemented, and the Polish society has the opportunity to use it. An additional unexpected result was the significance of SN in predicting the intention to use the deposit system. Previous studies (Zdonek et al., 2024) indicated that SN is typically insignificant for newly introduced ecological innovations. A similar conclusion can be drawn from the findings of (Mularczyk et al., 2022). However, the widespread awareness of environmental pollution in Poland may have led to strong societal approval of initiatives aimed at reducing it, making social pressure a significant factor. This conclusion aligns with the findings from (Zdonek, Jaworska, 2024).

The pilot verification of the hypotheses also showed the consistency of our research with the results of other researchers. First, our research confirms the significant impact of ecological awareness on attitudes towards the deposit system and subjective norms. This result is consistent with the work (Amirudin et al., 2023; Juliana et al., 2022; Wang et al., 2021; Liao, Xing, 2023). The influence of environmental awareness is stronger on attitude than on social pressure. Therefore, the personal decision to use the deposit system, in the light of our research, is more determined by attitude than by social pressure. Moreover, we also validated the importance of public information and convenience on perceived behavioural control. This conclusion is consistent with the works (Amirudin et al., 2023; Soomro et al., 2022). The impact of convenience is stronger, so it is one of the most important factors determining the decision to use the deposit system.

### **Practical implications**

The practical implications of this study are primarily associated with the validation of the presented measurement scales. While two scales require redevelopment, the remaining scales can be employed in future studies of the deposit system. Such research will likely gain momentum following the system's implementation. Due to the fact that during the pilot we

verified the hypotheses regarding the factors determining the use of the deposit system, during the final verification it will be possible to check whether we will obtain similar results.

### Research limitations and directions for further work

The main limitation of the research is its pilot nature. We did not select the research sample in a representative way. Moreover, the research sample is not very large. This results from the purpose of our article, i.e. validation of measurement scales and preliminary verification of hypotheses regarding the factors determining the intention to use the deposit system in Poland. Another limitation of our research is that it was conducted at a time when the deposit system in Poland was not yet universally applicable. Therefore, the directions for further work include re-conducting research after the introduction of the deposit system in Poland.

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## CONVERGENCE OF CHANGES IN THE EMPLOYMENT STRUCTURE IN THE EUROPEAN UNION COUNTRIES

Monika ZIOŁO<sup>1</sup>, Lidia LUTY<sup>2</sup>, Dagmara K. ZUZEK<sup>3\*</sup>

<sup>1</sup> Department of Statistics and Social Policy, University of Agriculture in Krakow; monika.ziolo@urk.edu.pl, ORCID: 0000-0003-0884-4083

<sup>2</sup> Department of Statistics and Social Policy, University of Agriculture in Krakow; lidia.luty@urk.edu.pl, ORCID: 0000-0001-8250-8331,

<sup>3</sup> Department of Statistics and Social Policy, University of Agriculture in Krakow; dagmara.zuzek@urk.edu.pl, ORCID: 0000-0002-7620-1621

\* Correspondence author

**Purpose:** Multidimensional scaling is a method that allows the representation of complex observations in a space with fewer dimensions (usually on the plane) in such a way that the distance matrix counted on the plane is as similar as possible to the matrix counted in the original space. The paper presents a proposal to use this approach in the analysis of spatial-temporal structures describing changes in the structure of employment in EU countries. The structures are described by shares, so no procedure is necessary to bring the shares to comparability due to the unit of measure. Separate multidimensional scaling is carried out for each unit of time. The purpose of the study is to try to separate groups of European Union countries similar due to their employment structures.

**Methodology:** The paper uses one of the frequently used non-hierarchical methods - the k-means method. The study of multidimensional clustering of EU regions, which uses the k-means algorithm to identify similar areas are used in many fields among others to group regions or countries.

**Findings:** In the EU countries, enterprises employing up to 9 people account for the largest percentage. On average, they accounted for 95.14% in 2015 and in 2020 the percentage of these enterprises increased slightly to 95.27%. The highest percentage of enterprises employing up to 9 people was in Slovakia, with 97.41% in 2020, while the lowest was in Germany, where the value of this indicator was 82.44%. Among the countries analysed, Germany and Luxembourg stood out in particular, where there was a relatively high number of companies employing between 50 and 249 people.

**Originality/value:** The importance of the indicated research is extremely important from the point of view of EU countries. Therefore, the methods indicated in the article can also be used in other aspects of the economy.

**Keywords:** employment; European Union countries; multidimensional scaling.

**Category of the paper:** Research paper.

## 1. Introduction

Data shows that small and medium-sized enterprises (SMEs) represent 99% of all companies in the EU and employ around 64.5% of workers in the EU non-financial sector. Small businesses (employing fewer than 50 people) account for approximately 48.4% of employment in the non-financial economy. Medium-sized enterprises (50-249 employees) employ an additional approximately 16% of employees and generate a similar percentage of added value in the economy. However, large companies, although they constitute only 0.2% of all companies, employ approximately 33.5% of employees, which shows their key role in employment at the European level.

The structure of companies by number of employees formed the basis of analyses carried out using the k-means method, which is based on the use of similarity measures.

The use of similarity (dissimilarity) measures in conjunction with the clustering method makes it possible to study the structural transformation of economic objects in time and space, i.e.: at different times for one object, at one moment for a group of objects, at many moments for many objects. Similarity (dissimilarity) of objects understood as similarity (dissimilarity) in the sense of the values of variables observed in these objects is the greater (smaller) the value of the measure (Walesiak, 1993).

Structural analyses, assessments of similarity and changes in structures are widely present in the literature and apply to all aspects of socio-economic processes. One of the most common research topics is the structure of employment (considered at different levels of territorial division), which determines the distribution of the population by employment in sectors, sections, industries and branches of the economy.

The structure of employment is determined by the level of economic development, resources (natural, capital and human), results from the specialization of the territorial unit shaped over the years, the needs of the internal market and the macro environment. Works on the nature of changes in European employment structures, along with attempts to look for patterns of structural changes in employment in Europe, are becoming an important part of research (Erber, 2002; Goos, Manning, Salomons, 2009; Fernández-Macías, 2012; Markowska, Sokolowski, 2019; Strahl, 2014; Canale, Liotti, Musella, 2022). The purpose of this study is to try to separate groups of European Union countries similar by employment structures in dynamic terms (period 2015-2020).

## **2. Employment structure in the European Union countries**

The labour market in the European Union (EU) is one of the most important components of its economy. It is a complex system that encompasses a variety of aspects, such as the level of unemployment, types of employment, industry structure, labour force demographics and government policies affecting its operation. This article discusses changes in the employment structure in terms of the number of people in employment so that it is possible to show how the structure of the labour market is evolving in the EU.

