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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 49 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: small and medium enterprises; energy management; human resources management; logistics; marketing; Industry 5.0; innovation management; strategic management; social responsibility; sustainable development; finances; crowdfunding; the impact of COVID-19 pandemic on management; Industry 4.0; social capital; the implementation of AI in management; circular economy and production management.

Bożena Skotnicka-Zasadzień
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COOPERATION OF SMALL AND MEDIUM-SIZED ENTERPRISES WITH RESEARCH AND DEVELOPMENT UNITS-AN ATTEMPT TO OPERATIONALIZE THE RESEARCH MODEL

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Purpose: The purpose of this study is to analyze the author's research model in the context of finding areas in which it can be operationalized.
Design/methodology/approach: The article employs a mixed-method approach, combining a literature review on cooperation between SMEs and R&D units with empirical research. The survey included a questionnaire administered to employees representing various levels of business management in Poland (N = 38). The questionnaire assessed the perception of the model of cooperation between small and medium sized enterprises and R&D units in the context of its operationalization.
Findings: The study found that the model contains elements that can be transformed into measurable indicators.
Research limitations/implications: Given that the study was conducted among a small number of respondents, its results cannot be directly generalized to the entire population. It is recommended to extend the analysis to other user groups of participants and a broader scope of research.
Practical implications: The research findings indicate the need to expand the author's research model.
Social implications: The analysis underscores that the indicated author's research model contains elements that can be transformed into measurable indicators, thereby influencing the improvement of the model and its practical application.
Originality/value: The article introduces a new perspective to the research on cooperation between SMEs and R&D units, making cooperation even better.
Keywords: cooperation of SME's, R&D units model, operationalization of the model.
Category of the paper: Research paper.

1. Introduction

An extremely important element of the activities of modern enterprises is cooperation, by which is meant the interaction between enterprises and their environment (Bańkowski, Rzepka 2024). Establishing cooperation between an enterprise and its environment is an important factor in economic development. In the environment of the enterprise, especially small and medium-sized enterprises, research and development units have a special place. The development of enterprises depends on the effectiveness of activities in creating knowledge within it and obtaining it from external sources. Therefore, such factors as knowledge and technology acquire fundamental importance for the development of enterprises (Haberla, Kuźmińska-Haberla, 2013). Cooperation of small and medium-sized enterprises with research and development units plays a special role in the development of the competitiveness of the economy.

The purpose of the article is to try to characterize the areas in which the research model can be operationalized to indicate the advantages and disadvantages of the research model and its impact on the areas indicated. The basis for measurement was the research conducted on a group of 38 people. The research was conducted in 2025.

2. Theoretical bases

Small and medium-sized enterprises play a special role in the economy, being a kind of stimulator of economic development, and the level of their saturation in the economy is one of the measures of this development (Poznańska, 2016). Despite many publications and studies, small and medium-sized enterprises still arouse great interest among researchers. Small and medium-sized enterprises play an important role in the economy of many countries, including Poland. Supporting the development of the small and medium-sized enterprise sector is important for the development of the Polish economy.

The functioning of small and medium-sized enterprises is important for the proper operation of the market mechanism. Increasing the number of enterprises belonging to the small and medium-sized enterprise sector accelerates the processes of ownership transformation and restructuring of the economy (Skowronek-Mielczarek, 2007). The concept of small and medium-sized enterprises (SMEs) is not clearly defined (Zeng, Xie, Tam, 2010). To date, no universal definition has been created to characterize this type of enterprise in all countries around the world. Therefore, a unified definition is fundamental for any audience that wants to understand the meaning of SMEs (Zastempowski, 2010). The criteria under which a company can be classified as an SME are set out in the EU Commission Regulation No. 651/2014 of June

17, 2014 declaring certain types of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty (Regulation 651/2014), which Poland has also adopted. In a single market without internal borders, it is important that measures in favor of SMEs are based on a common definition in terms of increasing their consistency and effectiveness, as well as to limit distortions of competition.

Table 1.
Criteria for quantitative classification of small and medium-sized enterprises

Criterion Company	**Enterprise**		
	micro	**small**	**medium**
Number of employees	less than 10 people	10-49 people	50-249 people
and			
Annual turnover or balance sheet total up	to 2 million euros	2-10 million euros	10-50 million euros
	to 2 million euros	2-10 million euros	10-43 million euros
and			
Capital independence from other entities	Capital independence from other entities. In the case of specific capital ties, these must be taken into account		

Source: own study.

This definition of small and medium-sized enterprises is a valuable aid to public authorities in distinguishing between such enterprises in their policies and programs (Kowalski, 2020). As rightly stated by J.A. Welsh and J.F. White (1981), small and medium-sized enterprises are not miniatures of large enterprises, hence the way they are managed and organized should be different. The presence of small and medium-sized enterprises is a manifestation of healthy competition, as well as a reflection of entrepreneurial activities, thus allowing the individual aspirations of society to be realized (Wojdyła-Bednarczyk, 2014).

An important feature of small and medium-sized enterprises is the direct involvement of business owners in their activities, which makes it possible to make a quick decision and implement it in a short time. The situation is different for large enterprises, where it is much more difficult to make an immediate decision. Responsibility is divided among several employees, and decision-making involves the development of a common position by the management of managers (Drab-Kurowska, 2007). Another feature of small and medium-sized enterprises is a dynamic approach to the environment. These enterprises respond quickly to emerging customer needs and preferences. Therefore, they are more mobile in committing financial resources to various industries, including profitable investment ventures. Small and medium-sized enterprises are able to create new value for buyers, taking into account the level of operational and financial risk. They often rely on production that is not based on economies of scale, but on seeking market opportunities (Skowronek-Mielczarek, 2007). Having a small number of employees, focusing on a strictly defined group of customers and a narrow assortment speeds up the flow of information and reduces anonymity. They rapidly take advantage of emerging opportunities to increase sales of their products and services, adjusting their production potential to the current demand (Bednarz, Gostomski, 2009). Not without

significance is their number in Poland, as they account for as much as 99.8% of all economic entities, so they can affect the processes taking place in Poland (Chaber, 2020).

Small and medium-sized enterprises are the pillar of the economy (OECD, 2020). Such enterprises play an important role in Poland's economy, generating 48.5% of GDP and creating jobs for 68% of the total number of employees in the enterprise sector. It should also be emphasized that small and medium-sized enterprises fill market gaps that large enterprises are unable to enter, with the result that they are more flexible compared to large entities. Therefore, small and medium-sized enterprises can achieve an advantage over large enterprises by responding quickly to the changing environment, entrepreneurial use of opportunities and market opportunities, activities aimed at meeting the needs reported by the local market, products and services oriented to high quality, and by best meeting the needs of customers (Orechwa-Maliszewska, 2003). The second important area is research and development units in Poland. The R&D sector consists of all entities engaged in research or development activities, which include both private companies and public institutions. It should be noted that for most of them R& D is one of many areas of activity, which usually results in a small number of employees along with a small number of resources being engaged in R&D activities. R&D activities in an R&D entity do not have to be carried out in the same unit, but can be outsourced, which increases the number of entities included in this group (Jasiński, Głodek, Jurczyk-Bunkowska, 2019).

Still a perceived limitation is the low degree of cooperation to share risks or stabilize the market (Bohatkiewicz-Czaicka, Gancarczyk, 2024). Research and development units are units that specialize in implementing new technologies and improving them. These units were established by the Law on Research and Development Units of July 25, 1985.

According to this law, research and development units are “state organizational units separated in legal, organizational and economic-financial terms, created for the purpose of conducting scientific research and development work, and the results of which should find application in specific areas of the national economy and economic life”. According to the CSO's definition, research and development activity includes creative work conducted in a methodical manner and undertaken to increase the stock of knowledge, i.e. knowledge of human kind, culture and society, as well as to create new ways of applying existing knowledge. Therefore, such activity must be:

- novel - aimed at new discoveries,
- creative - based on original, non-obvious concepts and hypotheses,
- unpredictable - not obvious and uncertain as to the final outcome and cost, including the time spent,
- methodical - carried out in a planned manner with the identification of the purpose of the R&D project and the method and source of funding,
- transferable or reproducible, leading to results that can be reproduced.

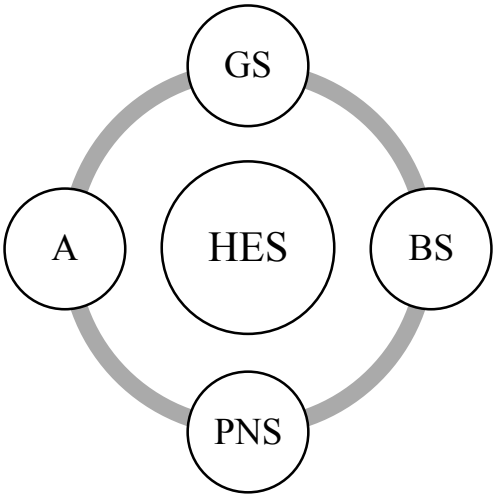


Figure 1. Component structure of the R&D sector.

Source: own compilation based on OECD 2023 data.

- HES-higher education sector.
- GS-government sector.
- BS-business sector.
- PNS-private nonprofit sector.
- A-abroad.

Figure 1 shows the structure of the R&D sector's components, indicating the central role of the higher education sector, as well as the tangential areas for each area. The area of centrality is occupied by the higher education sector, encompassing all universities, technical colleges, as well as other institutions providing formal higher education programs (regardless of funding source or legal status), as well as all research institutes, centers, experiment stations and clinics conducting R&D activities under the direct control or management of higher education institutions. The special distinction of this sector in the OECD handbook allows analysis of groups of entities that are key to the science policy of many countries.

The inclination to cooperate, and the search for suitable partners to achieve common goals is a fundamental characteristic of human beings, which translates not only into individual relationships, but, above all, into the functioning of economic activity (Pietruszka-Ortyl, 2020).

The need to undertake cooperation is the result of the specific characteristics of knowledge, especially in strictly defined content (Scherngell, 2021). Cooperation between small and medium-sized enterprises and R&D units occurs in formal and informal forms. Entering into formal cooperation obliges both parties to enter into a bilateral agreement. In the case of informal interactions between the university and the enterprise, such cooperation is not of a direct commercial nature, most often consisting in the exchange and acquisition of basic knowledge (Garcia-Perez-de-Lema, 2017). Small and medium-sized enterprises cooperate with R&D units in a variety of ways, ranging from the exchange of knowledge and information to joint investment to support the creation of continuous innovation (Grasjo, Karlsson, Bernhard 2018).

Among the forms of knowledge flow from science to business, one should also point out joint scientific and research projects (including those financed from public sources within the framework of national and EU programs), sale of patents, consulting services, student internships, postgraduate studies, conferences, symposia, industrial fairs and exhibitions, cooperation of employees within the framework of professional associations, personnel flow between science and business, training of enterprise personnel, use of university laboratories by the enterprise, acquisition of new knowledge and technology, participation of enterprise employees in the teaching process at the university. Nowadays, in scientific research it is extremely important to be able to transform theoretical concepts into concrete variables that the researcher is able to analyze and observe. The primary task of operationalization is to assist in accurately and unambiguously understanding the concepts of the phenomena under study, transforming them into variables and measuring them. The use of operationalization increases the reliability of research by creating precise conditions for repetition (BIC, 2025).

The operationalization of a research model is the process of transforming abstract theoretical concepts into concrete indicators and measurable variables that can be used in research (Zakrzewska-Bielawska, 2018). Research proceedings in management and quality sciences are accompanied by models, such as theoretical and conceptual, research or statistical (Nowosielski, 2016). A model is a construct, or scheme, that describes a certain activity and is shown as a simplified reflection of reality (Sławińska, 2010). An increasingly common phenomenon in scientific research is the exploration of the area of operationalization of the research model. The primary determinant of the objectives of the process of determining the purpose, is the need to carry out scientific research (external to the researcher or his own - internal), and as a consequence of its operationalization - the content and nature of the object and research problem.

The research model shows the path of activities performed step by step for proper cooperation between small and medium-sized enterprises and R&D units. This model is shown in Figure 2.

The model consists of seven points, and the elements of the model have been connected by arrows to indicate the path to the next area. The starting point for the model in question is the identification of cooperation as the main element connecting small and medium-sized enterprises and R&D units. The first point is the establishment of the first contact between the entrepreneur and the university. This is a key element in the establishment of cooperation, as it has a direct impact on further stages and decisions on the part of both SMEs and R&D units. The establishment of the first contact should result from its exploration and openness expressed in the need to actively seek opportunities for meetings, net-working and presentation of its offer. The establishment of the first contact is followed by a joint search for an area of cooperation. The search for areas of cooperation should be the result of joint work, both by the entrepreneur and the R&D unit. The joint search for areas for cooperation should be the result of joint work, exchange of knowledge of current trends and experiences.

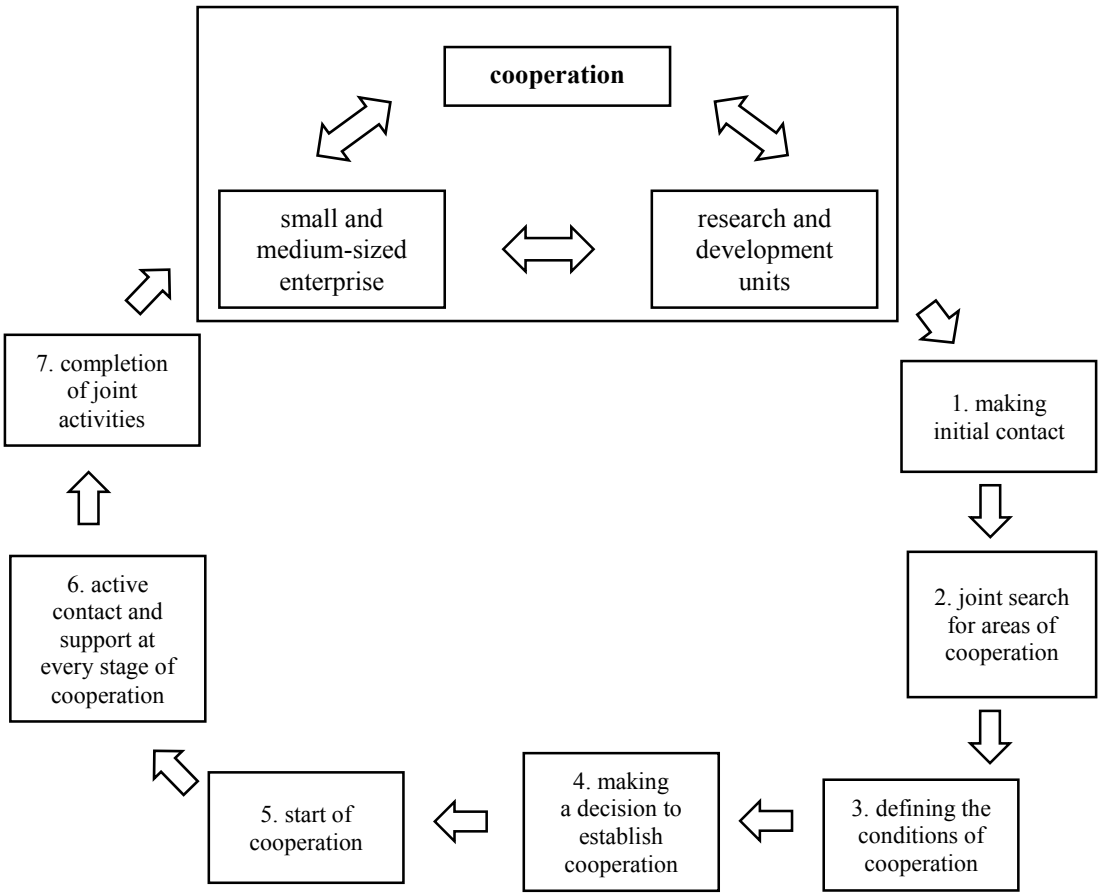


Figure 2. Research model of cooperation between small and medium-sized enterprises and R&D units. Source: own elaboration.

Next comes a clear definition of the terms of cooperation, followed by the decision to establish cooperation. Clear definition of the terms of cooperation refers to the most important elements affecting the start of cooperation, among which are the determination of the time of cooperation, personnel and financial facilities. It is important that the decision-making time does not take long, so that both parties can take joint action as early as possible The decision to cooperate is followed by the start of cooperation. For the proper implementation of the joint venture, it is important to have ongoing contact between the parties to discuss the progress of joint activities, as well as to resolve emerging issues. During the course of the cooperation, active contact and support at each stage of the cooperation is evident. The final, seventh stage involves the completion of joint activities. It includes accounting for joint activities. It is crucial to create an area for good relations, which in the future may result in another successful cooperation. The author's research model presented became the basis for further analysis.

3. Research methodology

The research results presented in this paper are part of the author's research project. The study was carried out on a sample of 38 employees working at various levels in enterprises in Poland. The selection of the research sample was purposive. In developing the criteria for the selection of the sample, several factors were taken into account among which are age, gender, experience in cooperation with R&D units (occurrence of cooperation or not) and also whether it is an employee of an SME. During the survey, respondents answered the research questions posed related to the research model presented and its application in business practice. The survey was conducted using a standardized questionnaire. Before the survey proper was conducted, a pilot survey was performed on a sample of three respondents to verify the validity of the research questions posed. The implementation time of the survey was 5 days. The survey was conducted using a survey questionnaire filled out in the presence of the researcher. Then, the resulting research material was coded in Maxqda24 software and then further analyzed.

The study posed the following three research questions:

PB1: What are the advantages and disadvantages of the presented research model?

PB2: Can the research model be operationalized and how?

PB3: To what extent could the areas identified affect cooperation if the model were used in practice?

Attempts to find answers to the indicated research questions are elaborated later in the article. Respondents to the survey were characterized by diverse characteristics. Such parameters as gender, age, experience in cooperation with R&D units, and employment in SMEs were taken into account. The characteristics of the respondents are shown in Table 2.