Since the creation of the European Community, one of the main objectives has been, among others, the creation of a common labour market. The 1957 Treaties of Rome laid the foundation for the free movement of people, with the goal of allowing citizens of member countries to move and work freely in other member states. This was the first step toward labour market integration in Europe.

Another important stage in the shaping of the EU labour market was the enlargement of the Union to include new Member States. In 2004 and 2007, many central and eastern European countries joined the European Union, significantly increasing the number of available workers on the EU labour market. This enlargement also introduced new challenges, such as the need to integrate new workers and manage migration flows.

## **3. Structure of businesses in EU countries**

In order to systematise structure of the labour market at the beginning of the 1990s, the statistical classification of economic activities in the European Community (called NACE Rev. 1 or NACE Rev. 1.1) was established by Council Regulation (EEC) No 3037/90 (Council, 1990), which, with various modifications, continued to operate and apply in the changing European Union until 2008. Due to technological developments and structural changes in the economy, an updated classification called NACE Revision 2 was introduced (Regulation..., 2006). This classification is the basis for assigning employed persons to specific sections, due to the primary activity of the company - the employer. The data collected in Eurostat relates, inter alia, to the EU countries - and it is this level of division that will constitute the spatial scope of the analyses conducted in this paper. The current statistical classification of activities (usually referred to as NACE Rev. 2), established - as indicated - in 2006, has been in force since 2008, and the latest available statistics on employment in EU countries are for the year 2020.

The structures in this regard covered in the analysis relate to the total business economy category. Business statistics cover industry, construction, distributive trades and most other services. They exclude a range of economic activities, such as: agriculture, forestry and fishing;

public administration; education; health and social work; arts, entertainment and recreation. Alongside these, financial and insurance activities have traditionally been excluded, given their specific nature and the limited availability of statistics in this area.

**Table 1.**

*Changes in key indicators characterising labour market dynamics in EU countries in 2015/2010, 2020/2015*

	Enterprises - 2015/2010 %	Value added at factor cost - 2015/2010 %	Persons employed 2015/2010 %	Enterprises 2020/2015 %	Value added at factor cost - 2020/2015 %	Persons employed - 2020/2015 %
Total business economy	9,31	12,51	4,85	4,81	10,48	4,22
Mining and quarrying	-5,06	-41,81	-18,23	-5,47	-20,02	-16,11
Manufacturing	-1,23	15,54	-0,06	3,90	9,99	5,44
Electricity, gas and air conditioning supply	68,91	1,59	-1,80	58,16	22,18	20,18
Water supply; waste management	11,91	16,22	11,29	7,00	18,91	15,94
Construction	5,70	2,49	-4,08	10,61	27,30	14,07
Wholesale and retail trade	0,87	10,02	0,22	-4,33	12,27	2,14
Transportation and storage	4,61	11,38	5,43	12,10	-5,67	3,61
Accommodation and food service activities	9,00	20,98	14,56	-0,39	-29,47	-3,57
Information and communication	28,32	10,45	14,58	18,15	26,63	16,72
Real estate activities	20,12	21,45	13,33	0,39	1,54	3,40
Professional, scientific and technical activities	19,24	18,54	16,72	9,29	10,26	3,38
Administrative and support service activities	25,85	24,82	15,64	11,86	10,21	-1,51
Repair of computers and household goods	10,88	1,25	5,25	-4,98	-3,40	-8,52

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/>, October 2024.

In the EU countries, there were 23.38 million enterprises operating in 2020, employing 127.62 million workers and generating €6,496,218.8 million in value added at factor cost. During the analysed period, the biggest changes occurred for value added at factor cost in the mining and quarrying sector of 2015 compared to 2010 (Tab. 1). The change was significant and indicated a decrease of as much as 42%. In the next period analysed, the decrease in this indicator was 20% in 2020 compared to 2015. Such a large change is due to the tightening of the European Union's policy on fossil fuel extraction companies. In the EU, it is forbidden to subsidise any loss-making industry with taxpayers' money unless the whole Union, represented by the European Commission, agrees (this is a consequence of the common open market), and this applies to a large extent to the mining sector.

The lack of subsidies has resulted in a decrease or total reduction in the extraction of fossil fuels and especially hard coal in Sweden, Ireland, the Netherlands, Belgium, France, Germany, the Czech Republic, Austria, Hungary, Bulgaria, Romania, Spain, Italy, Croatia and Poland. Another reason for the reduction in the extraction of fossil fuels within the EU has been the increase in output per worker outside Europe, which is several times higher, the reason for the closure of many European mines. Employment in the sector was also systematically reduced by 18% in 2015 compared to 2010 and by 16% in 2020 compared to 2015, respectively.

There was also a significant decrease in value added at factor cost in the accommodation and food service activities sector in 2020 compared to 2015 of 29.47%. This industry was mainly affected by the COVID-19 pandemic.

The most favourable changes can be observed in the electricity, gas and air conditioning supply sector. The number of start-ups increased by 68.91% in the first years analysed and by 58.16% in the following period. This resulted in a 20.18% increase in employment in 2020 compared to 2015 and the value added at factor cost increased by 22.18% in this sector. There is also dynamic growth in the information and communication sector, where the number of businesses increased by 28.32% in 2015 compared to 2010, resulting in a 26.63% increase in revenue over the following five years. Income also increased in the administrative and support service activities sector by 24.82%, similarly, the number of businesses operating in this sector increased by 25.85%. A favourable trend in this sector can also be observed in the next analysed period, with income increasing by 10.21% and the number of enterprises by 11.86% in 2020 compared to 2015. Further analysis was carried out on the structure of enterprises in the total business activity category in terms of the structure of employment in terms of the number of persons employed.

#### **4. Material and method**

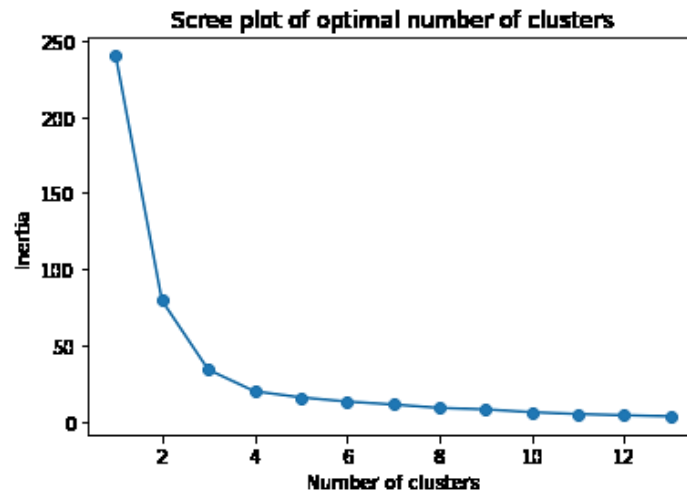
In this paper, selected methods from the group of non-hierarchical methods were used to group European Union countries in terms of employment structure.

The k-means method is a method belonging to the group of cluster analysis algorithms, i.e. an analysis involving the search for and separation of groups of similar objects (clusters). It represents a group of non-hierarchical algorithms. The main difference between non-hierarchical and hierarchical algorithms is the need to specify the number of clusters in advance and that objects can change the cluster they belong to during running of the algorithm.

With the k-means method, k different possibly distinct clusters will be created. This algorithm consists of moving objects from cluster to cluster until intra-cluster and inter-cluster variability is optimised. It is obvious that the similarity within a cluster should be as high as possible, while the separate clusters should differ from each other as much as possible.

Among the non-hierarchical methods, the k-means method is often used. A study on multidimensional clustering of EU regions based on this method was presented by Pavone and Pagliacci (2021) and Rybak (2022). Another example of the application of the k-means method is a paper describing the grouping of EU countries according to the development of a circular economy using k-means by Gomorov and Ratner (2021).

The analyses were carried out for the European Union countries for the years 2015, 2020. Using a landslide diagram, it was decided to create 4 groups of countries similar in terms of the structure of the number of people employed (Figure 1).



**Figure 1.** Landslide plot for the optimal number of clusters.

Source: own study.

## 5. Results of the research

The use of non-hierarchical methods made it possible to create groups of countries similar in terms of their employment structure, taking into account the number of people employed. A landslide diagram indicated that 4 groups of countries made the most sense. Of these, group one is the most numerous and includes 12 countries, group two includes four countries. Taking into account the specifics of the employment structure, one site was classified in group 3 and this was Germany, while group 4 included seven countries.



**Table 2.**

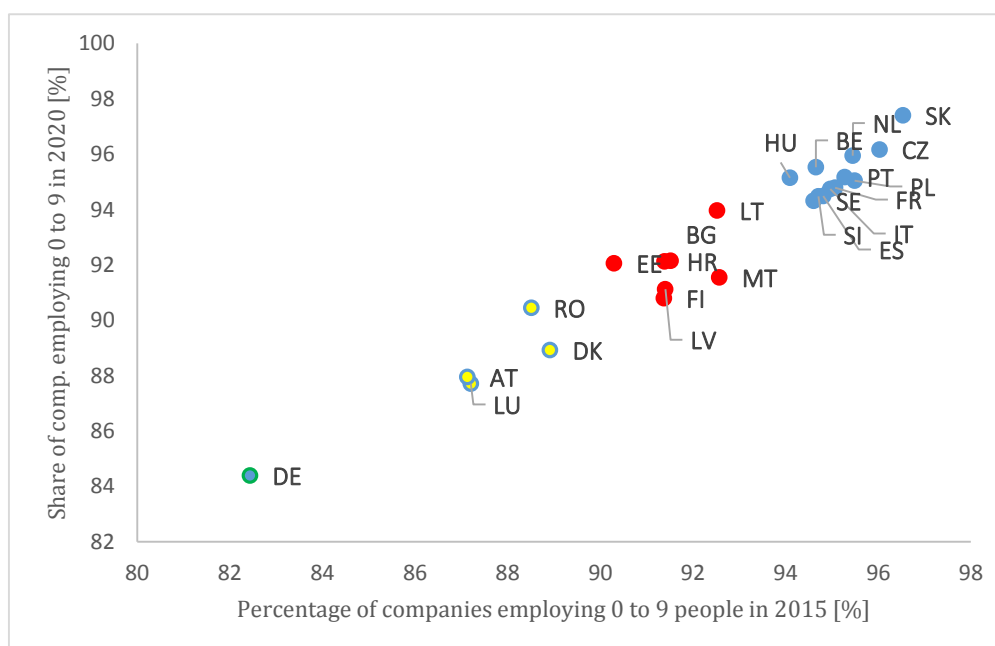
Key characteristics for EU countries classified in Group 1(%)

GROUP I	Belgium, Czechia, France, Hungary, Italy, Netherlands, Portugal, Poland, Slovakia, Slovenia, Spain, Sweden,									
	2015					2020				
	0-9	10-19	20-49	50-249	>250	0-9	10-19	20-49	50-249	>250
mean	95,14	2,60	1,42	0,70	0,14	95,27	2,54	1,39	0,66	0,14
minimum	94,09	1,92	0,81	0,51	0,09	94,31	1,23	0,79	0,46	0,10
maximum	96,53	3,27	1,68	0,93	0,20	97,41	3,27	1,72	0,85	0,20
SD*	0,67	0,48	0,24	0,12	0,03	0,89	0,60	0,24	0,11	0,03
CV**	0,70	18,33	17,05	17,84	21,56	0,93	23,69	17,23	16,08	20,21

SD\* - standard deviation, \*\*CV – coefficient of variation.

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/>, October 2024.

In the first group, the highest percentage of countries with the number of enterprises employing up to nine people was observed. On average, it represented 95.14% in 2015 and in 2020 the percentage of these enterprises increased slightly to 95.27%. In this group of countries, the percentage of enterprises with the smallest employment was a very homogeneous group and the coefficient of variation for this characteristic was 0.7%. The greatest coefficient of variation between countries in this group was in 2020 in the group of enterprises with 10 to 19 employees, as indicated by the highest value of the coefficient of variation at 23.69%.

**Figure 2.** Share in the employment structure of EU countries of enterprises employing up to 9 persons.Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/> October 2024.

In order to present the specifics of the phenomenon in individual countries, it can be observed that the highest proportion of enterprises employing up to 9 persons was in Slovakia (Fig. 2). In 2020, it was 97.41%, while it was lowest in Germany, where the proportion of the smallest enterprises was 82.44%. The biggest changes, however, occurred in Hungary and Belgium, but the increase in the number of these smallest enterprises did not exceed 1pc there.