Table 2.
Characteristics of respondents from the survey sample

Criterion		**Percentage of indications**
gender	female	60,52
	male	39,48
age	18-34	60,40
	34 and over	39,60
experience in cooperation with R&D units	yes	84,21
	no	15,79
SME employee	yes	76,31
	no	23,69

Source: Own elaboration based on the results of the survey.

In addition to the open-ended questions, respondents additionally rated on a 5-point Likert scale whether, if the model were used in practice in its current form, whether and how it would improve project performance, reduce implementation time, increase participant satisfaction, or whether it would decrease the number of delayed or failed projects (PB.3.).

4. Findings

The author's research model presented has its advantages and disadvantages. Of all the contributions, the author has collected the five most common advantages and disadvantages of the research model in tabular form each in the respondents' answers. The presentation of the advantages and disadvantages of the model is included in Table 3.

Table 3.
Advantages and Disadvantages of the research model

Advantages	**Disadvantages**
Transparent	Inability to respond to unpredictable immediate changes
Representing an organized and thoughtful way of doing things	Lack of consideration of external factors
Structured	It does not provide for continuous cooperation or repetitive processes
Meticulously prepared	Lack of assumption of failure
Clearly guides companies and R&D units interested in cooperation	Requires high commitment from both sides

Source: own elaboration based on research results.

Among the most common advantages in the answers given by respondents was the transparency of the model. The model shown is clearly prepared and well thought out. The model shown is a model of desirable cooperation, which means that if small and medium-sized enterprises and R&D units (in this case, technical universities) worked together in the manner indicated, the cooperation would be successful. In contrast, one of the most common disadvantages of this model is that there is no room for consideration of external factors, such as the outbreak of a pandemic or war. This model leads along a path that requires the involvement of both sides. If there were a lack of commitment from at least one side, then the cooperation could fail. Therefore, the success of cooperation relies on mutual commitment.

After receiving answers related to the advantages and disadvantages of the model, the author attempted to look for areas where it would be possible to operationalize the model. Based on the literature on the subject and in the opinion of the respondents, the model can be operationalized. As a result, five areas were characterized, which are presented in Figure 3.

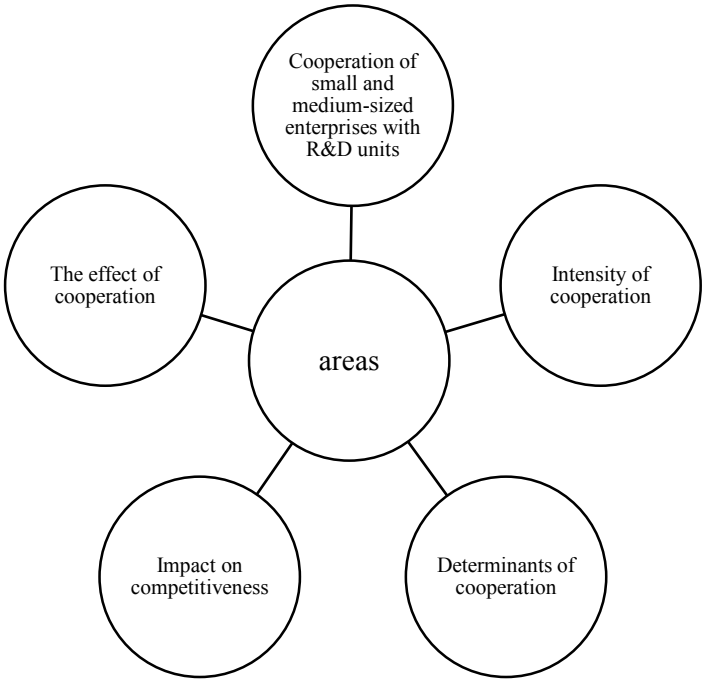


Figure 3. Areas that can be operationalized.

Source: own elaboration based on research results.

The characterized areas can be transformed into indicators and then the method of measuring them can be determined. The results of the analysis are presented in Table 4.

Table 4.
Areas in which the research model can be operationalized

Theoretical concept	Operational definition	Indicators	Measurement method
Cooperation of small and medium-sized enterprises with R&D units	Formal interactions of small and medium-sized enterprises with R&D units preceded by a relevant agreement between the parties	- number of jointly implemented projects per year/over the indicated number of years; - number of contracts signed; - number of meetings before/ during and after cooperation	- a survey of cooperating SMEs and R&D units; - analysis of documents, e.g., the contract and its provisions; - (IDI) individual in-depth interviews after the cooperation
Intensity of cooperation	Frequency and scale of contacts	- number of projects implemented annually; - type of cooperation established and its rules; - duration of individual stages	- questionnaire; - interview
Determinants of cooperation	Factors affecting cooperation	- financial availability; - experience of staff; - research infrastructure	- a survey; - expert interviews
Impact on competitiveness	Change in the market position of the company	- increase in revenue; - number of new customers	- financial data available; - interview
The effect of cooperation	Satisfaction with cooperation	- satisfaction rate with cooperation	- a survey distributed during and after the cooperation; - individual in-depth interviews (IDI)

Source: own elaboration.

In order to more accurately verify the effects of cooperation or satisfaction with cooperation, it would be good practice to set indicators and targets to be achieved at each of the steps in the model. That is, with each of the indicated points, it is assumed to develop two indicators that would be realized after each step in order to move on to the next step.

The next stage of the survey was to obtain answers to the question of indicating to what extent the implementation of cooperation based on the model in its current form would affect the following aspects, i.e. improvement of project results, reduction of cooperation implementation time, increase of participants' satisfaction and number of delayed or failed projects. The obtained answers were aggregated and shown in Fig. 4.



Figure 4. Impact of the model on the following areas.

Source: own elaboration.

If the indicated research model in its current form was used in business practice, according to the answers received by the respondents, the implementation of cooperation between small and medium-sized enterprises and R&D units will improve the project results to a medium extent. The implementation of cooperation in the presented research model, in the opinion of respondents, will to a small extent affect the shortening of cooperation implementation time. On the other hand, such a structured model of cooperation will to a large extent influence the increase of satisfaction of cooperation participants. To a medium extent, the implementation of cooperation based on the presented model will affect the number of delayed or failed projects.

5. Summary

The area of cooperation between small and medium-sized enterprises and R&D units is of great importance for economic development. Among the advantages of using the model in its current form is its transparency and orderliness, which clearly guides both parties along the path of cooperation. On the other hand, among the disadvantages of the indicated model are min: the inability to respond to unforeseen situations or the lack of assumption of failures. Thus, the research model can be operationalized. As a result of our own research, five areas were found in which the model can be operationalized. The implementation of the joint cooperation activity in the current structure, to a good extent, will increase the satisfaction of those participating in the cooperation. On the other hand, however, the implementation of the model will have a medium impact on improving project performance or reducing implementation time. The considerations arising from this publication will provide the author with an impetus for further exploration of the issue. The main limitation of the implementation of the indicated survey was the number of respondents. Future surveys will be expanded to include a larger number of respondents - a planned 150 respondents, and expanded to include a group of university employees. In addition, in order to further exploit the research, the questions posed in the questionnaire will be expanded and individual in-depth interviews (IDI) will be conducted with purposefully selected respondents.

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THE VULNERABILITY OF THE SME SECTOR TO BUSINESS CYCLES

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Purpose: The significance of small and medium-sized enterprises (SMEs) for economic development is recognized in Poland and globally. The cornerstone of this article's discussions is the idea that the SME sector embodies the strength of each economy and its ability to withstand external challenges. This paper seeks to advance the existing state of the art by providing a literature review on the diverse perspectives concerning the influence of a company's size on its vulnerability to business cycles.
Design/methodology/approach: The article provides a literature review regarding the two hypotheses: 1. SMEs are more vulnerable to economic fluctuations than large enterprises. 2. SMEs are more resilient to economic fluctuations than large enterprises.
Findings: The literature studies conducted do not provide a specific and convincing answer to whether the SME sector is less vulnerable to and, as a result, more resilient to business cycle fluctuations than the large enterprises sector. In other words, the literature review results do not confirm that the SME sector is less vulnerable to recession than the large enterprise sector. At the same time, the above conclusions do not support the statement that the small and medium-sized enterprise sector has proven to be more vulnerable to the recession than the large enterprise sector. The relationship between a firm's size and its vulnerability to economic fluctuations is complex and often ambiguous.
Practical implications: Insights may be crucial for shaping policies that support businesses and foster entrepreneurship.
Originality/value: This paper is directed towards policymakers and seeks to impart knowledge regarding the support of entrepreneurship, particularly in relation to the business cycle.
Keywords: SME sector, vulnerability, business cycle, economic growth.
Category of the paper: Literature review.

1. Introduction

The small and medium-sized enterprises (SMEs) sector is an extremely important part of modern market economies, given its share of the total number of businesses, contribution to employment, and gross value added. The belief that the SME sector reflects the strength of individual economies and that its resilience to external shocks is essential for their development

serves as the foundation and starting point for the considerations presented in this article. Analyzing the relationship between company size and economic fluctuations, the literature presents arguments supporting both hypotheses: 1. SMEs are more vulnerable to economic fluctuations than large enterprises. 2. SMEs are more resilient to economic fluctuations than large enterprises. The conclusion largely depends on the indicators used in the analysis - specifically, the measures of economic conditions and the indicators of vulnerability (Lechman, Dominiak, 2016).

The article provides a literature review regarding the two previously mentioned hypotheses. The first part of the study highlights the role of the SME sector in the growth and economic development of highly developed countries. Analyzing demographic changes underscores the concept of creative destruction (Schumpeter, 1934) and business survival rates. The analysis also examines changes in employment and the contribution of the SME sector to gross value added. The study focuses on the non-financial sector of the EU-27 countries, with particular emphasis on Poland. The second part of the article assesses the vulnerability of the SME sector to economic fluctuations. It provides a brief overview of vulnerability as an economic concept, which has gained increasing importance, especially in light of the economic crisis that began in 2008. The article further examines the factors that affect the vulnerability of small and medium-sized enterprises to economic fluctuations. The third part of the article presents an overview of the latest global reports regarding the relationship between firm size and changing economic conditions. It emphasizes that a business's age has a more significant impact on stability during economic fluctuations than its size. The final section concludes the paper.

2. Discussion

2.1. The importance and economic effects of the SME sector

The relationship between the state of the SME sector and economic growth and development is crucial. SMEs constitute a significant portion of the overall business population, create jobs, and generate gross value added. In 2023, the SME sector accounted for 99.8% of all active businesses in the EU-27 countries. Small and medium-sized enterprises comprised 65.2% of employment and 53.1% of gross value added (Figure 1).

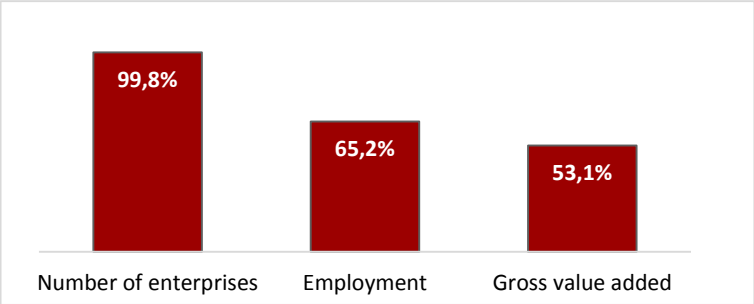


Figure 1. The share of the SME sector in terms of the number of enterprises, employment, and gross value added within the non-financial business sector across the EU-27 countries in 2023.

Source: European Commission, 2024, SME Performance Review, Annual Report on European SMEs 2023/2024, Luxembourg.

The observation of changes in the number of businesses in Poland, based on data from the Central Statistical Office, over recent years indicates a 32.6% increase in the number of firms between 2013 and 2022 (Figure 2).

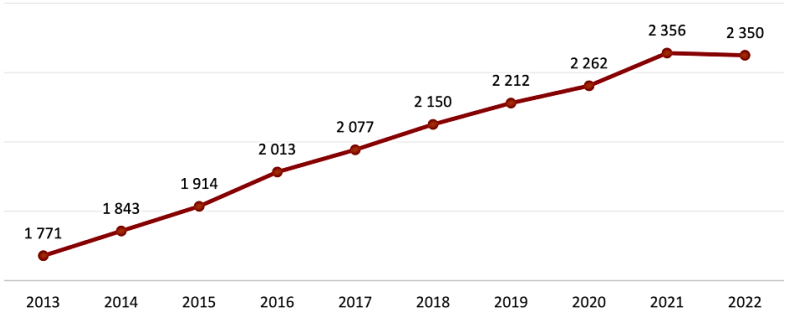


Figure 2. Number of active enterprises in Poland from 2013 to 2022 (in thousands).

Source: Polish Agency for Enterprise Development, 2024, Small and medium-sized enterprises in Poland, Warsaw.

The number of large and medium-sized enterprises remained relatively stable from 2014 to 2023. Micro-enterprises experienced the most notable growth, whereas small enterprises experienced a decline (Figure 3).

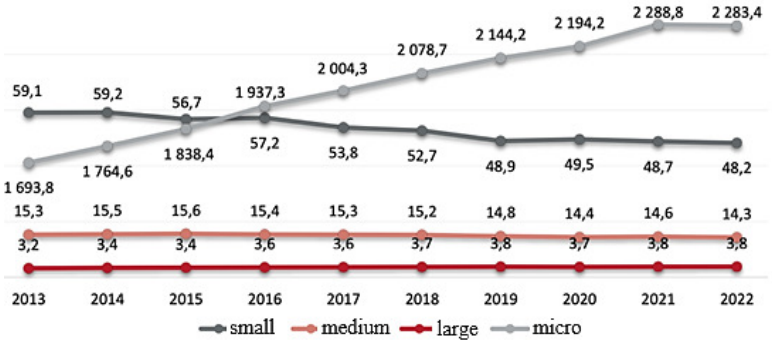


Figure 3. Number of active businesses in Poland categorized by size from 2013 to 2022 (in thousands).

Source: Polish Agency for Enterprise Development, 2024, Small and medium-sized enterprises in Poland, Warsaw.

The influence of small and medium-sized enterprises (SMEs) on macroeconomic outcomes arises not only from their significant share of the overall business population but also from their economic contribution through creative destruction, which is characterized by a continuous process of entry and exit (Schumpeter, 1934). Demographic changes foster competition and underscore the potential role of new businesses in driving economic growth, employment, and productivity (Decker et al., 2014; Garcia-Macia et al., 2019).

The number of new businesses in Poland has remained relatively stable from 2014 to 2023, with a minor drop in 2019-2020. In contrast, business closures experienced more significant fluctuations, especially from 2018 to 2023 (Figure 4).

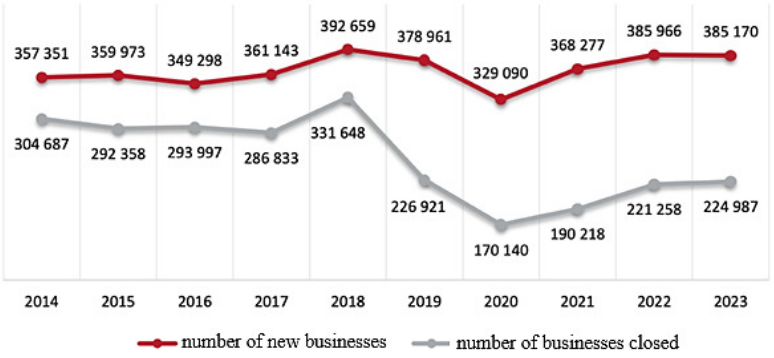


Figure 4. The number of new and closed businesses in Poland from 2014 to 2023 (in thousands).

Source: Polish Agency for Enterprise Development, 2024, Small and medium-sized enterprises in Poland, Warsaw.

The analysis of business dynamics also highlights the importance of start-ups and young firms in creating jobs, despite the higher failure rate among new businesses, particularly in their first year. In Poland, the highest percentage of businesses fail within their first year of operation - the survival rate for 2022/2023 was 67.0%, indicating that nearly one in three businesses closed. In the following years, the survival rate improves. The survival rate for businesses founded in 2018 by their fifth year (2023/2018) was 92.4% (Figure 5), emphasizing the long-term viability of older SMEs.

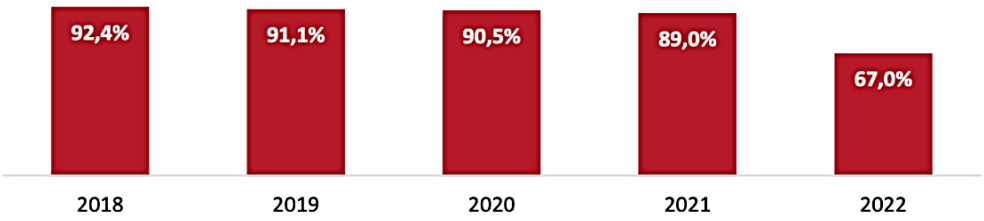


Figure 5. Businesses established from 2018 to 2022 that remain active in 2023 – survival rate for 2023 compared to 2022 (in %).

Source: Polish Agency for Enterprise Development, 2024, Small and medium-sized enterprises in Poland, Warsaw.

Since the 1990s, employment has significantly stabilized in all size classes of enterprises in European economies (Daszkiewicz, Wach, 2013). In the EU-27 countries, the employment dynamics rate is higher in the entire SME sector than in the large enterprise sector. Moreover, the pace of employment changes decreases as the size of the company increases (Table 1).

Table 1.
Average annual employment growth rate in the non-financial sectors of the EU-27 for 2023 (in %)

Economy	Large enterprises	SME sector	SME in details		
			micro	small	medium
EU-27	1,2	1,8	2,3	1,6	1,1

Source: Own study based on European Commission, 2024, SME Performance Review, Annual Report on European SMEs 2023/2024 Luxembourg.

According to data from the Central Statistical Office, businesses generate nearly two-thirds of Poland's GDP (PARP, 2024). SMEs contribute over 50% to the gross value added generated by all Polish businesses. The table below shows the differences in gross value added produced by different size classes of businesses in Poland and the EU-27 countries (Table 2).

Table 2.
Contribution of the SME sector to the gross value added in the non-financial business sector of Poland and the EU-27 countries 2023

Economy	Large enterprises	SME sector	SME in details		
			micro	small	medium
Poland	49,7	50,3	19,3	15,1	16,0
EU-27	46,9	53,1	19,8	16,8	16,6

Source: Own study based on European Commission, 2024, 2024 SME Country Fact Sheet Poland and 2024 SME Fact Sheet European Union, Luxembourg.

Poland has one of the lowest shares of the SME sector in generating value-added compared to other EU countries (Table 2). This can be seen as a legacy of the centrally planned economy, where the previous dominance of large-scale production continues to influence the structure of value-added creation throughout the economy (Kokocińska, 2012).

2.2. Vulnerability as an economic concept

The rising importance of vulnerability to global economic fluctuations is associated with growing globalization, technological progress, and increasing negative economic shocks. In a macroeconomic dimension, vulnerability can be understood as susceptibility to external influences that disrupt a given economy's expected development path. In a narrower sense, vulnerability refers to economic structures and their ways of mitigating adverse shocks and threats and taking advantage of emerging opportunities without structural changes (Gawlikowska-Hueckel, Szlachta, 2014). The terms resilience and adaptive capacity are often used interchangeably in the literature. These concepts are described as the system's flexibility, stability, extensive tolerance range, and coping ability (Eklund et al., 2023). There remain many

ambiguities surrounding vulnerability and its measurement, both in terms of terminology and research methodology (Palosaari et al., 2024). Vulnerability is a multidimensional concept, and its definition varies based on the research objective and the methodology adopted (Deppisch, 2017). Tasanuva et al. (2022) propose various types of analyses to assess vulnerability, including comparative analysis, indicator-based methods, and statistical analysis. Key factors affecting SME sector vulnerability to economic fluctuations include the following:

1. The structure of the SME population. Micro-enterprises are the most vulnerable to economic fluctuations. Therefore, the larger the share of micro-enterprises within the SME population, the more vulnerable the entire sector becomes to changes in the business cycle.
2. The share of SMEs in the creation of gross value added.
3. SMEs' structure and diversification (Pedauga et al., 2022). Construction, the automotive industry, transportation, tourism and recreation, and luxury goods are among the sectors most vulnerable to economic fluctuations. In contrast, the services sector exhibits high resilience to economic changes (Gupta et al., 2023). Additionally, the medical industry (Beller et al., 2023) and the public utilities sector (Gajdosikova, Vojtekova, 2024) are less vulnerable to economic downturns.
4. The maturity of the SME sector. Small and medium-sized enterprises' vulnerability to economic fluctuations depends on the sector's age (Seimer, 2019). Young firms (those no more than 5 years old or employing fewer than 20 employees) are more vulnerable to these fluctuations than older, established firms (Haltiwanger et al., 2013; Kim et al., 2024).
5. The level of internationalization. SMEs engaged internationally tend to be more innovative and achieve greater employment growth (Jabar et al., 2016; Daszkiewicz, 2019).
6. The degree of innovation. Innovative companies frequently experience employment growth, which tends to be greater than that of non-innovative firms (Santoreli, 2020). Additionally, unlike their non-innovative counterparts, innovative companies can maintain a high growth rate over the long term. Among declining firms, non-innovative companies often experience a more rapid deterioration in economic performance compared to innovative ones (Ciriaci et al., 2016). Furthermore, during the economic crisis of 2009 - 2010, innovative economies felt the effects of the recession much more mildly than less innovative economies (De Kok, De Witt, 2014).

2.3. Company size and economic fluctuations

Analyzing the relationship between company size and economic fluctuations, the literature presents arguments supporting both hypotheses: 1. SMEs are more vulnerable to economic fluctuations than large enterprises. 2. SMEs are more resilient to economic fluctuations than large enterprises (Chari et al., 2007; Crouzet, Mehrotra, 2020).

Gertler and Gilchrest (1994), Cravo (2011), Lai et al. (2016), and Seimer (2019) support the hypothesis that SMEs are significantly more vulnerable to external shocks. However, research by Moscarini and Postel-Vinay (2012) shows that large enterprises respond more sharply to changes in economic conditions than smaller firms. Kudlyak and Sanchez (2016) indicate that the sales of large firms declined relatively more than those of small firms during the 2008 financial crisis and in most recessions since 1969.

At the same time, Fort et al. (2013) and Mehrotra and Sergeyev (2016) highlight a missing element in the above analyses, specifically the need to differentiate between a firm's size and age. The findings from Fort et al.'s (2013) research on the U.S. economy indicate that small, young firms are more vulnerable than both their small, older counterparts and large, older firms (it was assumed that young firms are no older than 5 years, and small firms employ fewer than 20 people). However, comparing vulnerability between small and large, older firms yielded few definitive conclusions.

The debate surrounding the connection between firm size, employment growth, and resilience to external shocks also engaged Haltiwanger et al. (2013). Their research indicates that a firm's age is a more crucial factor than its size in explaining variations in responses to external shocks. Challenging the belief that the SME sector generates most jobs, they examined data from the U.S. economy from 1976 to 2005. Nonetheless, they found no statistically significant correlation between firm size and employment growth. However, they observed that a firm's age significantly impacts job creation. Highlighting the importance of start-ups and young firms, the authors emphasize that these businesses typically either expand or exit the market, demonstrating an "up or out dynamic". When a young firm manages to survive, it typically grows faster and more aggressively than its older counterparts. These innovative, fast-growing firms, comprising a small percentage of SMEs, are responsible for creating the majority of jobs in this sector (Dachs, Peters, 2014; Haltiwanger, 2016).

Innovative companies are more likely to experience employment growth, which is usually greater than non-innovative firms (De Kok et al., 2011). Moreover, Dachs and Peters (2016) research shows that internationalized SMEs are more innovative and experience higher employment growth. In addition, innovative economies during 2009–2010 were significantly less affected by the crisis than their less innovative counterparts (De Kok et al., 2011). This supports the positive relationship between innovation and employment (Ciriaci, 2016).

3. Summary

The literature studies conducted do not provide a specific and convincing answer to whether the SME sector is less vulnerable to and, as a result, more resilient to business cycle fluctuations than the large enterprises sector. In other words, the literature review results do not confirm that

the SME sector is less vulnerable to recession than the large enterprise sector. At the same time, the above conclusions do not support the statement that the small and medium-sized enterprise sector has proven to be more vulnerable to the recession than the large enterprise sector. The relationship between a firm's size and its vulnerability to economic fluctuations is complex and often ambiguous. Current literature reveals contradictory results, predominantly influenced by variables such as the age of the enterprises, their ability to innovate, and their exposure to the international market. Future research should examine these factors to understand better how companies navigate economic challenges. These findings can be vital for policymakers, particularly in light of economic uncertainties. Policies that promote innovation and internationalization could strengthen the resilience of small and medium-sized enterprises.

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SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 226

SPATIAL DIVERSITY OF ENERGY COOPERATIVES IN POLAND

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Purpose: The aim of the study is to identify the regional specialization of energy cooperatives in Poland.
Design/methodology/approach: The research employs a quantitative approach using the location quotient (LQ) method to analyze regional specialization. Three LQ indicators were calculated to assess the relationship between the capacity of photovoltaic installations and the number of cooperative members, number of installations, and number of energy consumption points. The analysis was conducted at the voivodeship level to identify regions with a strong concentration of large photovoltaic farms and higher specialization in energy cooperatives.
Findings: The study found significant regional disparities in the development of energy cooperatives in Poland. Four voivodeships (Kujawsko-Pomorskie, Łódzkie, Warmińsko-Mazurskie, and Wielkopolskie) demonstrated strong regional specialization with high LQ values in all three criteria, indicating a high concentration of large-capacity photovoltaic installations.
Research limitations/implications: The study focuses on quantitative indicators of specialization and does not incorporate qualitative factors such as policy influences or market conditions. Future research could explore these aspects to provide a more comprehensive understanding of the regional dynamics of energy cooperatives.
Practical implications: The findings can guide policymakers and stakeholders in identifying regions with high potential for the development of energy cooperatives.
Originality/value: This paper offers a perspective by using the location quotient method to evaluate the specialization of energy cooperatives beyond merely counting the number of cooperatives.
Keywords: energy cooperatives, spatial diversity, the location quotient (LQ), rural area.
Category of the paper: research paper.

1. Introduction

The current energy system in Europe largely relies on external suppliers. The escalation of Russia's military actions against Ukraine has severely disrupted the global energy system and highlighted the excessive dependence of EU countries' energy security on imports of gas, oil, and coal from Russia. The European Commission notes that decentralizing energy production

could reduce European countries' reliance on Russian fossil fuels and accelerate the adoption of renewable energy. Considering that by 2050, 50% of citizens could produce energy from renewable sources to meet 45% of their needs, emphasis is placed on a grassroots-driven energy transition involving society (European Commission, 2022).

Energy communities can contribute to mitigating the effects of the energy and climate crisis and reducing energy poverty. Energy cooperatives primarily operate in the member states of the European Union. The largest numbers of energy cooperatives contribute to the energy market in Germany, Austria, and Denmark (Marzec, 2021). The concept of energy cooperatives in Poland was implemented based on German experiences. In Germany, as early as the late 19th century, the first cooperatives were established to distribute electricity and create the necessary infrastructure for the country's electrification. After the Fukushima nuclear disaster in 2011, the German authorities decided to intensify investments in renewable energy sources. As noted by Hartmann and Palm (2023), during this period, the concept of "citizens' energy cooperatives" (German: Bürgerenergiegenossenschaften) emerged. These cooperatives enable local communities to jointly invest in renewable energy technologies and take responsibility for their energy consumption. The development of German energy cooperatives exemplifies an energy transition aligned with sustainable development principles and widely accepted by society (Klagge, Meister, 2018).

The rationale for investing in energy independence and developing a stable and innovative infrastructure to support economic growth and social well-being is reflected in global and European strategies. These objectives are included in the 2030 Agenda for Sustainable Development, particularly Goal 9 (A/RES/70/1) (UN, 2015), as well as in the "6 priorities of the European Commission for 2019-2024", which align with the European Green Deal. The strategy, known as the "Green Deal", introduced in 2019 (EC, 2019), sets a goal of achieving climate neutrality by 2050.

In Polish law, the term "energy cooperative" has been in use since 2016. As Marzec (2021) notes, the impetus for creating a legal framework for this type of initiative in Poland was inspired by German solutions. The implementation of the energy cooperatives concept in Poland took place through the Renaldo Program, initiated by the Kuyavian-Pomeranian Agricultural Advisory Center. The program, approved in 2019, was an initiative of the Ministry of Agriculture and Rural Development aimed at providing expert support in establishing pilot energy cooperatives in the Podlaskie and Kuyavian-Pomeranian regions. The entire project was 100% financed by the European Union under the Structural Reform Support Program and the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety. According to Spiller (2023), the experiences gained during the program allowed for the development of best practices, support tools (such as the Renaldo Calculator), and recommendations for legislative changes.

According to the definition contained in the Act of August 17, 2023 (Dz.U. 2023, item 1762), an energy cooperative is a form of cooperative or agricultural cooperative engaged in the production of electricity, biogas, biomethane, or heat from renewable energy sources, as well as their distribution and storage for its own needs and those of its members. A cooperative member can be any entity whose installation is connected to the power, gas, or heating network. Polish literature emphasizes the need to prioritize promoting energy cooperatives in rural areas, where, compared to urban areas, there is a greater risk of poverty, including energy poverty (Błażejowska, Gostomczyk, 2018). These suggestions are reflected in the conditions that energy cooperatives in Poland must meet. According to regulations (Dz.U. 2019, item 1524; 2021, item 1093; 2022, item 1723), cooperative members are required to operate within the area of a rural or mixed rural-urban municipality or within no more than three directly neighboring such municipalities.

In Poland, the first energy cooperative was registered in December 2021. This cooperative comprised 19 members who owned 20 photovoltaic installations with a capacity of 0.18 MWe and consumed energy from 20 consumption points. The establishment of additional energy cooperatives was only noted in 2023. In 2023, the KOWR Register recorded 19 new cooperatives with 48 members who owned 94 photovoltaic installations with a total capacity of 3.62 MWe and consumed energy from 320 points. The following year, 35 new energy cooperatives were established, comprising 117 members who consumed energy from 281 points and owned 141 installations with a total capacity of 10.43 MWe. In January 2025, seven more energy cooperatives were established, bringing together 27 members who owned 27 photovoltaic installations with a total capacity of 2.22 MWe and consumed energy from 38 points. As of January 29, 2025, Poland had 62 registered energy cooperatives comprising 211 members consuming energy from 659 points and owning 282 installations with a total capacity of 16.45 MWe. All energy cooperatives' activities are based on electricity production using photovoltaic installations. Additionally, one cooperative operates a wind power plant, and another has an energy storage facility.

Energy cooperatives are unevenly distributed across the country. Interestingly, for two cooperatives, the registered office address (Małopolskie Voivodeship) differs significantly from the area of operation (Świętokrzyskie and Wielkopolskie Voivodeships). Therefore, further analyses consider the location of the operational area rather than the registered address of the energy cooperative.

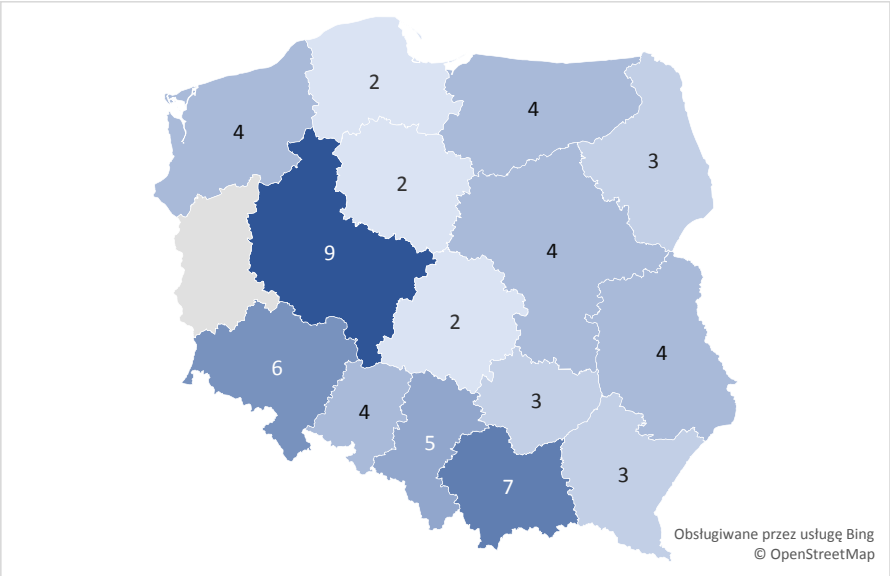


Figure 1. Number of energy cooperatives in Poland by Voivodeship. As of January 29, 2025.

Source: Own elaboration based on the List of Energy Cooperatives maintained by the National Support Centre for Agriculture (KOWR).

As we can see, a significant number of cooperatives operate in the southwestern part of the country. Most of them are in the Wielkopolskie (9), Małopolskie (7), Dolnośląskie (6), and Śląskie (5) voivodeships, the latter of which saw the establishment of Poland's first energy cooperative in 2021. Only in the Lubuskie Voivodeship has no energy cooperative been registered yet.

2. Material and Research Methodology

Using data obtained from the literature (desk research) and statements from members of the National Forum of Energy Cooperatives in Poland, the process of implementing energy cooperatives in Poland was presented. Based on data from the Register of Energy Cooperatives maintained by the National Support Centre for Agriculture (KOWR), the dynamics of the establishment of successive energy cooperatives in Poland over the years were shown. To assess regional specialization, the location quotient (LQ) was used. This is a classic indicator that allows for the determination of local specialization and concentration (Gwosdz et al., 2021). The location quotient (LQ_i), also known as the regional specialization index, for a spatial unit (region) is the ratio of the value of a specific economic or social activity indicator (S_i) in a spatial unit (region i) to the value of this indicator (A) in a higher-order spatial unit (country):

$$LQi = \frac{Si}{A} \quad (1)$$

LQ_i indicates in which regions there is an "overrepresentation" of a particular activity (LQ > 1) and where there is a relative "deficiency" (LQ < 1). "Overrepresentation" can be positively interpreted as regional specialization. The location quotient (LQ) also enables comparisons across different time periods (Czyż, 2016). To assess regional specialization, three indicators were used, based on photovoltaic installation capacity, the number of photovoltaic installations, the number of energy cooperative members, and the number of energy consumption points.

3. Energy Cooperatives in Poland - Regional Specialization

Knowing that regional specialization cannot be assessed solely on the basis of the number of organizations, the study utilized analytical tools and a well-established indicator in the scientific literature, namely the location quotient (LQ) (Gwosdz et al., 2021). The applied index method assumes a realistic approach, in light of which even non-directly observable cognitive constructs (e.g., residents' entrepreneurship) can be described by observable empirical or empirical-inferential indicators (e.g., the number of companies established by residents) (Czyż, 2016). The main objective of using the location quotient and analyzing its values in this study is to identify in which regions (voivodeships) in Poland there is a specialization resulting from the number and capacity of photovoltaic installations and the number of points from which energy is drawn by members of energy cooperatives.