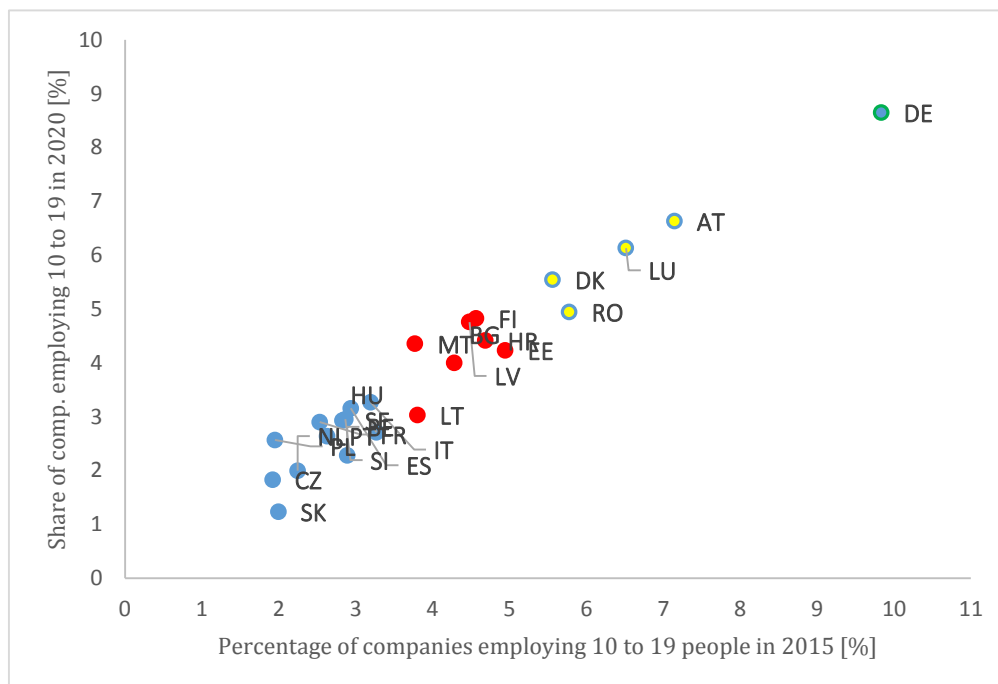
**Table 3.***Key characteristics for EU countries classified in Group II(%)*

Group II	Luxembourg, Denmark, Romania, Austria									
	2015					2020				
	0-9	10-19	20-49	50-249	>250	0-9	10-19	20-49	50-249	>250
mean	87,94	6,25	3,67	1,77	0,37	88,76	5,81	3,43	1,65	0,35
minimum	87,13	5,56	3,49	1,62	0,32	87,71	4,94	2,96	1,35	0,29
maximum	88,91	7,15	3,84	1,98	0,46	90,45	6,63	3,70	2,00	0,46
SD*	0,91	0,72	0,16	0,15	0,06	1,24	0,73	0,32	0,27	0,08
CV**	1,03	11,58	4,41	8,55	16,63	1,40	12,54	9,33	16,45	21,49

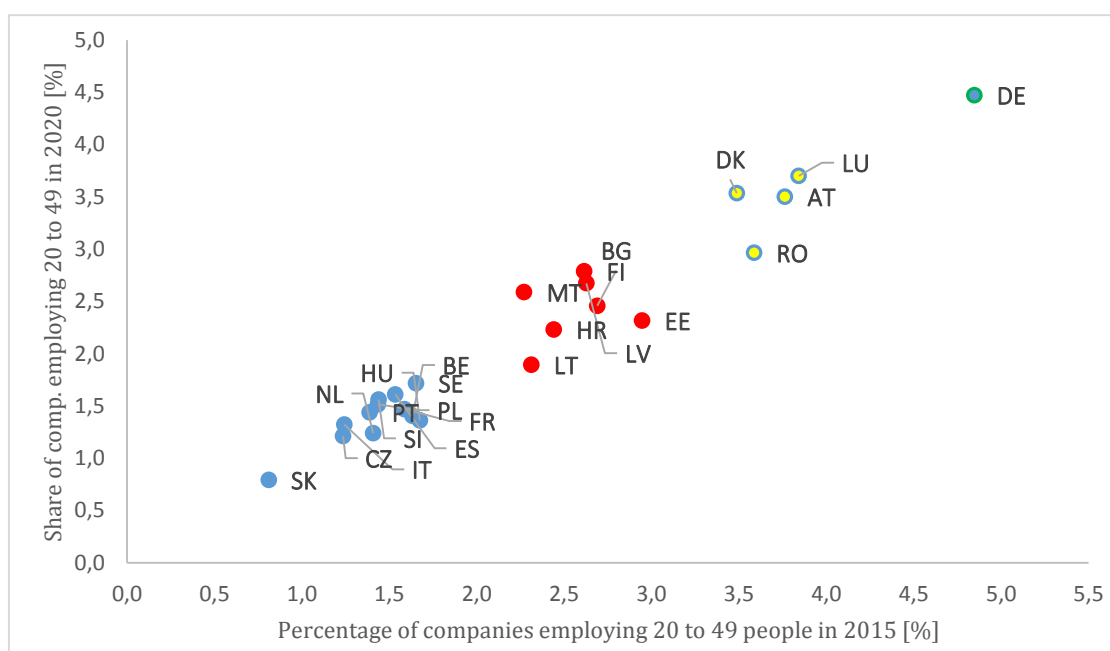
SD\* - standard deviation, \*CV – coefficient of variation.

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/>, October 2024.

The second group of countries in the employment structure has the highest number of enterprises employing between 10 and 19 people. On average, the percentage of these companies was 6.25% in 2015 and 5.81% in 2020. The percentage of companies employing between 20 and 49 people is also highest in this group. In 2015 and 2020, the percentage of medium-sized enterprises was 3.67% and 3.43% respectively. During the analysed period, there was a slight increase in the average value (by 0.82 p.p.) of the number of companies employing fewer than 9 people. In other categories, a decrease in the average share of employment in the total number of enterprises was observed.

**Figure 3.** Share in the employment structure of EU countries of enterprises employing between 10 and 19 persons.Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/>, October 2024.

The highest percentage of companies with 10 to 19 employees was in Germany, with 9.84% in 2015 and 8.64% in 2020. This was followed by Austria and Luxembourg where the percentage of those employing 10 to 19 people was at 7.15% and 6.52% respectively in 2015. The lowest percentage of small enterprises was in Slovakia and Poland and the Czech Republic where the number of small enterprises did not exceed 2% of the total (Fig. 3).



**Figure 4.** Share in the employment structure of EU countries of enterprises employing between 20 and 49 persons.

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/>, October 2024.

The third group is the one where Germany is classified and the percentage of companies employing between 20 and 49 people in the group of all operating companies did not exceed 4.85% in 2015 and 4.37% in 2020. %. Due to this feature, the EU countries create visible separate groups in 2020 (Fig. 4).