The study used the regional specialization index (location quotient LQ_i) in three aspects. First, as the ratio of the indicator showing the relationship between the power generated by energy cooperatives and the number of members (S_{i1}), second, to the number of installations owned by cooperatives (S_{i2}), and third, as the ratio of the number of energy consumption points (S_{i3}). Then, individual indicators S_{i1-3} in the voivodeship were compared to the value of this indicator (A) in a higher-order spatial unit, i.e., the country.

$$\mathrm{LQi} = \frac{\mathrm{Si}}{\mathrm{A}} \tag{2}$$

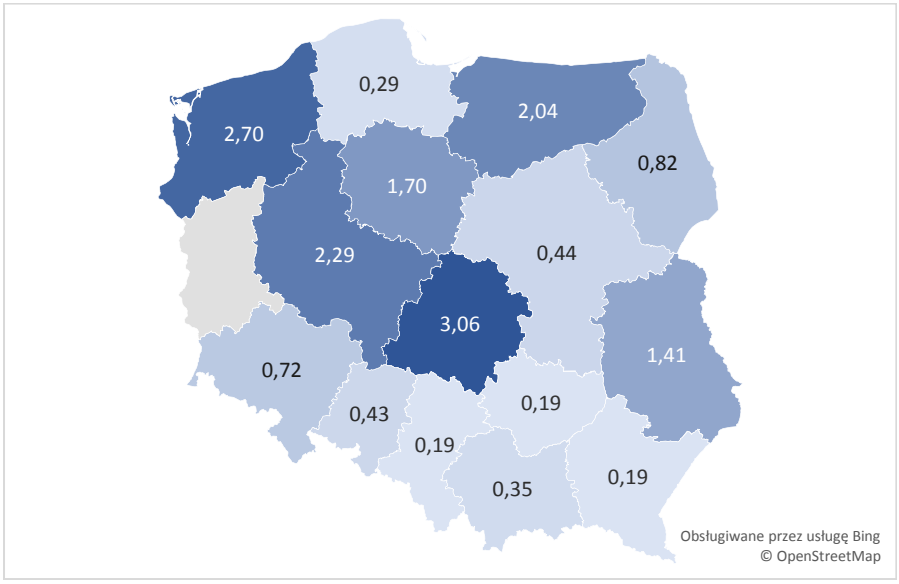


Figure 2. Location quotient (LQ_1) for the installation capacity per number of cooperative members.

Source: Own elaboration based on the List of Energy Cooperatives maintained by the National Support Centre for Agriculture (KOWR).

Based on the data presented in Figure 2, we can observe that the highest value of the location quotient (LQ_1) was recorded in the Łódzkie Voivodeship (3.06). This indicator value suggests that the power of installations per energy cooperative member in this region is more than three times higher than the national average. High values (indicating regional specialization) were also noted in the Zachodniopomorskie (2.70), Wielkopolskie (2.29), Warmińsko-Mazurskie (2.04), Kujawsko-Pomorskie (1.70), and Lubelskie (1.41) voivodeships. In the remaining regions, the index value was below 1.

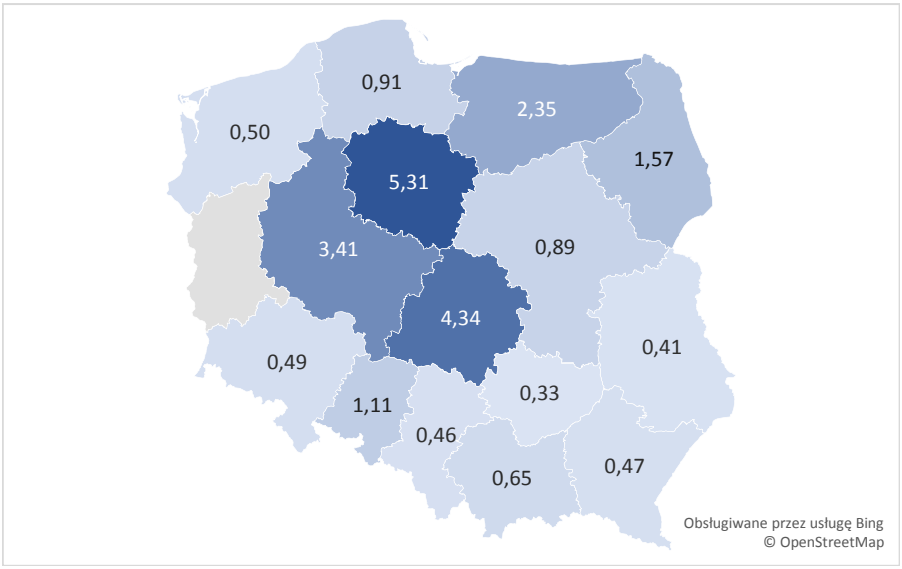


Figure 3. Location quotient (LQ_2) for the installation capacity per number of energy consumption points.

Source: Own elaboration based on the List of Energy Cooperatives maintained by the National Support Centre for Agriculture (KOWR).

Figure 3 illustrates the values of the location quotient (LQ_2) from the perspective of the ratio of photovoltaic installation capacity owned by energy cooperatives to the number of their energy consumption points. The highest values of this indicator were recorded in the Kujawsko-Pomorskie (5.31), Łódzkie (4.34), and Wielkopolskie (3.41) voivodeships, indicating that each energy consumption point is associated with significantly higher photovoltaic installation capacity. Above-average values (LQ2 > 1), albeit much lower, were also observed in the Podlaskie (1.57) and Opolskie (1.11) voivodeships. In the remaining regions, the indicator value was below 1, with the lowest value noted in the Świętokrzyskie Voivodeship (0.33).

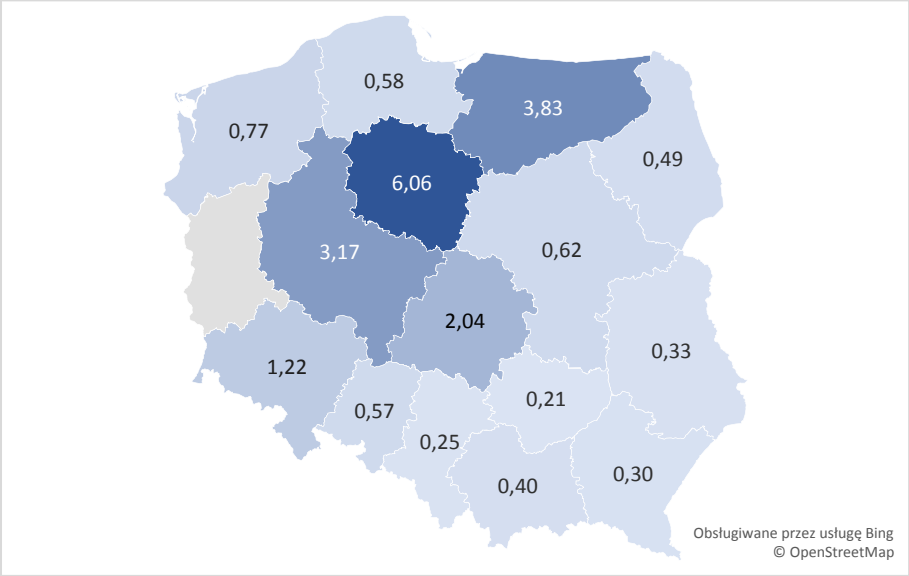


Figure 4. Location quotient (LQ_3) for the installation capacity per number of existing installations.

Source: Own elaboration based on the List of Energy Cooperatives maintained by the National Support Centre for Agriculture (KOWR).

Figure 4 presents the value of the location quotient (LQ_3) for installation capacity per the number of installations. The highest value was observed in the Kujawsko-Pomorskie Voivodeship (6.06), indicating that photovoltaic installations owned by energy cooperatives in this region have more than six times the capacity of the national average. Next, relatively high-capacity installations are found in the Warmińsko-Mazurskie (3.83), Wielkopolskie (3.17), Łódzkie (2.04), and Dolnośląskie (1.22) voivodeships. In the remaining regions, the installations have lower capacity than the national average.

4. Summary

The literature emphasizes that the location of energy cooperatives is spatially diverse (Kostecka-Jurczyk et al., 2024). However, these conclusions were based on an analysis of the distribution of energy cooperative headquarters in Poland. This study focused on analyzing the

location of energy cooperatives from the perspective of the voivodeship in which they operate, considering the capacity of their installations, the number of installations, the number of energy consumption points, and the number of cooperative members.

The obtained values of the location quotient indicators for all three categories are summarized in Table 1.

Table 1.
Voivodeships according to the location quotient index LQ_{1-3}

Voivodeship	LQ power capacity/number of cooperative members	LQ power capacity/number of energy consumption point	LQ power capacity/number of installations
dolnosląskie	0,72	0,49	1,22
kujawsko-pomorskie	1,70	5,31	6,06
lubelskie	1,41	0,41	0,33
łódzkie	3,06	4,34	2,04
małopolskie	0,35	0,65	0,40
mazowieckie	0,44	0,89	0,62
opolskie	0,43	1,11	0,57
podkarpackie	0,19	0,47	0,30
podlaskie	0,82	1,57	0,49
pomorskie	0,29	0,91	0,58
śląskie	0,19	0,46	0,25
świętokrzyskie	0,19	0,33	0,21
warmińsko-mazurskie	2,04	2,35	3,83
wielkopolskie	2,29	3,41	3,17
zachodniopomorskie	2,70	0,50	0,77

Source: Own elaboration based on the List of Energy Cooperatives maintained by the National Support Centre for Agriculture (KOWR).

The analysis of these values reveals significant regional differences, indicating the uneven development of energy cooperatives in Poland. Regional specialization is observed in four voivodeships: Kujawsko-Pomorskie, Łódzkie, Warmińsko-Mazurskie, and Wielkopolskie. In these regions, the location quotient (LQ) value exceeded 1 in all three criteria, highlighting a strong concentration of large photovoltaic farms with high-capacity installations relative to the number of installations, energy consumption points, and energy users.

Voivodeships such as Dolnośląskie, Lubelskie, Opolskie, Podlaskie, and Zachodniopomorskie exhibit regional specialization in only one of the examined aspects.

Regions like Małopolskie, Mazowieckie, Podkarpackie, Pomorskie, Śląskie, and Świętokrzyskie are characterized by a smaller number of installations with lower capacity. This may result from geographical conditions, the investment policies of cooperative members, or the availability of energy infrastructure.

Moreover, it should be noted that the example of the Małopolskie Voivodeship is a good illustration of the value of the location quotient (LQ) analysis as a measure of specialization. It provides a different perspective than if we only considered the number of energy cooperatives operating in a given area.

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SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 226

IMPORTANCE OF MANAGEMENT PARTICIPATION IN EMPLOYER BRANDING FOR GENERATION Z

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* Correspondence author

Purpose: To determine whether Generation Z people expect to participate in various forms of participation in corporate decision-making.
Design/methodology/approach: The survey was conducted on a sample of 256 people in 2024. The sample includes people born after 1996 (234) of whom 128 are working and 106 are not working. The number of respondents born before 1996 is 22 of whom 18 are working. The survey was built on YES/NO (1/0) responses. In addition to the label, the survey asked 2 series of 23 questions each. The first concerned a positive perspective of employees' expectations of the work environment. The respondent was asked to indicate the five most important perspectives on the provision of work for them. The second was about the negative perspective of employees' expectations.
Findings: The results on the empowerment item indicate that the concept is not known and interpreted rather intuitively. Statistical analysis of r-Pearson correlations showed a correlation between year of birth and the ability to participate in decision-making processes and influence on work time organization as factors important to Generation Z.
Research limitations/implications: The research sample is not representative (large imbalance between representatives of generation Z and those born before 1996). The conclusions formulated can only be an indication, not a paradigm. The survey was constructed based on 0/1 responses, which has its interpretive limitations. The cognitive value is limited to people with higher education.
Practical implications: The results obtained can provide clues on how to shape the company's image from the perspective of participation in decision-making activities among Generation Z.
Originality/value: The article is addressed to researchers dealing with employee expectations, employee value proposition and practitioners shaping: working conditions, EVP, EB and recruiting generation Z employees. The article sheds light on the difference in the importance given to elements of participation in company management by employed and unemployed people with greater or lesser professional experience.
Keywords: management participation, empowerment, employer branding, generation Z.
Category of the paper: Research paper.

1. Introduction

Employer branding (EB) is the totality of an organization's activities, aimed at current and potential employees, aimed at improving the attractiveness of the employer, as well as supporting the strategic goals of the organization (Kozlowski, 2012). Thus, it becomes an important task for management to create a so-called "employer value proposition - EVP". One of these propositions could be the inclusion of employees in the management of the company, which should be accompanied by the ability of employees to influence decisions in the company. It is worth pointing out here the importance of empowerment, which is an extension of earlier theoretical currents in management science like participative management or labor enrichment. Empowerment is a concept that involves providing employees with the opportunity to participate in decision-making processes, delegating both rights and responsibility for their work, but also ensuring that they have the opportunity to acquire and enhance their knowledge, abilities and skills (Pytel-Kopczynska, 2019).

The specific characteristics of generation Z (e.g., loyalty dictated by meeting their expectations or willingness to change jobs in the absence of favorable resolutions for themselves) but also their needs (including a desire for development, participation in problem solving, control over decisions that affect them, or the ability to go beyond their assigned roles) seem to confirm the validity of treating participation in management, including empowerment, as a tool for employer branding in this generational group.

Research problem: Is the exposure of opportunities for employees to participate in activities related to participation in decision-making processes relevant to corporate branding. The problem posed in this way leads to the formulation of the goal, which is to identify whether people from generation Z expect to participate in various forms of participation in corporate decision-making. And from there, 2 main and two auxiliary hypotheses were derived.

Hypothesis A: Generation Z shows more interest in participation in business management than the earlier generation (born before 1996).

Hypothesis B: Working people show more interest in participation in business management.

Hypothesis B1: Working people from Generation Z show more interest in participation in enterprise management.

Hypothesis B2: Working people from generation earlier than Z show more interest in participation in enterprise management.

In-depth data analysis and r-Pearson correlation analysis were used to verify the hypotheses. Such a wide range of methods used is due to the specifics of the study and the nature of the research sample. The correlation analysis seemed insufficient because a significant portion of the responses were shared by both groups of respondents (in extreme cases, the correlation was 0), which means that a statistically significant relationship will not appear.

Questions about respondents' interest in participation in governance can be identified by referring to several survey questions (variables), these include:

- Participation in decision-making processes.
- Empowerment.
- Participation in meetings.
- Formal expression of opinions.
- Informing on important issues concerning the operation of the company.
- Influence on the organization of work time, as a form of autonomy in decision-making.

Thus, these eight variables (along with year of birth and work situation) will form the strict scope of the analysis conducted.

2. Characteristics of generation Z

Generation Z are those born after 1996 (Konkel, 2023). It is indicated that they are more inclined to the concept of "working with" than "working for". In practice, this means that Zetas prefer working in a team and with a leader, rather than one that involves being subordinate to a hierarchical manager (Aggarwal, Sadhna, Gupta, Mittal, Rastogi, 2020). An important value in their lives is self-reliance (Kukla, 2019), and they also attach great importance to the possibility of challenges (White, 2022). Young workers are pragmatic by nature and thirsty to learn, they want to be involved in solving problems and have control over decisions that affect them. Zetas are individualists who are eager to make their own rules, rebelling against some of the phenomena that occur in company cultures. Many times they feel a strong need to modify these cultures in a way that will allow them to spread principles in line with their value system. The aforementioned individualism refers to the "individualism of self-actualization" (from Charles Taylor's model), where self-actualization is understood as the result of loyalty to oneself, not giving in to established patterns (Higher School of Humanitas, 2023). Today's managers should be aware that representatives of this generation are ruthless to those companies that have failed their trust - most of them, wanting to warn their friends, are willing to provide them with negative information about the company's activities (Ławińska, Korombel, 2023).

3. Empowerment as an EB tool to stimulate employees to action

Empowerment can be understood in two ways: as an employee's motivational state or as a management style (Fernandez, Moldogaziev, 2013). In the first, it refers to an employee's beliefs about his or her own position, influence, competence, sense of work and autonomy,

which is indicated to enhance the sense of professional effectiveness (Spreitzer, 2008). The second relates to managerial practices that involve sharing power, resources and information with employees, involving them in decisions (Ahearne et al., 2005). This partnership style of management fosters a sense of agency and responsibility in employees (Kulikowski, 2017). Spreitzer (2008) states that empowerment increases labor productivity (performance) because it makes them go beyond rigidly defined roles and responsibilities to take more innovative actions. Chen and co-authors (2007) emphasize building trust and mutual respect between managers and subordinates. Importantly, empowerment flows into economic profits and promotes improvements in the quality of services provided (Geralis, Terziovski, 2003; Murray, Holmes, 2021) by the company.

4. Methodology

The survey was conducted on a sample of 256 people in 2024. The sample includes people born after 1996 (234) of whom 128 are working and 106 are not working. The number of respondents born before 1996 is 22 of whom 18 are working. The survey was built on YES/NO (1/0) responses. In addition to the label, the survey asked 2 series of 23 questions each. The first concerned a positive perspective of employees' expectations of the work environment. The respondent was asked to indicate the five most important perspectives on the provision of work for them. The second was about the negative perspective of employees' expectations.

5. Research

The first step is to present the results of the in-depth data analysis. Tables 1, 2 and 3 show the synthetic results of the analysis conducted.

Table 1.
Synthetic layout of data analysis results by date of birth

Specification	**Positive**		**Negative**	
	After 1996 Item = 234	Before 1996 Item = 22	After 1996 Item = 234	Before 1996 Item = 22
Participation in decision-making processes	14%	50%	15%	5%
Empowerment	3%	5%	13%	23%
Attendance at meetings	14%	14%	29%	32%
Formal expression of opinions	1%	5%	47%	55%
Keeping you informed about important issues concerning the company's operations	13%	14%	11%	9%
Impact on the organization of working time	23%	45%	19%	9%

Source: own study.

Table 1 shows the results on the expectations of respondents, divided into those born before 1996 and those born after 1996. The percentages reflect the proportion of responses in each group. The columns include the values of positive (significant importance) and negative (insignificant importance) responses.

Table 2.
Synthetic layout of data analysis results by employment status

Specification	Positive		Negative	
	I don't work Item = 110	I work Item = 146	I don't work Item = 110	I work Item = 146
Participation in decision-making processes	11%	21%	17%	11%
Empowerment	1%	5%	16%	12%
Attendance at meetings	16%	12%	21%	35%
Formal expression of opinions	0%	2%	49%	46%
Keeping you informed about important issues concerning the company's operations	16%	10%	8%	13%
Impact on the organization of working time	16%	31%	23%	15%

Source: own study.

Table 2 illustrates the expectations of respondents by working and non-working, and Table 3 relates the relationship of the variables of employment status by age group to the variables describing expectations of participation in decision-making processes.