**Table 4.**

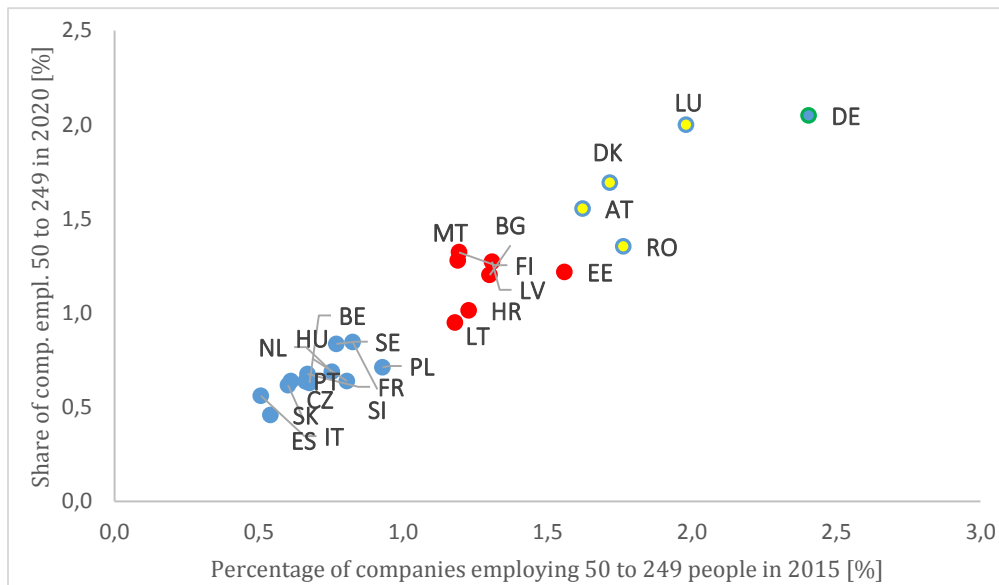
*Key characteristics for EU countries classified in Group IV(%)*

IV	Bulgaria, Estonia, Malta, Finland, Latvia, Croatia, Lithuania									
	2015					2020				
	0-9	10-19	20-49	50-249	>250	0-9	10-19	20-49	50-249	>250
mean	91,58	4,36	2,56	1,28	0,22	91,97	4,23	2,42	1,18	0,20
minimum	90,30	3,77	2,27	1,18	0,18	90,80	3,03	1,89	0,95	0,16
maximum	92,57	4,95	2,95	1,56	0,26	93,96	4,82	2,79	1,32	0,27
SD*	0,78	0,44	0,24	0,13	0,04	1,03	0,60	0,30	0,14	0,04
CV*	0,85	10,11	9,20	10,46	16,20	1,12	14,23	12,56	12,07	18,72

SD\* - standard deviation, \*\*CV – coefficient of variation.

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/>, October 2024.

Seven countries were classified into group four. In 2020, compared to 2015, the diversity in all analysed employment groups increased, as indicated by increasing coefficients of variation. Countries were the most diverse in terms of the group of enterprises employing more than 250 persons. The coefficient of variation in this group increased by 2.52 p.p. in 2020 compared to 2015. The average share of enterprises employing up to 9 persons also increased slightly (by 0.39 p.p.).



**Figure 5.** Share in the employment structure of EU countries of enterprises employing between 50 and 249 persons.

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/>, October 2024.

The proportion of the largest enterprises employing up to 249 people was highest in Germany and Luxembourg (Fig. 5). Although small and medium-sized enterprises are the most common employers in Germany, with as many as 59% of employees in the labour market working for SME companies, among EU countries in Germany the largest enterprises account for a relatively large proportion of employers.

Germany's economy is very versatile, but as far as manufacturing companies are concerned, it is based most heavily on the highly developed engineering industry. The automotive industry and the mechanical and plant engineering industry are the most important here. Germany is one of the largest car manufacturers in the world. The world's top two companies are the Volkswagen Group and Daimler. The number of employees testifies to the importance of the German automotive industry. It employs nearly 800,000 people (Destatis, 2024). In addition to the automotive industry, Germany also has a highly developed engineering industry. It is made up of almost 6500 companies in Germany. One of the largest representatives of this industry on the market is Siemens. The German economy also includes a very strong chemical, medical, pharmaceutical and food industry. All of these industries are represented by large corporations, hence Germany's clear advantage in terms of the share of large companies in the employment structure.

## 6. Conclusions

In a dynamically changing market environment, small and medium-sized enterprises are the main group of employers in all EU countries analysed. However, small changes in the structure of employment can be observed. In the group of enterprises employing up to 9 persons, the largest decrease was observed in Denmark, Romania, Estonia and Lithuania. In terms of employment structure, the number of small businesses has fallen in these countries respectively 1.95 pp, 1.94 pp, 1.77 pp, 1.44 pp respectively.

In the employment structure, the share of enterprises employing between 10 and 19 persons increased in 10 countries. Of which the largest increase was in Malta, Lithuania and France. In turn, the increase in the proportion of small companies was insignificant and did not exceed 0.4pc in these countries. Even smaller changes of less than 0.1 pp were observed in Finland and Slovenia in the group of companies employing 20-49 people. In the case of 15 countries, the proportion of companies employing between 50 and 249 people decreased, whereas the largest increase was observed in Finland and amounted 0.13 pc. For the largest companies, employing more than 250 people, there was little change in all countries analysed.

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## CONTINUOUS IMPROVEMENT: LEVERAGING DATA SECURITY IN INDUSTRY 4.0 SETTINGS

Justyna ŻYWIOŁEK

Faculty of Management, University of Technology; justyna.zywiolek@pcz.pl, ORCID: 0000-0003-0407-0826

**Purpose:** This study aims to explore the critical role of data security in continuous improvement within Industry 4.0 settings. It focuses on identifying how robust data security practices enable organizations to enhance operational efficiency, foster innovation, and protect sensitive information assets. Additionally, the research highlights the interplay between technological advancements, regulatory compliance, and proactive risk management in achieving sustainable organizational growth.

**Design/methodology/approach:** The research adopts a mixed-method approach to investigate the role of data security in continuous improvement within Industry 4.0. A comprehensive literature review was conducted to identify key theoretical frameworks and best practices related to cybersecurity and continuous improvement. The study also incorporates case analysis of Industry 4.0 technologies, such as IoT, AI, and big data analytics, highlighting their integration with data security strategies. By analyzing real-world applications and leveraging predictive analytics and compliance audits, the research demonstrates how secure data practices can enhance organizational performance and foster innovation.

**Findings:** The study identifies that data security is an indispensable component of continuous improvement in Industry 4.0. Secure data practices enhance decision-making, promote operational resilience, and enable proactive risk mitigation. Moreover, they support compliance with regulatory frameworks, such as GDPR and ISO 27001, while fostering a culture of innovation and trust among stakeholders. The findings also reveal significant challenges, including technological complexity, resource constraints, and rapidly evolving cyber threats.

**Research limitations/implications:** The research is limited by the availability of empirical data on specific Industry 4.0 applications. Future studies could expand on the practical implementation of data security measures across diverse industries and explore the economic implications of continuous improvement strategies. Additional research on emerging technologies, such as blockchain and quantum computing, could further enrich the understanding of secure data management.

**Practical implications:** The study provides actionable insights for businesses seeking to integrate data security into their continuous improvement processes. It emphasizes the importance of investing in advanced security technologies, workforce training, and compliance frameworks to enhance organizational resilience. These recommendations are particularly relevant for enterprises navigating the complexities of Industry 4.0.