Table 3.
Synthetic layout of data analysis results by age group employment status

	After 1996				Before 1996			
Specification	Positive		Negative		Positive		Negative	
	I don't work Item = 106	I work Item = 128	I don't work Item = 106	I work Item = 128	I don't work Item =	I work Item = 18	I don't work Item = 4	I work Item = 18
Participation in decision-making processes	11%	16%	18%	12%	0%	61%	0%	6%
Empowerment	1%	5%	16%	11%	0%	6%	25%	22%
Attendance at meetings	16%	12%	20%	36%	25%	11%	50%	28%
Formal expression of opinions	0%	2%	48%	45%	0%	6%	75%	50%
Keeping you informed about important issues concerning the company's operations	16%	10%	8%	14%	25%	11%	25%	6%
Impact on the organization of working time	16%	28%	23%	16%	25%	50%	25%	6%

Source: own study.

Table 3 shows detailed results on the expectations of Generation Z respondents, broken down by working and non-working. Thus, for example, participation in decision-making processes is significantly more important to working people in the group born after 1996, with a difference of 4.3%. The situation is reversed when expressing an opinion about the

irrelevance of the variable. The second part of this table shows the same pattern of variables but for those born before 1996.

Another research method used in the study is the r-Pearson correlation method. In this study:

– Year of birth, 1996 and later years designation 1, before 1996 designation 0.
– Work situation (current). Working designation 1, not working designation 0.

It should be noted that correlation analysis considers the relationship between variables. It does not identify the significance or numerosity of responses. Table 4 shows the obtained results of the correlation analysis for the entire sample.

Table 4.
The r-Pearson correlation matrix for the variables in the entire sample

	r Pearson`s	**r Pearson`s**
IMPORTANT	**Birth year**	**Situation Professional (current)**
Impact on the organization of working time.	-0.148*	0.166**
Attendance at meetings.	0.000	-0.068
Participation in decision-making processes.	-0.272***	0.137*
Formal expression of opinions.	-0.096	0.095
Keeping you informed about important issues concerning the company's operations.	-0.007	-0.090
Empowerment	-0.017	0.123*
UNLESS		
Impact on the organization of working time	0.071	-0.108
Attendance at meetings	-0.020	0.153*
Participation in decision-making processes	0.081	-0.091
Formal expression of opinions	-0.045	-0.032
Keeping you informed about important issues concerning the company's operations	0.018	0.077
Empowerment	-0.076	-0.057
comment * p < .05, ** p < .01, *** p < .001		

the highlights in the table indicate a significant correlation.

Source: own study.

The strongest correlation was observed between year of birth and participation in decision-making processes. The r-Pearson coefficient is -0.272, which means that with 99% certainty, those born before 1996 consider it important to participate in decision-making processes. The correlation is slightly weaker between those who are working and participation in decision-making processes.

Table 5 shows the results of correlations in age groups with their work situation and work environment factors important and unimportant.

Table 5.
The r-Pearson correlation matrix for age groups in the working/non-working category

IMPORTANT	Situation Professional (current) r Pearson`s After 1996	Situation Professional (current) r Pearson`s Before 1996
Impact on the organization of working time	0.144*	0.194
Attendance at meetings	-0.063	-0.156
Participation in decision-making processes	0.062	0.471*
Formal expression of opinions	0.084	0.103
Keeping you informed about important issues concerning the company's operations	-0.088	-0.156
Empowerment	0.124	0.103
UNLESS		
Impact on the organization of working time	-0.089	-0.261
Attendance at meetings	0.178**	-0.184
Participation in decision-making processes	-0.088	0.103
Formal expression of opinions	-0.028	-0.194
Keeping you informed about important issues concerning the company's operations	0.103	-0.261
Empowerment	-0.075	-0.026

the highlights in the table indicate a significant correlation.

Source: own study.

6. Discussion

In our research, we wanted to show what meaning the Zetas ascribe to empowerment. As it turned out, this concept was not fully understood or known by the respondents. More often, they pointed to other response options that are close to epowerment, but do not fully capture its meaning. Among them, were: the opportunity to participate in decision-making processes; participation in meetings; the opportunity to formally express opinions; to be informed about important issues concerning the company; and to influence the organization of time. The most frequent indications were the opportunity to participate in decision-making processes and influence on the organization of work time.

In studies by other authors, such as Sladek and Grabinger (2014), we read about a slightly different set of Zet needs related to management participation in the broadest sense. They mention the need to listen to Generation Z representatives; to provide immediate feedback; and to offer their representatives a flexible work schedule (coinciding with our research). The authors point out that managers who are open to constructive conversations with Zetas, while taking their suggestions into account, will gain the loyalty and respect of representatives of this generational group. Also, White writes about the validity of informing the Zetas and holding routine meetings to communicate to them how their work is evaluated. The study reads that 40% of Generation Z employees expect daily interactions with their boss.

At the same time, according to Sladek and Grabinger (2014), it is also important for managers to be aware of the importance Generation Z places on work-life balance. The authors point out that in order to maintain this balance, leaders should allow young employees to perform some tasks at home. Ulrych (2022) writes about work autonomy, which manifests itself in the ability to plan work independently (when and where), decide how to do it and choose methods (indications received values of 62%, 35% and 40%, respectively). Generation Z expects support from a supervisor, but still values autonomy in decision-making and autonomy in performing tasks. In a study by Defraktyka and Morawski (2019), we read that flexible working hours (27%) are important to the Zetas when choosing a workplace. These issues, particularly related to flexible working hours, are consistent with the results of our research, in which we indicate that working representatives of Generation Z show interest in influencing the organization of working time. It is also worth citing the results of a study by Kincentric Poland (2022), which indicates that Zets appreciate the freedom to choose how they do their work and greater flexibility in their role, understood, for example, as mobility between jobs (68%), and it is also important to match tasks to their skills and needs (57%). They also value it when the organization they work for allows them to experiment and learn from their mistakes (51%) and allows them to develop ideas (40%) with a manager who will encourage them to present their solutions (58%).

Kostro cites business practices to engage younger generation employees in the affairs of the organization. He is referring to giving a sense of influence, providing flexibility in the role or, finally, inclusion in the creation of a "better world," which involves a certain amount of autonomy.

7. Summary

Workers' freedom of action, self-reliance and autonomy are very important elements. An analysis of the literature provides evidence that employees who have the opportunity to do work in small groups show greater loyalty and personal responsibility for each other's commitments, which determines better performance. Companies with highly engaged employees perform better than companies with the most unengaged people - by 54% in terms of employee retention, by 89% in terms of customer satisfaction and by four times in terms of revenue growth (Pytel-Kopczynska, 2019). It is therefore necessary to build a work environment that meets the expectations of employees and at the same time expects and rewards commitment. The cognitive value of the article stems, from its unique approach to the construction of the survey, which asked not only what is important to the respondents, but also what is unimportant. In this way, a picture of essential and non-essential expectations was built.

The data analysis was carried out not only by year of birth, but also by work situation, which highlighted some difference in declared expectations.

The practical value is in answering how to shape the company's image from the perspective of participation in decision-making activities among Generation Z. The leading results indicate that people born before 1996 show a willingness to be involved in decision-making. However, this is not so clear-cut. The survey indicated that working people among those surveyed value their autonomy more, which is expressed in the fact that they want to participate in decision-making processes that directly affect them. They avoid activities they assess as unproductive.

Limitation - the sample is not representative, there is a large imbalance between representatives of generation Z and those born before 1996, hence the conclusions can only be a guide, not a paradigm. The representation of Generation Z is significant subtracting 234 people. The survey was built on 0/1 responses, which has its interpretive limitations. The cognitive value is limited to those with higher education.

Directions for further research should address the possibility of shaping EB in specific groups of recipients of this message. The research shows that in the analyzed area there is a diversity of expectations across both the age of respondents and their employment status.

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ANALYSIS OF GENERATION Z EXPECTATIONS IN THE CONTEXT OF EMPLOYEE RETENTION

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Purpose: The purpose of the article is to identify those aspects of organizational functioning that are not attractive to representatives of Generation Z.
Design/methodology/approach: We conducted the survey among 234 students of the Wroclaw University of Economics. The sample was purposive, with respondents born after 1996 taking part in the survey. The questionnaire consisted of a section identifying the demographics of respondents, including age, gender, work situation. The main part of the survey consisted of closed-ended questions, where, among the suggested answer options, respondents were asked to indicate the five factors that matter least to them at work.
Findings: In our research, we recognized that for young employees it is not important to fulfill such needs as: formal procedures for expressing opinions, functioning of trade unions, outplacement, organizing team-building events or mentoring support.
Research limitations/implications: A limitation of our study is the acquisition of results from students at only one university. Our research was a pilot study. In the first instance, we wanted to validate the research tool.
Practical implications: Knowing the expectations and reasons why the younger generation is not engaged in work can be useful in the process of making personnel decisions by various actors, e.g. leaders, managers and recruiters. The results can also be inspiring for people dealing with employer branding strategies. Awareness of factors that are not important for Z can lead to taking appropriate actions, including, among others, recruitment, personal marketing or retention programs. The benefits can concern both image aspects and budget savings.
Originality/value: Working with Generation Z is becoming a challenge for today's leaders. This generation is perceived as extremely demanding, difficult to cooperate with; Zetas are attributed with a lack of loyalty, a loose approach to work. The value of our article is to look for factors that are irrelevant to building engagement with the younger generation. While other researchers have focused their hypotheses around important/satisfying factors.
Keywords: Generation Z, trade unions, outplacement, formal expression procedures, team building events, mentoring, retention.
Category of the paper: Research paper.

1. Introduction

Attracting and retaining talented employees has always been a challenge for companies. Research has repeatedly confirmed that while salary and benefits are important, money alone is not enough to successfully attract and retain qualified personnel, especially in the face of alternative job offers (Aburub, 2020,) and a growing trend of people leaving organizations (Rakic, Zivkovic, 2020,). Organizations are increasingly aware of the key factors influencing the attractiveness of employment (Muster, 2020; Tomaszuk, Wasiluk, 2023). Nevertheless, they often lack effective implementation of this knowledge in practice. The gap between theory and practice is due to the need to adopt a systemic approach, which is becoming increasingly difficult to design and implement in a dynamic business environment. Under these circumstances, the problems of employee retention and engagement are ranked among the most important and urgent issues (Aburub, 2020).

A strategy for retention activities can involve identifying employees who are key to the organization's competitiveness and developing dedicated retention programs for them. In such an approach, the organization creates and develops internal human resources, tailoring retention activities (e.g., development or salary programs) to their needs and expectations (Skowron-Mielnik, Bor, 2015). It is worth asking whether, in the case of representatives of Generation Z, this approach will prove sufficient/justified?

Generation Z, in the view of many employers, is perceived as extremely demanding, difficult to work with, and requiring a change in the management methods previously used. Zetas are attributed with a lack of loyalty, a casual approach to work. All this makes cooperation with the younger generation a challenge for today's leaders. The literature emphasizes that this is a very diverse generation, nevertheless, it is possible to attribute to it some characteristic features such as mobility, flexibility, multitasking, being constantly "online" (Kukla, 2010), openness to new experiences, creativity, among others (Wiktorowicz et al., 2016). It is often heard that the younger generation rejects the cult of work characteristic of earlier generations and treats work as an "add-on" to life, rather than an end in itself.

This results in the need for frequent modification of retention programs. Therefore, it is also important to recognize those factors that - from the perspective of shaping engagement - are perceived as less important. While research typically focuses on the positive aspects of an employer's performance, our goal is to explore areas marginalized by Generation Z.

2. Characteristics of Generation Z in the context of expectations from the employer

Generation Z (born after 1996) are the youngest participants in the labor market. By their general sensitivity, Generation Z is called the snowflake generation. This comparison stems from the Zets' belief in their uniqueness but also their difficulty in accepting criticism about themselves, making it easy to offend representatives of this generation (quite like snowflakes, each of which is different and very delicate) (Konkel, 2023).

This generation is distinguished by multitasking, freedom in the use of modern technologies, the ability to quickly search and process information. A large proportion of its representatives are fluent in at least one foreign language and have a high degree of both professional and spatial mobility. Zetas are creative, communicative and able to work in a group (Muster, 2020). Zetas believe in diversity, value equality and the absence of broad discrimination (organizational, social, etc.). They are quite optimistic, driven by personal ambitions (Dadić et al.). Gocłowska points out that for the Zetas it is passion that matters most, the most important thing is that they can do things they love and to which they can devote themselves fully and happily. For Generation Z, work and career are not a priority, an end in themselves; rather, they are a means of realizing non-work goals and values that are important both in their private lives and in their social activities (Higher School of Humanitas, 2023). Generation Z adheres to the principle that if not this job, then another. Thus, if working conditions do not meet their expectations, they do not hesitate to leave. They consistently pursue this attitude, looking for organizations that meet their expectations (Śliwińska). Their approach is dominated by pragmatism and unscrupulousness. Mahmoud and colleagues (2021) point out that work should enable Zetas to achieve personal satisfaction, which, according to Zylowska (2022), is strongly correlated in this group with the importance of leisure time (for regeneration and rest from work), since fatigue and routine in the long term can lead to job burnout, which this generation explicitly avoids. When choosing a workplace, Zetas pay attention to the management style adopted in the organization. Their specific expectations and perceptions of the labor market force managers to make significant changes (primarily internal) to meet these demands and become an attractive employer for them (Kotter et al., 2022).

3. Methodology

We conducted the survey among 234 students of the Wroclaw University of Economics. The sample was purposive, with respondents born after 1996 taking part in the survey. They were students of the Faculty of Production Engineering (part-time, first-year graduate

studies). Women accounted for 72% and men for 28% of the respondents, 45% of the respondents were not economically active, 55% were working. The survey was prepared in MS Forms. The questionnaire consisted of a section identifying the demographics of respondents, including age, gender, work situation. The main part of the survey consisted of closed-ended questions, where, among the suggested answer options, respondents were asked to indicate the five factors that matter least to them at work. Among these factors were: Safe and sanitary working conditions; Wages adequate to the duties performed; Employment protection; Protection (security) of social benefits; Training at the employer's expense; Good atmosphere in the workplace; Efficient flow of information "top-down", "bottom-up"; Empowerment; Equal treatment; Influence on the organization of working time; Assistance from superiors and co-workers; Health benefits at the employer's expense; Functioning of labor unions; Assistance with layoffs (outplacement); Transparent rules for promotion; Formal procedures for expressing opinions; Adaptation programs for new employees; Organizing team-building events; Informing on important issues concerning the functioning of the company; Participation in decision-making processes; Organizing meetings, gatherings with the crew; Providing assistance to employees in difficulty; Mentoring programs for employees.

4. Results

Respondents were asked to identify the workplace expectations that matter least to them. As can be seen in Figure 1, these factors included: functioning of unions (65%), organizing team-building events (58%), formal procedures for expressing opinions (47%), assistance with layoffs (outplacementnet) (45%), mentoring support (37%).

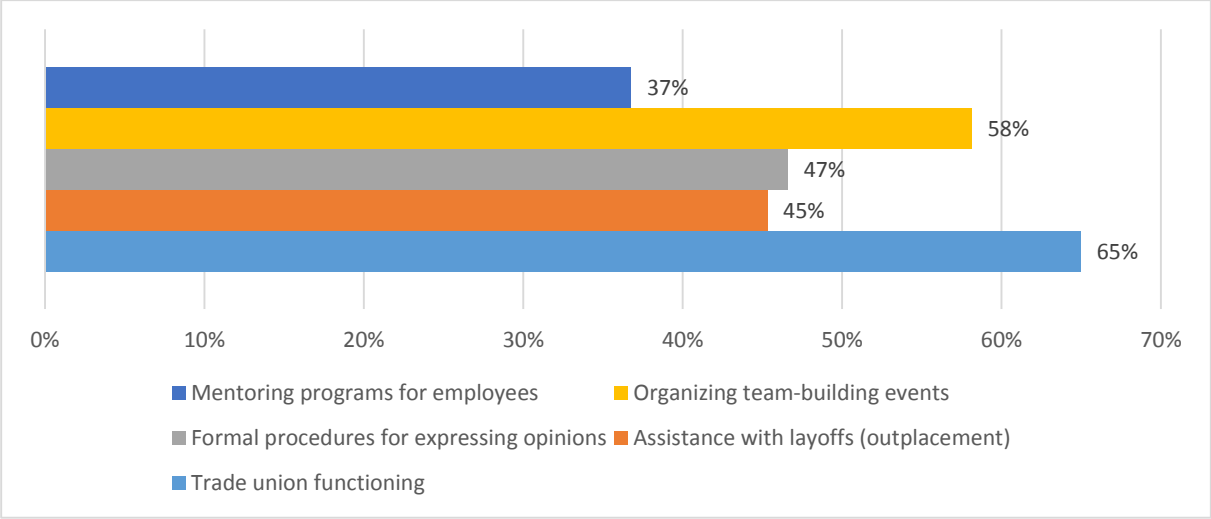


Figure 1. Factors that matter least to respondents.

Source: own study.

As can be seen in Figure 2, the least attractive to respondents of both sexes turned out to be the functioning of trade unions (indicated by 65% of women and men). Organizing team-building events was indicated as unimportant more often by women (63%) than by men (45%). Formal procedures for expressing opinions and assistance with layoffs received indications at a similar level in both groups (about 45%). Slightly more men (42%) rated the importance of mentoring as unimportant than women (35%).