**Originality/value:** This paper contributes to the literature by linking data security directly with continuous improvement in Industry 4.0. It offers a novel perspective on the strategic importance of secure data practices, supported by both theoretical insights and practical applications. The findings are valuable to researchers, policymakers, and industry leaders focused on sustainable growth and technological innovation.

**Keywords:** Data Security, Continuous Improvement, Industry 4.0, Cybersecurity, Operational Resilience.

**Category of the paper:** Viewpoint.

## 1. Introduction

Continuous improvement within the framework of Industry 4.0 emphasizes the strategic use of advanced technologies to drive operational efficiency, foster innovation, and safeguard critical information assets. Industry 4.0, characterized by the integration of the Internet of Things (IoT), artificial intelligence (AI), and big data analytics, has reshaped industrial processes and information flow management (Shahin et al., 2020). Central to this evolution is the ability to secure and utilize vast amounts of data generated by interconnected systems and devices, which is essential for maintaining operational continuity and driving continuous improvement (Żywiołek, 2024c).

Data security plays a pivotal role in enabling continuous improvement in Industry 4.0 environments. As organizations increasingly depend on real-time data from sensors, production systems, customer interactions, and supply chains, ensuring the security and integrity of this information becomes fundamental. According to Żywiołek (Żywiołek, 2024b), secure data management practices not only protect organizational assets from external and internal threats but also ensure the reliability of insights derived from analytics, which are critical for informed decision-making and process optimization. Similarly, Shafiq et al. (Shafiq et al., 2016) emphasize that real-time data security is critical for enabling the integration of smart systems and for maintaining the efficiency of Industry 4.0 operations.

The integration of data security into continuous improvement processes offers organizations the ability to proactively manage risks, enhance compliance with international standards such as ISO 27001, and foster trust among stakeholders (Żywiołek et al., 2023). As noted by Xu et al. (2018), the dynamic and interconnected nature of Industry 4.0 demands robust cybersecurity frameworks to mitigate vulnerabilities that can disrupt operations and compromise sensitive data. Wolniak similarly highlights that secure data practices are vital in addressing the challenges posed by an evolving cyber threat landscape, where new vulnerabilities can quickly undermine technological advancements (Wolniak et al., 2024).

At the same time, continuous improvement in Industry 4.0 is fundamentally about leveraging advanced data-driven approaches, such as business analytics, to refine operations and foster innovation. The vast volumes of data generated by interconnected systems reveal

patterns and trends that can inform decision-making and enhance process optimization (Tortorella et al., 2021; Rosin et al., 2020). By combining data security with predictive analytics, organizations can forecast potential vulnerabilities and proactively address them, minimizing downtime and extending the lifecycle of critical assets (Vinodh et al., 2021; Miqueo et al., 2020). Bai et al. further argue that predictive analytics in secure environments enables not only operational continuity but also strategic decision-making aligned with Industry 4.0 principles (Bai et al., 2020).

Moreover, secure data management supports a deeper understanding of customer behavior, facilitating tailored solutions and improved experiences, while fostering a culture of data-driven innovation (Frank et al., 2019). This culture, central to continuous improvement, encourages ongoing refinements and iterative enhancements that are essential for maintaining competitiveness and achieving sustained growth (Da Costa et al., 2019). Rossini underscores the role of secure data analytics in driving innovation while ensuring compliance with regulatory frameworks, which is critical in the context of global Industry 4.0 adoption (Rossini et al., 2019).

Despite its transformative potential, implementing data security within Industry 4.0 is not without challenges. Technological complexity, high implementation costs, and the rapid evolution of cyber threats require organizations to adopt a strategic and proactive approach (Żywiołek, 2024a; Valamede, 2020). Additionally, regulatory compliance with frameworks such as GDPR and ISO standards imposes administrative and operational burdens, further underscoring the need for a skilled workforce and robust risk management practices.

This publication explores the critical role of data security in supporting continuous improvement within Industry 4.0 settings. By highlighting the interplay between technological advancements, regulatory compliance, and organizational resilience, this study underscores the necessity of leveraging data security to drive innovation, maintain competitiveness, and achieve sustained operational excellence.

## **2. Selected aspects of using business analytics to ensure the security of information resources**

Business analytics plays a pivotal role in ensuring the security of information resources by enabling organizations to proactively identify vulnerabilities, detect threats, and implement robust security measures. By leveraging advanced analytical tools, organizations can analyze vast amounts of data in real time, uncovering patterns and anomalies that may indicate potential security breaches (Mrugalska, Wyrwicka, 2017). Predictive analytics, for example, can forecast emerging cyber threats by analyzing historical data and identifying trends, allowing organizations to adopt preemptive measures to mitigate risks before they materialize (Mayr et al., 2018).

One critical application of business analytics in information security is monitoring network activity to detect and respond to potential intrusions. Analytical tools can continuously assess traffic patterns, identifying deviations from normal behavior that may signify malicious activity (Meister et al., 2019). For instance, if a sudden surge in data access requests from a particular IP address is detected, analytics can flag this anomaly for further investigation, helping to prevent data breaches. Similarly, machine learning algorithms can differentiate between legitimate user behavior and unauthorized access attempts, enhancing authentication processes and safeguarding sensitive information (Taylor et al., 2019).

Another significant aspect is the use of business analytics to evaluate the effectiveness of existing security protocols. By analyzing data related to past incidents, organizations can identify gaps in their defenses and optimize their security strategies (Tuominen, 2016). For example, root cause analysis of security breaches enables organizations to pinpoint weaknesses in their infrastructure and implement targeted improvements, such as updating outdated software or strengthening encryption methods. Business analytics also supports compliance with information security standards, such as ISO 27001 and GDPR (Żywiołek et al., 2022). Analytical tools can streamline the process of tracking and reporting on compliance metrics, ensuring that organizations adhere to regulatory requirements. This not only minimizes the risk of legal penalties but also enhances stakeholder trust in the organization's commitment to safeguarding information resources.

In addition, the integration of business analytics within Industry 4.0 and digital transformation initiatives fosters a culture of proactive information security. Employees across all organizational levels can access real-time insights into security risks and recommended actions, enabling a more collaborative and responsive approach to information protection. This democratization of data empowers teams to make informed decisions that align with the organization's broader security objectives.

Lastly, the iterative nature of continuous improvement in information security is well-supported by business analytics. Analytical tools enable organizations to measure the impact of implemented changes, refine their strategies based on new data, and adapt to evolving threats. This cyclical process ensures that information security remains dynamic and resilient in the face of emerging challenges.

By leveraging the capabilities of business analytics, organizations can ensure the security of their information resources, fostering trust, compliance, and operational excellence in an increasingly data-driven world.