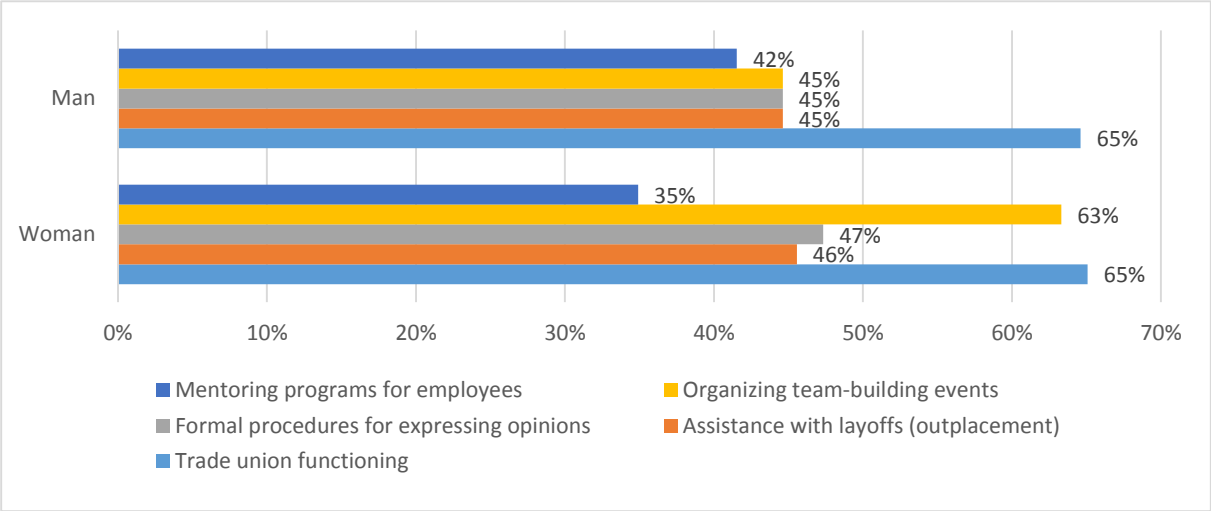


Figure 2. Factors that matter least to respondents - gender perspective.

Source: own study.

Figure 3 takes into account the perspective of labor activity. As can be seen, both working and non-working respondents indicated the low importance of the functioning of labor unions (68% of working and 61% of non-working) and the organization of social events (58%). Interestingly, more working respondents (52%) indicated the low importance of outplacement than non-working respondents (38%). The need for mentoring and formal expression of opinions received similar indications in both groups.

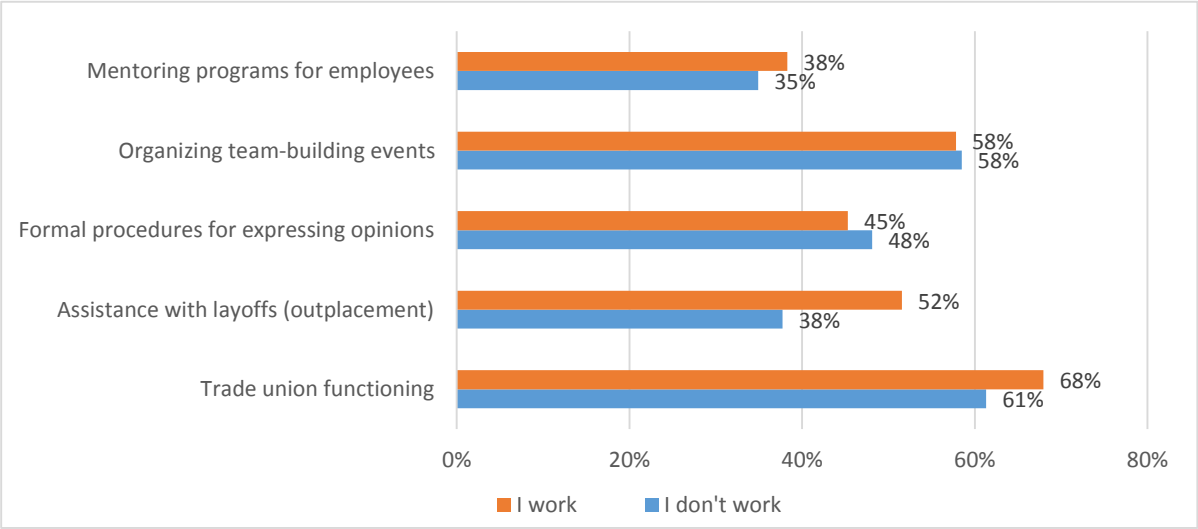


Figure 3. Factors that matter least to respondents - perspective of work situation/activity.

Source: own study.

5. Discussion

Numerous studies emphasize that Generation Z are people who place personal life goals above career. They expect that work will not hinder them from achieving these goals, but, on the contrary, will support them. A study by the Institute for Labor Market Analysis (2023) reads that the most valued values in their lives are happiness (62%), family (60%), the opportunity to pursue passions (56%), ecology (51%), independence/freedom (51%), health (44%) and love (37%). Zetas expect employers to understand their life priorities, share their value system, and support them in non-work activities (social, civic or charitable). As you can see, these are values not directly related to the professional sphere. It seems that building their commitment should be accompanied by integrating these values with different areas of professional activity. Żarczyńska-Dobiesz and Chomątowska (2014) indicate that more than 50% of the young people surveyed do not want to work in corporations, "get stuck in them", "be absorbed by them". A report by the Higher School of Humanitas (2023, p. 10) says that among the factors that can discourage a Zetka from taking up employment in a company, the incompatibility of the company's mission with the job candidate's personal values (63%) is an important one. Only the answer "unclear job profile" received more indications (71%). This was followed by the answers "high competition" (43%), lack of information about working conditions in the job advertisement (40%) and negative opinions about the organization (33%).

In our research, we tried to capture aspects of the organization's functioning that were not of interest to the Zetas. These included: formal procedures for expressing opinions, the functioning of unions, assistance with layoffs, organizing team-building events and mentor support. Generation Z seeks employers with whom they can realize visions that are in line with their values, and their ideas and solutions are implemented, which fosters their growth (Kincentric, 2022). However, they prefer direct contact with their superiors instead of formal procedures. According to the report "Zoomers at Work", (Piotrowska) they want to be heard, have a say in reality and discuss their work face to face, with 18% of respondents indicating that a good relationship with their supervisor leads them to stay with a company for more than two years.

Trade union functioning

The low level of respondents' interest in the functioning of trade unions, we have established, is surprising in the context of reports of growing awareness of the need for them; labor law expert and deputy chairwoman of the Labor Protection Council at the Polish Parliament Barbara Godlewska-Bujok (2024) says that "there is a visible revival around this topic; young people in particular are moving toward unions and believe more in their sense and strength". Representatives of Generation Z are increasingly joining unions because they want to be treated as partners, do not agree with violations of rights and assertively do not accept

everything imposed on them by their employer. People employed in services, trade, e-commerce often join nationwide trade unions, which, according to the cited expert, is a consequence of the servitization of the economy, the high percentage of young people among service sector workers, the spread of contracts other than the labor contract. The need for union protection is evident among young workers on digital platforms (e.g., couriers, food deliverers, translators, copywriters); gaming workers have also established their own union (pracuj.pl). Against this background, how can we explain the indications of our respondents? Perhaps it is due to a lack of negative experiences in relations with employers, insufficient education about the role of trade unions in enforcing employer obligations, and limited awareness of the causal power and potential effectiveness of these organizations in holding employers accountable for their promises.

Assistance with layoffs

Our research revealed the low importance of outplacement. This alludes to the characteristics of Generation Z described in the literature, which shows that this generation initiates job changes on its own and is not afraid of possible layoffs; it believes that some form of professional activity will always be found. The study "Generation Z at work", conducted on a group of 226 respondents, aged 18-24, reads that 58% of representatives of the surveyed generation (professionally active) predict that they will change jobs at least several times in their careers, 53% believe that they will do several different jobs during their careers, 51% indicate that they do not want to spend their entire career in one job (ARC Market and Opinion, 2024). The literature indicates that educational exchanges have prepared Generation Z for mobility in terms of work as well. Labor migration is natural, and choosing between employment in Poland and abroad is not a problem for young workers (Bartkowski, Pytlak, 2024).

Organizing team-building events

Also, organizing social events has proved unattractive to Zetas. Meanwhile, a study by the Higher School of Humanitas (2023) indicates that, contrary to common stereotypes, Zetas do not avoid building social relationships. On the contrary, it notes the need to establish and develop such ties at work, both in relationships with co-workers and superiors. Experts involved in organizing such events indicate that traditional team-building trips are losing their appeal and do not make sense for a generation that values its time. After all, Zetas expect more personalized and authentic experiences that bring them tangible benefits and give them a sense of purpose (Staszewska), and offer more than just passive participation. They are looking for excitement, adrenaline and true engagement (Eventivo).

Mentoring

The last place in the ranking of least important factors was taken by mentoring programs. Such a result can be explained by the short tenure of our respondents and the willingness of Zetas to change employers frequently, as shown by other researchers (Śliwinska, 2023). In the context of retention, it becomes a challenge to have an adequately prepared workforce that could and was willing to take on this extremely difficult role of being a mentor, as research on the demand of Generation Z representatives for mentoring support (Pietroń-Pyszczek, Borowska, 2022) shows that one in two respondents needs a mentor, and that more than half of all respondents have no knowledge of who could help them realize their own career vision.

6. Summary

The literature primarily presents studies showing what the young generation expects. In our research, we pay attention to those aspects of work that, in the optics of Generation Z, are not conducive to building their commitment. Nowadays, the problem of retaining valuable employees in the organization is observed. Bearing in mind that Generation Z will dominate the market in the coming years, it is worth prioritizing issues related to their retention. After all, as indicated in the literature, their loyalty (considered as the desire to stay in the organization) depends on the satisfaction of their needs. In our research, we recognized that for young employees it is not important to fulfill such needs as: formal procedures for expressing opinions, functioning of trade unions, outplacement, organizing team-building events or mentoring support. Generation Z values freedom, including that related to how to influence decisions in the company. Addressing their needs in this regard, rather than formalized forms of expression, should include greater accessibility to management where face to face opinions can be expressed. It seems that the low ratings of outplacement are due to the young generation's lack of bad experiences with layoffs. On the one hand, they themselves very often change jobs, on the other hand, a large number of representatives of this generation still live with their parents, so periods of unemployment are not so severe, as they can count on family support. Therefore, it is worth continuing research in this area, when the Z generation will have longer work experience and the first negative experiences of job loss. The Zetas also attribute little importance to trade unions. On the one hand, this fact is not surprising, since the heyday of these entities coincided with the functioning of much older generations in the market. Perhaps the expansion of union activities, for example, to include so-called "green aspects" would increase their attractiveness. On the other hand, however, Generation Z tends to be interested in wages commensurate with their duties, which is also known to be a concern for trade unionists. This may suggest that the younger generation does not have full knowledge of the

activities that unions undertake. Interestingly, respondents also gave low marks to organizing team-building events. It seems that if they were to serve the purpose of keeping the Zetas in the organization, it would require management to adopt a different form of organizing them than before. Traditional team-building meetings, it seems, do not fit in with the needs of the younger generation, which is definitely more in need of personalized activities. With regard to mentoring programs, we think that this area would require more in-depth research, as it was characterized by the lowest indications of respondents (it was apparently lower than for the other factors analyzed). At the same time, we read in the literature that the young generation, due to their relatively high dependence, requires help and support in the workplace; the relationship between leader and employee is important, which influences the Zetas' job satisfaction and desire for long-term employment.

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INVESTMENT RISK MANAGEMENT: CONTEMPORARY APPROACHES TO RESPONSIBLE INVESTING IN THE REAL ESTATE MARKET

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Purpose: The research examines how Responsible Property Investment (RPI) functions as a risk mitigation tool for commercial real estate properties while emphasizing environmental, social and governance criteria. The research focuses on Polish property companies during times of market instability and rising regulatory requirements regarding ESG and sustainability.
Design/methodology/approach: The research followed three stages and included examining 100 major Polish real estate firms' investment strategies through desk research and conducting qualitative interviews with industry professionals and a CATI survey of 54 firms with majority operating in Poland for more than 15 years. The survey collected both numerical and descriptive information about investment choices and sustainability practices and ESG integration.
Findings: The research shows that more than half of the surveyed organizations recognize RPI as a risk management approach, but its implementation varies across different companies. The drivers for companies included factors like regulatory compliance and energy efficiency and formal certifications while social aspects of sustainability received less attention. The study revealed also that greenwashing practices such as selective market reporting and symbolic actions were common among property investors. The research data demonstrates that ESG principles have become mainstream but actual change remains blocked by poor implementation and insufficient social oversight.
Research limitations/implications: The research study focuses on companies investing in the Polish real estate market. Future studies could analyse how investor education along with policy development affects RPI adoption rates across different property sectors and cities worldwide.
Practical implications: The research demonstrates that better regulatory oversight together with improved investor education and standardized sustainability metrics are essential. Companies need to synchronize their internal plans with changing ESG standards to protect their reputation and maximize long-term asset worth.
Social implications: The increased adoption of RPI will lead to better urban sustainability and improved community well-being. The current investment practices demonstrate weak community involvement and insufficient social elements in their strategies which requires both policy changes and stakeholder participation.
Originality/value: The research provides a knowledge regarding RPI elements and their application as investment risk management tools in the real estate market. The research demonstrates RPI's strategic importance while adding to the discussion about sustainable development and most recent regarding ESG.

Keywords: responsible property investment (RPI), ESG, risk management, greenwashing, real estate sector.
Category of the paper: Research paper.

1. Introduction

Over the past decade, market risks have increased in complexity and social and environmental responsibility is now a significant concept within the real estate industry. Global markets, the real estate investors had to rethink traditional risk assessment frameworks in an economy of volatility, climate change risks, and changing stakeholder expectations, and therefore, social and environmental responsibility had to be incorporated as crucial components of investment strategies. Also environmental, social and governance criteria are no longer a niche approach that is integrated into investment decision-making, but a strategic necessity, which is motivated by regulatory changes, investor expectations, and societal needs for sustainable development. In essence responsible property investment (RPI) is the pursuit of financial performance while advancing environmental protection and social responsibility (Pivo, McNamara, 2005). RPI can enhance not only financial performance, reduces operational costs, mitigates environmental and regulatory risks, improves tenant satisfaction, increases asset value, and provides access to green financing and incentives while promoting long-term sustainability (Sayce, 2013; Newell, Marzuki, 2022).

The adoption of RPI in the real estate market is mainly manifested in the form of green buildings, which are certified in systems like the Building Research Establishment's Environmental Assessment Method (BREEAM) and the Leadership in Energy and Environmental Design (LEED) (Belniak, Głuszak, Zięba, 2013; Brodowicz, Pospieszny, Grzymała, 2015). Yet, it is important to stress that there are numerous concerns about greenwashing, as well as compliance with environmental, social and governance (ESG) principles or simply going beyond only green buildings (Areco, 2023; Siemińska, 2023). This article investigates the interaction between risk management, responsible property investment (RPI) and environmental, social, and governance (ESG) criteria, and their impact on investment decision making in the commercial real estate sector. Based on empirical data from a study of real estate firms in Poland, this research adds value to the risk management discourse by offering insights into how investors steer through changing market challenges while embedding sustainability principles into their plans.

2. Managing Risk and Responsibility in the Context of Property Investing

The integration of environmental and social risk management in the commercial real estate sector has received much attention as all types of risks are addressed while complying with the principles of RPI and most recently with ESG criteria. In this context, this literature review aims to discuss only key areas of risk management in real estate and how they are related to RPI. Investment in the commercial real estate sector is always accompanied by various risks such as market risk, financial risk, operational risk, reputational risk, and purchasing power risk (McNeil, Frey, 2005; Hopkin, 2010; Siemińska, 2013). Market risk is one of the most common risks in economic activities and can include factors beyond the control of market participants such as natural disasters or changes in economic conditions that are averse to property values (Fraser, Simkins, 2010; Bryx, 2021). This is because property investors, especially in the commercial sector are usually dependent on the funding from other sources including banks Interest rate risks, liquidity risks, or difficulties in the flow of funds are major risks that can jeopardize the investments (Vose, 2006; Siemińska, 2013). Reputational risks have also become more important with growing interests of stakeholders in social and environmental responsibility (Brodowicz, 2017). Focus on sustainability and compliance with environmental standards has expanded the risk scope and this applies to all property sectors, including housing (Bryx, 2021). For instance, the Green Real Estate Financing Market Report (2024) lists regulatory factors, such as the sustainable finance initiatives of the European Union, as the main factors that determine risk in property investment (Saari et al., 2024). Therefore, risk management cannot be based only on the financial analysis but must include an assessment of environmental impacts and social implications of property investment in specific location.

Already in 2005 one of the pioneers of RPI, Gary Pivo, identified this concept as a key strategy in the real estate industry that seeks to balance investment returns with social and environmental bottom-line. This approach goes beyond the normal investment practices to include sustainability in the investment decision. Some of the aspects of RPI include energy conservation through building, waste management (Schueth, 2003) other go far beyond and include social considerations (Brodowicz, 2017; Newell, Marzuki, 2022). RPI is defined by its focus on long-term investment performance that is advantageous to the investor and society, or more specifically local communities and stakeholders directly affected by the investment. Properties that meet the green building standards such as LEED and BREEAM certifications have been seen to have a better financial return than those that do not (Belniak, Głuszak, Zięba, 2013). This includes lower operating costs due to energy consumption and higher levels of tenant satisfaction that mean lower vacancies. A study by Jamaludin and Razali on real estate firms revealed that companies that embrace RPI not only have financial gain but also improve their competitive standing to meet the changing market demands of sustainable properties (Jamaludin, Razali, 2024). The importance of green buildings in RPI is evident since sustainable

construction is known to improve property value and reduce the adverse impact on the environment (UNEP FI, 2016). Recent studies show that the integration of social responsibility and environmental stewardship into property investment decisions is not only the right thing to do among entities operating in the EU but is required by financial institutions (European Commission, 2021; EBA, 2025). Risk management, RPI and ESG frameworks are converging, and this is becoming a major issue in the commercial real estate sector. At present, ESG is critical in the management of long-term risks such as climate change, social changes and changes in regulations (Galkiewicz, Wollmann, 2023). The Sustainable Real Estate Development survey conducted in 2023 shows that the adoption of ESG increases investor confidence, the accessibility of capital and compliance with environmental standards (Haryani, Anjani, 2023) which are also part of RPI principles. However, the market also has its negative phenomena, which are usually referred to as greenwashing. This is the practice of companies or organizations harming the environment and at the same time trying to portray themselves as environmentally friendly to the consumers through their products, policies and initiatives.

3. Materials and Methods

To investigate the challenges to implementing RPI the study was divided into three, interconnected stages throughout the 2024. First, the desk-top research regarding the strategies, projects and investment plans of leading property investors active in Polish cities was conducted between February and April leading to the identification of 100 large and medium size enterprises investing in commercial real estate market in Poland. Secondly, over a dozen of interviews with real estate professionals was conducted by the researcher between May and June to identify major, contemporary risk and challenges connected to property investing with a specific focus of social and environmental issues. Thirdly, based on the secondary and primary data gathered in first two stages, a survey was conducted among leading real estate investors between August and October.

Survey data collection was done through telephone interviews, specifically Computer-Assisted Telephone Interviewing (CATI). The survey was directed at one hundred real estate investment companies that were very active in the Polish urban property markets. These firms were recognized from market reports from big real estate consulting firms including Jones Lang LaSalle (JLL) and CBRE, which provide analysis of real estate markets worldwide, including Poland. Out of the one hundred companies contacted, fifty-four firms participated in the survey, thus achieving a response rate of 54% (N = 54). The sampling technique was made on firms that have engaged in large format commercial and residential developments in the major Polish cities included Skanska, Yareal and Ghelamco. The survey was administered by the research laboratory specializing in CATI, based on 17 questions and contacts to 100 investing companies

provided by the author of this article. The questioner was in multiple choice format where the respondents were to pick from the options provided but were also free to offer feedback. This approach was useful in providing both quantitative and qualitative data on the investment strategies, sustainability practices, and decision making of the surveyed companies. With a systematic survey with CATI, the study ensured that data collected was accurate and that comparison between different responses was possible, to provide an assessment of responsible investment in the Polish real estate sector.

4. Results and discussion

In the first stage of the study, an investigation of real estate investors from the Polish real estate market was made, and an analysis of websites, market reports, and media coverage was done. This phase was to examine the current state of play regarding RPI and its presence within the market. The second phase of the study was to gather insights on the risks and challenges of investing in real estate. It was done through interviews with over a dozen property professionals, all focusing on green buildings, social responsibility, environmental responsibility, and the role that sustainability plays in investment decisions.

A major finding from these interviews was the perception of RPI as risk management tool and a very strong willingness to use it as a support mechanism when getting ready for ESG reporting. Moreover, both positive and negative cases of RPI were presented, and doubts were raised as to its possible abuse, which is often called “greenwashing”. In connection with the results of the first and second stages of the research, the third stage was carried out. This phase included a CATI study to quantitatively examine the role of RPI as a risk management tool, the relative importance of various aspects, and possible misuse in the real estate market.

All participants of CATI have been provided a definition of RPI which is an investment approach that integrates environmental, social and governance factors into investment decisions. The purpose of this is to generate sustainable value, considering the long term social and environmental impacts along with the financial returns. Some of the key aspects include environmental management, social equity and ethical governance, thus supporting sustainable and fair urban development while reducing investment risks for real estate market entrepreneurs. The firms that were selected for the study have been operating on the Polish market for more than 15 years. Furthermore, 50% of them were large enterprises with more than 250 employees and more than one-fourth were representatives of companies with 50-250 employees. The data shows (see Fig. 1) that most of the surveyed companies (53.7%) regard RPI as risk management tool, in line with the concept that sustainability is part of risk management strategies in the real estate sector. Nevertheless, the result shows that 38.9% of

respondents are not sure what their company's position is on this issue, which may be related to lack of knowledge or clear definition of investment strategies within organizations and as it was stated in numerous interviews from stage one, with strong shift towards ESG with weaker interest in RPI itself. The results also show that only 7.4% of respondents rejected RPI as a risk management tool.

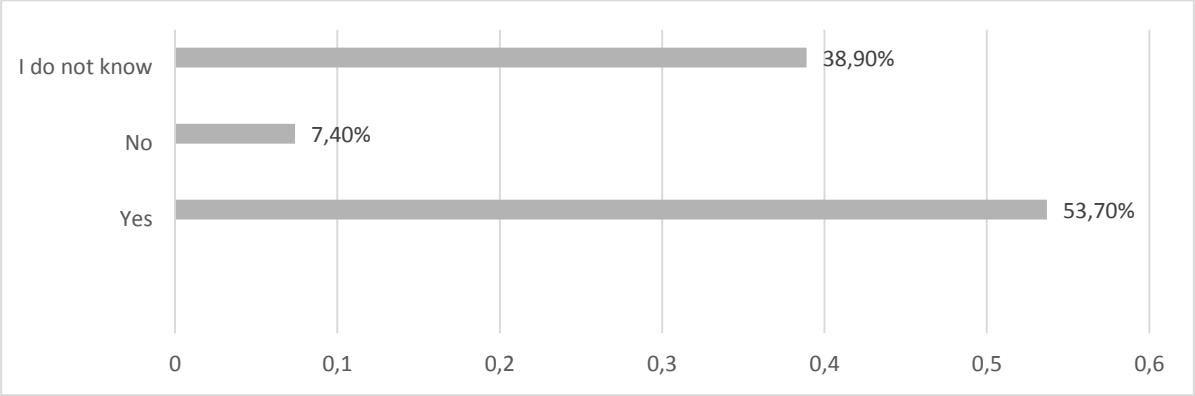


Figure 1. Use of RPI as a risk management tool.

Source: own elaboration based on conducted research.

The analysis of the importance of RPI aspects for a company's investment strategy provided insights into the perceived importance of the various factors associated with RPI in the decision-making process (see Fig. 2). The data revealed a distinction in the emphasis placed on different sustainability-related factors, especially regarding ESG factors.

The most important factors from a strategic point of view were the degree of investment compatibility with building standards, which was evaluated as highly important by half of the respondents; energy efficiency of the implemented investment, which was assessed as highly important by around 4 in 10 respondents and as a determining factor by over one-third; and the realization of environmental certifications, including ISO 14001. A little over one-third of respondents said that the actual implementation or the processes which are currently in progress for environmental protection certification are of high significance. However, 50 per cent of them argued that it is crucial. These results show that legal requirements, formally established sustainability processes and certifications are the primary drivers of investment decisions – given the existence of legal requirements and the increasing focus on sustainability reporting.

In addition, the strong presence of energy efficiency in investment choices highlights the sector's recognition of long-term operational cost optimization and environmental benefits as critical drivers of responsible investment. Social aspects of sustainability were not as clearly understood in terms of their significance. Community engagement in investment planning and project development was considered highly significant by nearly half of the respondents, but only around 1 in 20 viewed it as a decisive factor. In the same manner, sustainability-based tenants and buyers' attraction was considered highly significant by over one-third of respondents, but decisive by only fewer than 1 in 10. This showed that although survey

participants were aware of the advantages of power sharing in decision making, it was not as critical as legal requirements or financial returns. A significant phenomenon was observed in the integration of ESG factors into investment decisions and compliance with the EU taxonomy, which was considered highly significant by close to 4 in 10 respondents, while only around 1 in 20 saw it as a decisive factor. This aligns with the increasing institutionalization of ESG standards in investment frameworks that are also consistent with other market trends targeting sustainable finance regulations and climate impact risk management. Nevertheless, the role of ESG factors as drivers of action is not as straightforward as it seems, indicating that investors are still in the process of moving from compliance to sustainability leadership.

The data overall showed that compliance, efficiency and formal certification were the dominant RPI themes. The results of the study show a slow but asymmetric integration of ESG principles, which indicates that regulatory incentives, investor education, and market signals will need to be further enhanced to drive the strategic effectiveness of sustainability actions in the real estate sector. This is especially important as not all real estate investors are listed on a stock exchange or must comply with ESG principles, and some reporting is voluntary.

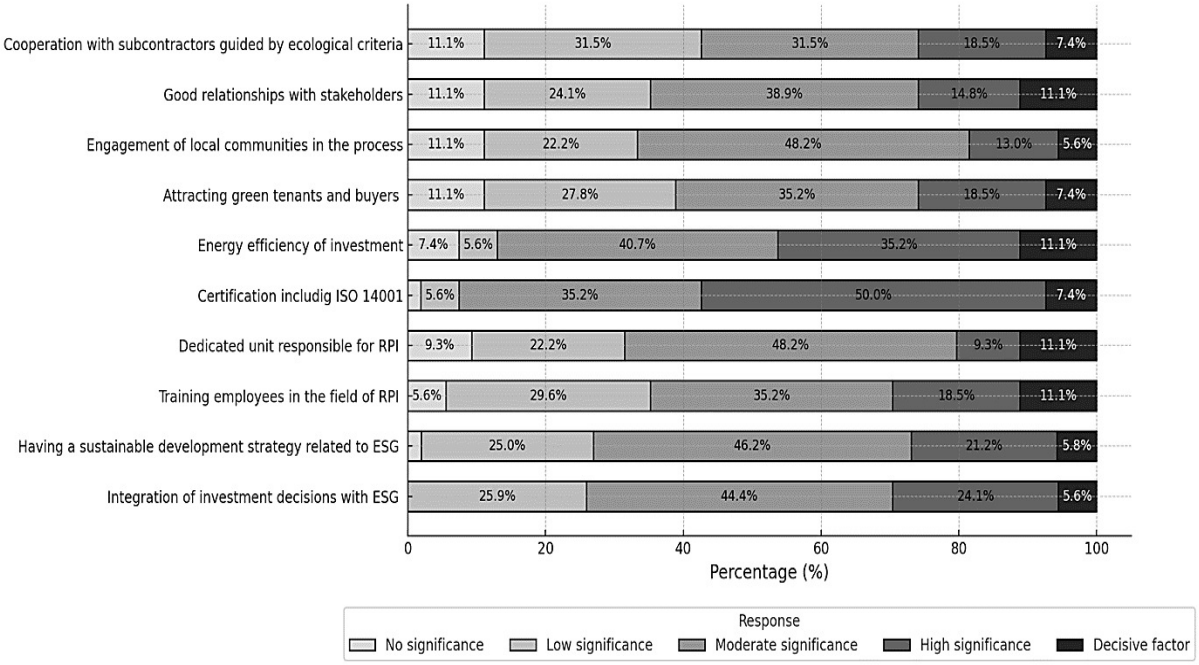


Figure 2. The importance of RPI aspects for company's investment strategy.

Source: own elaboration based on conducted research.

Following the issues raised during the second stage of the study, the problem of greenwashing among property investors was investigated further in CATI (see Fig. 3). The data showed that selective reporting and the exaggeration of results are the most common forms of greenwashing. Nearly 3 in 10 respondents rated selective reporting as moderate, about 1 in 8 as high, and fewer than 1 in 10 as the primary form of communication. For instance, one-third of respondents reported that exaggerated claims occur with moderate frequency, nearly 1 in 5 saw

them as frequent, and around 1 in 20 considered them exclusive. This means that many investors only present the positive environmental aspects of their projects while not showing or downplaying the negative aspects.

Another important problem was the use of symbolic initiatives, which do not have a significant impact overall, such as planting trees or installing bike racks. Such initiatives, according to the respondents, are reported to happen infrequently by 20%, moderately by 25%, and frequently or only by less than 10%. This implies that investors could have more interest in the image-based RPI initiatives than in the real environmental responsibility. Furthermore, the results indicated that investors tend to overlook the life cycle of buildings. The results also showed that 1 in 5 respondents agreed that this only happens rarely, over 1 in 4 said that it happens moderately, and fewer than 1 in 10 stated that it occurs frequently or exclusively. This omission gives a false impression of sustainability since the long-term environmental impacts of construction, demolition, and material sourcing are not captured (often referred to as the cradle-to-cradle approach).

A particular issue that came up during the data analysis was the use of misleading advertisements. The CATI study found that 1 in 5 respondents employed misleading advertisements occasionally, another 1 in 5 used them moderately, and about 1 in 20 used them frequently or exclusively. This suggests a need to investigate further the reasons behind the use of such advertisements. Green visuals and terminology are often used to give the consumer a positive perception without the actual implementation of such solutions. This raises concerns about regulatory oversight and the need for more stringent standards regarding the accuracy of sustainability information in real estate advertising. In addition, the data show that social aspects of sustainability are not well captured. The results showed that omitting social aspects was reported to happen infrequently by 1 in 5 respondents, occurred moderately by around 1 in 4, and happened frequently or exclusively by fewer than 1 in 10. Most investors do not involve local communities in the planning process, despite social responsibility being an important aspect of sustainable development. This lack of engagement is consistent with an approach to RPI that focuses more on environmental aspects while being indifferent to social considerations.

The results of the study presented in this analysis show that greenwashing is widespread in the real estate investment industry and that professionals representing this sector see it as a challenge. The data indicate that while RPI and ESG are frequently discussed, actual practices are inconsistent and often superficial. These findings underscore the need for stronger regulatory frameworks and more accurate reporting.

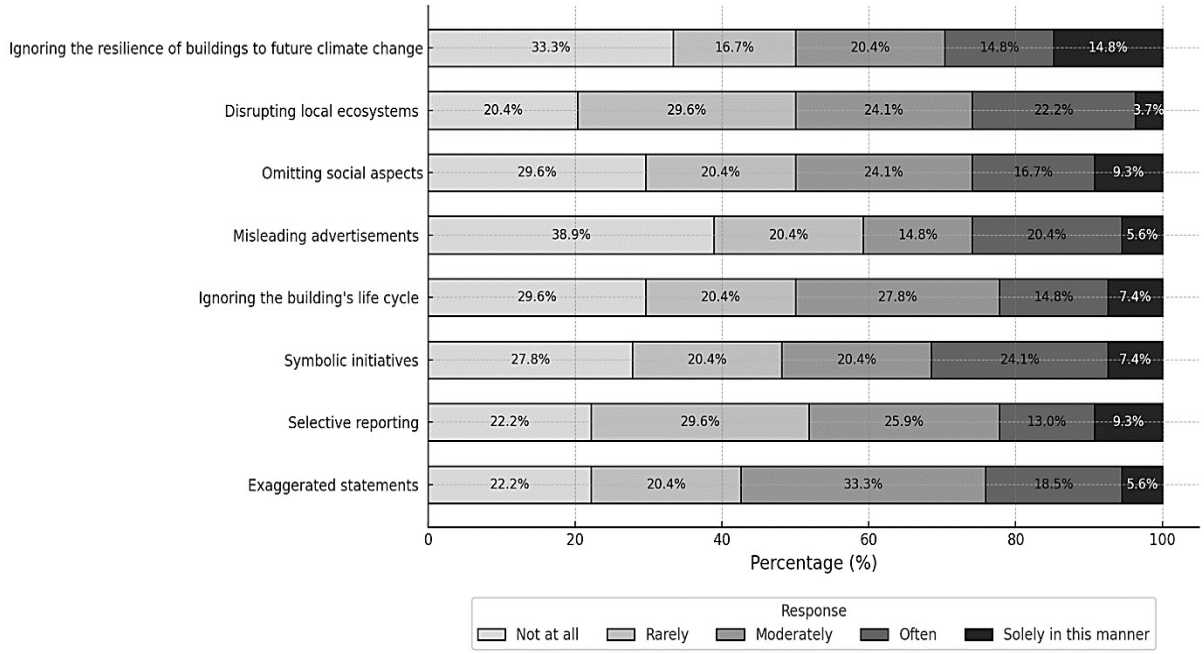


Figure 3. Greenwashing practices among property investors.

Source: own elaboration based on conducted research.

5. Conclusions

The study reveals RPI as a framework that should be used to manage environmental and social risks in the commercial real estate sector. The results show that more and more real estate investors are bringing ESG risk into their risk management approaches and understand the financial and social benefits of green investment. However, there are still many problems regarding integration of RPI and its application as risk management tool. The last conclusion of the study is the polarization of the adoption of RPI principles across real estate firms. Nevertheless, most companies embrace RPI ideas, but many of the organizations are lagging or have not incorporated these concepts into their investment plans. This lack of clarity suggests that internal communication gaps and policy implementation inconsistencies might be limiting the adoption to the wider audience.

The research also reveals the problem of greenwashing in the real estate sector. Responsibility, greening and other broader ESG commitments are often used by investors in their marketing and reporting, but in practice, these commitments are not always backed by real action. Common problems include selective reporting, greenwashing, limited focus on social capital, and lack of accountability for sustainability metrics, thus highlighting the need for better oversight, new and better sustainability metrics, and stronger accountability measures to create real progress in responsible investing. All things considered, the results show that while the overall trend within the commercial real estate sector is towards integration of sustainability

and ESG principles, there is much scope for enhancing the synchronisation of policies with long term environmental and social value. Maturities, sustainability and risk resilience in the real estate market will require therefore stronger regulatory frameworks, improved investor education, and better transparency.

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THE MODAL REGRESSION MODEL AS A MANAGERIAL INSTRUMENT IN LOGISTICS AND MARKETING

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Purpose: The purpose of this paper is to identify possible directions of applications of the modal regression model in enterprise management, with a focus on the areas of logistics and marketing, and to illustrate the use of such model in constructing helpful managerial instruments. The modal regression model serves the purpose of modeling the mode of a given dependent variable conditionally on certain covariates, and, thus, it supplements both the traditional analysis based on modeling the conditional mean and the quantile regression approach. In this paper, we show that this statistical technique can be of help in developing useful decision instruments for logistics and marketing management.
Design/methodology/approach: The paper is based on a review of the relevant statistical literature, conceptual work, simulations, and two empirical studies.
Findings: It is shown that the modal regression model can find uses, among other things, in demand forecasting and logistics planning, optimization of industrial processes, and designing marketing mix strategies. It will enable a direct computation of the demand forecasts minimizing the total logistics cost, modeling the nominal value of an industrial process in a way guaranteeing its high capability to meet the highest quality standards, and building marketing mix models for a target consumer group without the need for market segmentation.
Research limitations/implications: In further research, it will be interesting to investigate possible directions of applications of the multivariate dynamic counterpart of the model studied in this paper, namely, the dynamic vector mode regression, in particular, in discovering the most probable future scenarios for an enterprise.
Practical implications: Our findings suggest that the modal regression model should be popularized among logistics and marketing managers and included in their managerial statistical toolbox.
Originality/value: This paper, for the first time in the literature, draws attention to the empirical modal regression model as a potential instrument in enterprise management and illustrate the use of modal regression in logistics and marketing management. The findings included in the paper should benefit both researchers looking for the most appropriate statistical approach for their research as well as logistics and marketing managers building their decision instruments.
Keywords: modal regression, managerial instruments, marketing mix models, demand forecasting, statistical process control.
Category of the paper: general review, conceptual paper.