**Table 1.***The Usage of Business Analytics in Ensuring the Security of Information Resources*

Aspect	Description of Usage of Business Analytics
Threat Detection	Business analytics tools monitor and analyze network activity in real-time to identify anomalies or suspicious patterns indicative of cyber threats.
Vulnerability Analysis	Predictive analytics assess historical security data to identify potential system vulnerabilities, enabling proactive mitigation measures.
Compliance Monitoring	Analytics tools track compliance with regulations like GDPR or ISO 27001, providing reports and alerts to ensure adherence to legal standards.
Incident Response	Business analytics provides real-time insights into security incidents, enabling rapid response and containment of potential breaches.
Access Control	Analytical tools assess user behavior to detect unauthorized access attempts, enhancing identity verification and access management processes.
Data Encryption Optimization	Analytics evaluate data encryption protocols and usage to ensure robust security measures are in place for sensitive information.
System Health Monitoring	Predictive analytics monitor the performance and health of IT systems, identifying risks of hardware or software failures that could compromise security.
Employee Behavior Analysis	Analytics tools evaluate patterns of employee activity to detect insider threats or unintentional security lapses, promoting a secure organizational environment.
Incident Root Cause Analysis	Post-incident analytics identify the root cause of breaches, guiding the improvement of security policies and preventive measures.
Security Training Assessment	Data analytics evaluate the effectiveness of cybersecurity training programs, ensuring employees are equipped to handle potential threats.

### 3. Software used in continuous improvement analysis for information security in enterprises

Analytical software plays a crucial role in the process of continuous improvement in ensuring the security of information resources in enterprises operating under Industry 4.0 conditions. The application of advanced analytical tools enables the transformation of raw data into actionable insights that support decision-making, process monitoring, and the identification of potential (Khan et al., 2024; Iuga, Rosca, 2017; Ito, 2020). Tools such as Tableau, Power BI, Qlik Sense, and SAS Analytics are particularly significant in processes related to the analysis of data concerning information security.

Tableau, as an advanced data visualization tool, enables the creation of interactive dashboards, allowing real-time monitoring of information security metrics. With real-time updates, enterprises can promptly respond to emerging threats by identifying trends and deviations in data (Maarof, Mahmud, 2016; Li et al., 2016). Power BI offers similar capabilities and integrates seamlessly with Microsoft's ecosystem, making it ideal for organizations utilizing its suite of products. Its AI-powered features facilitate advanced threat analysis, which is critical for strategic planning and ensuring information security (Manuri, 2018; Gomes Leite et al., 2018).

Qlik Sense stands out with its intuitive interface and associative data model, enabling users to freely explore data and uncover hidden threats. This functionality is particularly valuable for risk management and anomaly detection in information systems (Hambach et al., 2017). SAS Analytics, on the other hand, provides advanced tools for predictive and statistical analysis, enabling the forecasting of threats and identifying patterns related to security incidents. Its high-performance capabilities allow for processing large volumes of data, which is essential for organizations with extensive IT structures (Mora, 2017).

IBM Cognos Analytics supports organizations in data management and generating reports related to performance and information security. Its ad hoc reporting and interactive dashboards allow users to analyze compliance with regulations such as GDPR and ISO 27001 standards in real time, thereby supporting effective risk management (Pekarčíková et al., 2019). Similarly, with its cloud-based architecture, facilitates real-time data monitoring and collaboration among teams responsible for information security (Cavdur et al., 2019). Tools such as Google Data Studio and SAP BusinessObjects offer intuitive interfaces and integration capabilities with various data sources, making them attractive solutions for enterprises of all sizes (Dallasega et al., 2017).

The application of these analytical tools enables effective monitoring of security incidents, risk analysis, and optimization of information management processes. Additionally, they support compliance with legal regulations and industry standards, which is a key element of strategies to protect information resources in the digital era. The aforementioned software allows enterprises to create an environment of continuous improvement that fosters a data-driven culture of security management and supports the achievement of operational excellence (Gattullo et al., 2019).

**Table 2.**

*Examples of Software and Applications Used in the Continuous Improvement Process for Information Security*

Software Name	Description	Application
Tableau	A data visualization tool that enables the creation of interactive dashboards.	Real-time monitoring of security metrics, identifying trends and anomalies in data.
Power BI	Microsoft's business intelligence software that integrates seamlessly with its ecosystem.	Visualization of system logs, threat analysis using artificial intelligence, and generating compliance reports.
Qlik Sense	A self-service data analytics platform with an intuitive interface.	Identifying hidden threats, analyzing dependencies in information systems, and creating interactive reports.
SAS Analytics	Advanced software for predictive and statistical analysis.	Forecasting potential threats, identifying patterns in security incidents, and optimizing information security processes.
IBM Cognos Analytics	An analytics platform offering ad-hoc reporting and interactive dashboards.	Analyzing compliance with regulations (e.g., GDPR, ISO 27001), generating performance and security-related reports.
Domo	A cloud-based analytics tool enabling real-time data integration.	Real-time data monitoring, team collaboration in security management, and strategy analysis in real-time.

Cont. table 2.

Google Data Studio	A free data visualization tool with integration capabilities for other Google products.	Creating intuitive reports on security status and real-time monitoring of security-related data.
SAP BusinessObjects	A comprehensive suite of tools for reporting and data analysis.	Managing large data sets, integration with SAP systems, and supporting security-related analyses.
Looker	A platform for data exploration and visualization, focusing on real-time analytics.	Cloud data analysis, creating custom reports, and modeling and managing data in the context of security.
MicroStrategy	Enterprise-grade software for advanced analytics and data visualization.	Generating detailed reports, analyzing trends related to security, and mobile access to analytical data.

#### 4. Advantages and Challenges of Using Data Security in Continuous Improvement for Industry 4.0

Data security plays a crucial role in the process of continuous improvement within the context of Industry 4.0, characterized by advanced automation, system integration, and intensive data utilization. Securing information supports organizations in improving decision-making quality by enabling reliance on accurate and reliable data. This approach eliminates the risk of errors caused by incomplete or uncertain information, leading to better process management and higher operational efficiency (Karlovits, 2017; Ghobakhloo, Fathi, 2020). Additionally, data security prevents operational disruptions resulting from cyberattacks, system failures, or the loss of critical information. In the highly interconnected systems of Industry 4.0, ensuring data integrity minimizes the risk of downtime and ensures business continuity (Dogan, 2018).

Another significant aspect is the ability to monitor data security in real time. Advanced analytical tools allow organizations to quickly detect potential threats and respond immediately, enhancing flexibility and enabling faster preventive actions (Greasley, 2019). Data security solutions also foster innovation by protecting information related to markets, customers, and technological processes. This protection enables organizations to safely explore new areas of development while minimizing the risks associated with the loss of valuable data (Arica, Powell, 2017; Bibby, Dehe, 2018). An important outcome of implementing these solutions is building customer trust. The use of advanced data protection technologies and compliance with legal regulations, such as GDPR, increases customer confidence and strengthens organizational reputation (Beifert et al., 2018).

At the same time, implementing data security systems poses several challenges. One of the primary issues is technological complexity and the integration of modern solutions with existing systems, which often involves high costs and time-consuming processes. Organizations also face a shortage of highly skilled cybersecurity professionals, limiting their capacity to manage this area effectively (Dombrowski et al., 2017). Internal threats, such as unintentional

employee errors or deliberate actions leading to data theft, are another significant concern. Furthermore, the rapid evolution of new cyber threats outpaces the capabilities of current security technologies, requiring organizations to continually update systems and procedures (Meesublak, Klinsukont, 2020). Lastly, the dynamically changing legal regulations surrounding data protection, such as GDPR and national laws, impose additional administrative and financial burdens that can be challenging for many businesses to address.

Despite these challenges, data security remains an indispensable element of continuous improvement strategies in Industry 4.0. Its integration with operational processes creates an environment conducive to innovation and long-term development, while simultaneously supporting the protection of critical informational assets. Moreover, it fosters a culture of continuous improvement and adaptation to the evolving technological landscape, ensuring sustainable growth and resilience in a competitive environment.

Table 3 lists the benefits of using continuous improvement in an Industry 4.0 environment for data security, along with descriptions of each benefit.

**Table 3.**  
*Benefits of Continuous Improvement in an Industry 4.0 Environment for Data Security*

<b>Benefit</b>	<b>Description</b>
Enhanced Decision-Making	Continuous improvement enables organizations to base decisions on accurate and reliable data, reducing errors and improving strategic planning.
Operational Resilience	Securing data and identifying risks proactively ensures business continuity by minimizing the impact of cyberattacks or system failures.
Real-Time Threat Monitoring	Advanced tools provide real-time insights into potential threats, allowing immediate responses and improved risk management.
Innovation Support	Protecting critical information fosters innovation by enabling the safe exploration of new technological and market opportunities.
Increased Customer Trust	Adherence to data protection standards like GDPR builds trust and strengthens customer loyalty by safeguarding personal and business information.
Cost Reduction	Identifying inefficiencies and addressing vulnerabilities reduces the financial impact of data breaches and operational disruptions.
Regulatory Compliance	Continuous monitoring and improvement help meet evolving legal and regulatory requirements, minimizing penalties and reputational risks.
Improved Collaboration	Secure data sharing across departments facilitates better coordination and alignment in addressing data security challenges.
Adaptability to New Threats	Regular updates to systems and processes ensure organizations remain resilient to emerging cyber threats and technological advancements.
Promotes a Culture of Excellence	Continuous improvement fosters a proactive mindset focused on refining data security practices and achieving long-term operational excellence.

This table highlights the multifaceted advantages of adopting a continuous improvement approach to data security within Industry 4.0, emphasizing its importance in achieving sustainability and competitiveness. Table 4 outlines the various challenges associated with implementing data security in continuous improvement processes within the context of Industry 4.0. It highlights key issues such as technological complexity, integration difficulties, compliance with evolving regulations, and resource constraints. These challenges underscore the importance of addressing both technical and organizational aspects to ensure



effective and sustainable data security practices. By understanding these issues, organizations can develop strategies to mitigate risks and enhance their ability to safeguard critical information in an increasingly digital and interconnected environment.

**Table 4.**

*Challenges of Using Data Security in Continuous Improvement within Industry 4.0 Conditions*

<b>Challenge</b>	<b>Description</b>
Technological Complexity	Implementing advanced data security systems in interconnected Industry 4.0 environments is often complicated and resource-intensive.
Integration Difficulties	Ensuring seamless integration of new security measures with legacy systems and diverse platforms can be challenging.
High Implementation Costs	Acquiring, maintaining, and updating data security technologies involve significant financial investment, especially for smaller enterprises.
Evolving Cyber Threats	The rapid evolution of cyber threats often outpaces the development and implementation of effective countermeasures.
Shortage of Skilled Workforce	The lack of qualified professionals in cybersecurity hinders the deployment and management of robust data security measures.
Compliance with Regulations	Adhering to complex and ever-changing data protection regulations, such as GDPR, adds administrative and operational burdens.
Internal Threats	Employee errors or intentional misuse of data can undermine security efforts and lead to significant vulnerabilities.
Data Volume and Complexity	The massive and complex data generated in Industry 4.0 environments can overwhelm traditional security measures and analytics tools.
Resistance to Change	Organizational reluctance to adopt new data security practices can delay implementation and reduce overall effectiveness.
Cost of Continuous Updates	Maintaining up-to-date security systems and processes to counter emerging threats requires ongoing investment and resource allocation.

This table highlights the key challenges organizations face in integrating data security into continuous improvement strategies within Industry 4.0, emphasizing the need for proactive measures, skilled personnel, and strategic resource management to address these issues effectively.

## 5. Conclusion

The integration of robust data security measures into continuous improvement efforts within Industry 4.0 settings represents a transformative approach to enhancing operational resilience, strategic decision-making, and overall business sustainability. By ensuring the integrity, availability, and confidentiality of data, organizations can drive efficiency, foster innovation, and build trust among stakeholders. Data security facilitates the identification and mitigation of risks in real time, enabling businesses to adapt swiftly to emerging threats and maintain operational continuity in highly interconnected environments.

Moreover, secure data management supports predictive capabilities, allowing organizations to anticipate potential vulnerabilities and address them proactively. This not only minimizes downtime and protects critical assets but also promotes a culture of continuous improvement

where data-driven insights guide strategic refinements and operational excellence. By safeguarding sensitive information and complying with regulatory requirements, companies can enhance customer confidence and strengthen their competitive position in the market.

However, leveraging data security in continuous improvement is not without challenges. Issues such as technological complexity, integration difficulties, high implementation costs, and the rapidly evolving cyber threat landscape demand strategic planning and resource allocation. Overcoming these obstacles requires a skilled workforce, effective change management, and a commitment to continuous updates and innovation.

Despite these challenges, the benefits of integrating data security into continuous improvement processes far outweigh the difficulties. Organizations that prioritize data security as a core element of their Industry 4.0 strategies are better positioned to achieve long-term success. By fostering agility, protecting critical information assets, and ensuring compliance with evolving standards, businesses can maintain their resilience, drive innovation, and sustain growth in an increasingly digital and interconnected world.

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## REVIEWERS

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Prof. Anna CIERNIAK-EMERYCH, Wrocław University of Economics and Business, Poland  
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