1. Introduction

The statistical literature over the past several years has established a formal statistical framework for a new analytical tool – the modal regression model, which serves the purpose of modeling the mode of the distribution of a given response variable or a vector of such variables of interest to the researcher. The concept of modal regression was introduced gradually, starting with linear modal regression for iid (independent and identically distributed) samples (Kemp, Santos Silva, 2012; Yao, Li, 2014) and nonparametric modal regression (Yao et al., 2012; Chen et al., 2016; Yang et al., 2020; Xiang, Yao, 2022), through modal regression for panel data (Ullah et al., 2021) and nonlinear modal regression for dependent samples (Ullah et al., 2022), and ending up with dynamic vector mode regression (Kemp et al., 2020) and the nonparametric estimation of the modal volatility function (Ullah, Wang, 2025).

On the other hand, applications of this concept, especially in economic sciences, are rare and mainly serve illustrating the statistical approach without discussing its merits in economic rational decision-making. Past applications of modal regression in the economic context encompass modeling per capita expenditures on public education in the U.S. (Yao et al., 2012), macroeconomic forecasting and investigating dynamic interrelations between inflation, unemployment, and interest rates in the U.S. (Kemp et al., 2020), modeling house prices in Boston (Yang et al., 2020), modeling the productivity of public capital in the U.S. (Ullah et al., 2021), and forecasting the industrial output in the OECD countries (Bruzda, 2024). As a motivation to introduce modal regression, authors such as Kemp and Santos Silva (2012) indicate econometric analyses serving the purpose of modeling such economic variables as income, prices, and expenditures, which are characterized by positive skewness. These authors also invoke the notion of growth regression, which, according to the researchers dealing with the empirics of growth theory, should fit the majority of the data. As noted by Kemp and Santos Silva (2012), in order to realize this goal, in the absence of appropriate tools for modeling the modal value of growth rates, they rely on robust regression.

Since the author of this paper is not aware of any theoretical or empirical work devoted to applications of modal regression in the fields of management and marketing, this paper aims to fill this research gap and indicate such applications jointly with their advantages and benefits. For this purpose, we present two empirical analyses on data from some publically available databases (as well as a supplementary simulation experiment), which exemplify the use of linear modal regression in logistics and marketing, showing the potential of the modal regression model in developing useful decision instruments for enterprise management. In addition, we also compare the modal and robust regression models, indicating their similarities and dissimilarities.

Further in this paper, the statistical fundamentals of the modal regression model and its relationship with the robust regression model are presented, and the above mentioned example managerial applications are discussed in detail. The last section briefly summarizes the main points of our discussion.

2. Modal regression – the statistical fundamentals

In this paper, we focus is on the linear modal regression model for dependent samples in the following form:

$$\begin{aligned} y_t &= \mathbf{x}_t\boldsymbol{\beta}^T + \varepsilon_t = \beta_0 + \beta_1 x_{1t} + ... + \beta_k x_{kt} + \varepsilon_t \\ Mo(y_t \mid \mathbf{x}_t) &= \mathbf{x}_t\boldsymbol{\beta}^T = \beta_0 + \beta_1 x_{1t} + ... + \beta_k x_{kt} \end{aligned} \tag{1}$$

where $t = 1,2,...$ is the index denoting the consecutive time units, y_t is the dependent variable, $\mathbf{x}_t = [1, x_{1t}, ..., x_{kt}]$ is a vector of independent variables, $\boldsymbol{\beta} = [\beta_0, \beta_1, ..., \beta_k]$ is a vector of structural parameters, $Mo(y_t \mid \mathbf{x}_t)$ denotes the conditional modal value of y_t, and ε_t denotes an iid sequence fulfilling the condition $Mo(\varepsilon_t \mid \Omega_t) = 0$ a.s., where Ω_t is the σ-algebra generated by $\{x_{is}, \varepsilon_r\}_{i=1,...,k, s\le t, r<t}$. Moreover, it is assumed that the conditional distribution of $\varepsilon_t = y_t - \mathbf{x}_t\boldsymbol{\beta}^T$ is absolutely continuous, supported on the real line, and has a well-defined global mode (Ullah et al., 2022). It is allowed that the errors ε_t are conditionally heteroskedastic, and, furthermore, it is assumed that the process $\{y_t, \mathbf{x}_t\}$ is stationary and fulfills certain conditions related to its memory (the so-called mixing conditions).

Having a sample $(y_t, x_{1t}, ..., x_{kt}, t = 1, ..., n)$, in order to estimate the structural parameters, one can solve the optimization problem formulated as:

$$\frac{1}{n}\sum_t \phi_h\left(y_t - \mathbf{x}_t\boldsymbol{\beta}^T\right) \to \max, \tag{2}$$

where $\phi_h(\varepsilon) = \frac{1}{h}\phi\left(\frac{\varepsilon}{h}\right)$, and $\phi(\varepsilon)$ is a smooth symmetric kernel function with a weak maximum at zero, while *h* is its bandwidth parameter (Yao, Lee, 2014; Ullah et al., 2022). Alternatively, the estimation problem can be formulated as (Kemp, Santos Silva, 2012):

$$\sum_i \left\{1 - \gamma\frac{1}{n}\sum_i \phi\left(\frac{y_i - \mathbf{x}_i\boldsymbol{\beta}^T}{h}\right)\right\} \to \min, \tag{3}$$

where $\gamma = \phi^{-1}(0)$. The usual choice for ϕ is the Gaussian kernel, i.e., the probability density function of the standard normal distribution. This is also the choice later in this paper.

In order to obtain consistency for the parameters of the conditional modal line, the bandwidth parameter needs to slowly converge to zero at a certain prespecified rate. Namely, it is required that, assuming $n \to \infty$, it holds $h \to 0$ and $nh^5 \to \infty$. Then, we get (for example Yao, Li, 2014):

$$\left\| \hat{\boldsymbol{\beta}} - \boldsymbol{\beta} \right\| = O((nh^3)^{-0,5} + h^2) . \tag{4}$$

The asymptotic normality result further strengthens the requirements regarding this rate of convergence. Namely, it is assumed that $nh^7 = O(1)$ (Ullah et al., 2022), which leads to the following large sample property:

$$\sqrt{nh^3}\left[\hat{\boldsymbol{\beta}} - \boldsymbol{\beta} - \frac{h^2}{2} J^{-1} K \{1 + o(1)\} \right] \Rightarrow N\left\{0, \nu_2 J^{-1} L J^{-1}\right\}, \tag{5}$$

where $\nu_2 = \int t^2 \phi^2(t) dt$, $J = E\left[f''(0 \mid \mathbf{x}_t)\mathbf{x}_t \mathbf{x}_t^T\right]$, $K = E\left[f'''(0 \mid \mathbf{x}_t)\mathbf{x}_t\right]$, $L = E\left[f(0 \mid \mathbf{x}_t)\mathbf{x}_t \mathbf{x}_t^T\right]$, and $f(\cdot)$ denotes the probability density function of the error term. If $nh^7 \to 0$, the large sample result (5) simplifies as follows:

$$\sqrt{nh^3}\left[\hat{\boldsymbol{\beta}} - \boldsymbol{\beta}\right] \Rightarrow N\left\{0, \nu_2 J^{-1} L J^{-1}\right\}. \tag{6}$$

To solve the optimization problem (2), Yao and Lee (2014) introduced a modification of the Expectation-Maximization (EM) algorithm that iteratively maximizes the expected value of the log-likelihood function. The suggested modal variation of the EM algorithm, called the Modal Expectation-Maximization (MEM) algorithm, in the case of the Gaussian kernel is equivalent to the iteratively reweighted least squares method.

The computational process is as follows. First, it is assumed that we found a good robust initial estimate of $\boldsymbol{\beta}$, denoted $\hat{\boldsymbol{\beta}}^{(0)}$, as an input to the further computation procedure. Then, two types of computation steps, the so-called E-step and M-step, are repeated until convergence. These steps are as follows (Yao, Li, 2014):

E-step: Calculate the weights:

$$\pi\left(t \mid \hat{\boldsymbol{\beta}}^{(k)}\right) = \frac{\phi_h\left(y_t - \mathbf{x}_t^T \hat{\boldsymbol{\beta}}^{(\mathbf{k})}\right)}{\sum_t \phi_h\left(y_t - \mathbf{x}_t^T \hat{\boldsymbol{\beta}}^{(\mathbf{k})}\right)}. \tag{7}$$

M-step: Update the estimates:

$$\hat{\boldsymbol{\beta}}^{(k+1)} = \arg\max_{\hat{\boldsymbol{\beta}}} \sum_t \left\{\pi\left(t \mid \hat{\boldsymbol{\beta}}^{(k)}\right) \log \phi_h\left(y_t - \mathbf{x}_t^T \hat{\boldsymbol{\beta}}\right)\right\} = \left(\mathbf{X}^T \mathbf{W}_k \mathbf{X}\right)^{-1} \mathbf{X}^T \mathbf{W}_k \mathbf{Y}, \tag{8}$$

where $\mathbf{X} = (\mathbf{x}_1, \mathbf{x}_2 ..., \mathbf{x}_n)^T$, $Y = (y_1, y_2 ..., y_n)^T$, and

$$\mathbf{W}_k = \begin{pmatrix} \pi\left(1 \mid \hat{\boldsymbol{\beta}}^{(k)}\right) & & & \mathbf{0} \\ & \pi\left(2 \mid \hat{\boldsymbol{\beta}}^{(k)}\right) & & \\ & & \ddots & \\ \mathbf{0} & & & \pi\left(n \mid \hat{\boldsymbol{\beta}}^{(k)}\right) \end{pmatrix}. \tag{9}$$

In the computations later in the simulation and empirical parts of the paper, the initial estimates in the MEM algorithm are set to those obtained with the robust linear regression estimation with the Huber function.

Yao and Li (2014) also derived the value of the bandwidth parameter h, which minimizes the asymptotic mean squared error (MSE) of the modal regression estimator (see the formula (9) in Yao, Li, 2014). We use this solution in our computations using the usual plugged-in estimates of the elements K and L defined in (5). In nonparametric density estimation, we rely on the method introduced in Botev et al. (2010), as suggested in the Matlab codes for modal regression made available by W. Yao.

3. Modal regression vs. robust regression

Popular estimators of the parameters in a regression equation, such as the least squares method, are sensitive to the presence of atypical observations in data samples. This will take place both when the atypical value concerns a certain independent variable, in which case the so-called high-leverage observation is identified, and when there is an atypical value of the response variable, in which case we talk of an outlying observation. In order to enable the proper examination of the dependence in the presence of atypical observations, one is advised to apply robust regression methods. Among the most frequently used estimations techniques from this group, the following estimation approaches can be indicated: M-estimators, GM-estimators, S-estimators, and MM-estimators (for example Hampel et al., 1986; Maronna et al., 2006).

M-estimators of the parameters in a regression equation, introduced by Huber in 1973 (see Huber, 1973), serve the purpose of removing or elevating the problem of atypical values in the response (the problem of large residuals). The M-estimation of the parameters in a regression line generalizes the estimation approach with the least squares method or the quantile regression method, whereas the term ‘M-estimation’ itself is an abbreviation of the phrase ‘Maximum likelihood-like estimation’.

However, when the M-estimation is applied, the so-called influence function, which measures the influence of the ‘contamination’ of the distribution on the obtained estimates, turns out to be unbounded with respect to high-leverage observations. GM-estimators, which is an abbreviation of Generalized M-estimators, were introduced for the purpose of elevating the impact of high-leverage observations through appropriately defined weights reducing their influence on estimates. S-estimators of regression equations are procedures characterized by a high finite sample breakdown point. This means that they admit a large fraction of atypical observations before the estimator returns aberrant results. They are based on a robust estimation of the scale parameter, from which the name ‘S-estimator’ comes. Finally, MM-estimators are

procedures joining S-estimation (in the first step) and M-estimation (in the second step), which are able to combine the merits of S-estimators with high efficiency for the normal distribution.

In the M-estimation of a regression line, one is looking for estimates of parameters of the equation in the form:

$$y_t = \beta_0 + \beta_1 x_{t1} + ... + \beta_k x_{tk} + \varepsilon_t$$

minimizing the sum:

$$\sum_t \rho_c \left(\frac{y_t - b_0 - b_1 x_{t1} - ... - b_k x_{tk}}{\hat{\sigma}} \right). \tag{10}$$

It is usually assumed that the objective function ρ_c is convex, admits the minimum value of zero at zero and has a derivative ψ_c. The quantity $\hat{\sigma}$ is a robust estimate of the standard deviation of the error term. Its presence in the function (10) results from the fact that the estimation result obtained through the minimization of the expression (10) is not scale equivariant, that is, it depends on the measurement units used (for example Maronna et al., 2006, Chapter IV). The solution to the optimization problem defined through (10) leads to the so-called studentized M-estimator.

In practice, the M-estimation of the parameters of the regression equation is usually performed with the help of the function ψ_c, called score function. This takes place if the score function ψ_c is smooth. Then, finding the minimum of (10) requires solving the equation:

$$\sum_t x_{ij} \psi_c \left(\frac{y_t - \mathbf{x}_t \mathbf{b}}{\hat{\sigma}} \right) = \sum_t x_{tj} \psi_c \left(\frac{e_t}{\hat{\sigma}} \right) = 0, \qquad j = 1,...,k\,. \tag{11}$$

The condition (11), after defining an appropriate weight function, reduces the computation procedure to the iterated weighted least squares method.

Table 1.
Chosen objective and score functions in robust estimation and the least squares method

	Objective function	**Score function**
Least squares method	$\varphi(u) = \frac{1}{2}u^2$	$\psi(u) = u$
Huber function	$\varphi_c(u) = \begin{cases} \frac{1}{2}u^2 & \text{for} \quad \lvert u \rvert \le c \\ c \lvert u \rvert - \frac{c^2}{2} & \text{otherwise} \end{cases}$	$\psi_c(u) = \begin{cases} u & \text{for} \quad \lvert u \rvert \le c \\ c\,\text{sign}(u) & \text{otherwise} \end{cases}$
Tukey function	$\varphi_c(u) = \begin{cases} \frac{c^2}{6}\left[1 - \left(1 - \frac{u^2}{c^2}\right)^3\right] & \text{for} \quad \lvert u \rvert \le c \\ \frac{c^2}{6} & \text{otherwise} \end{cases}$	$\psi_c(u) = \begin{cases} u\left(1 - \frac{u^2}{c^2}\right)^2 & \text{for} \quad \lvert u \rvert \le c \\ 0 & \text{otherwise} \end{cases}$
Welsch function	$\varphi_c(u) = \frac{c^2}{2}\left(1 - e^{-\frac{u^2}{c^2}}\right)$	$\psi_c(u) = ue^{-\frac{u^2}{c^2}}$

Note. The constant *c* is usually defined as that guaranteeing 95% asymptotic efficiency for the normal distribution.

Source: own elaboration.

Table 1 contains example objective and score functions used in robust estimation and compares them with the corresponding functions from the least squares estimation. Among the compared functions, the Tukey and Welsch objective functions, similar to the objective functions in modal regression estimation, are bounded. In fact, for the Gaussian kernel, the maximization problem (2) is equivalent to the non-studentized M-estimation based on the Welsch function. It should be noted, however, that robust regression serves the purpose of modeling the conditional mean value and assumes a symmetric error distribution. As indicated in the previous section, it turns out that, with a judicious definition of the bandwidth parameter h in the appropriate objective function, a consistent estimation of the parameters in the equation for the conditional mode (1) can be guaranteed even if the distribution of errors is asymmetric.

4. Benefits of using modal regression

Among the potential benefits of using modal regression, one can indicate the following (compare Bruzda, 2024, and references therein):

- Modal regression enables measuring marginal effects for typical units in the population in a cross-section study (the response of a typical enterprise, client, worker etc.) and typical responses of a single examined unit over time in a time series scenario.
- It is robust to outlying observations and tick tails of the conditional distribution.
- It enables a direct calculation of modal forecasts and the most likely trajectories of the examined phenomena over time (Dimitriadis et al., 2024).
- Under certain conditions, it should result in the narrowest interval forecasts and the smallest values of symmetric and bounded forecast loss functions (Yao, Li, 2014; Chen et al., 2016; Bruzda, 2024).
- It can provide more accurate parameter estimates in the conditions of asymmetry of the error term (Yao, Li, 2014).

Thus, it appears that the modal regression model will constitute a significant addendum to the existing analytical toolbox. The potential area of its applications in management, marketing, economics, and finance is broad, encompassing, among other things,

- the evaluation of the impact of different components of marketing mix strategies on sales in order to maximize the effectiveness of promotional and advertising activities,
- the computation of logistics demand forecasts evaluated with bounded and symmetric loss functions, that is, forecasts associated with limited (and similar) overstocking and understocking costs for material or distribution inventories (composed of, for example, the cost of the next transport to replenish or reduce the inventories in the production cell or the point of sale),
- forecasting prices of the underlying financial instruments when using derivatives with payoff functions that depend on the price remaining within a certain band,

- macroeconomic forecasting maximizing credibility measures.

To illustrate the potential of modal regression to find forecasts that minimize symmetric and bounded loss functions, the following simplified simulation experiment was conducted. The data were generated according to the model adopted in simulation experiments in Yao and Li (2014), which is as follows:

$$Y = 1 + 3X + \sigma(X)\varepsilon, \quad X \sim U(0,1),$$

$$\varepsilon \sim 0{,}5N(-1, 2{,}5^2) + 0{,}5N(1, 0{,}5^2), \quad \sigma(X) = 1 + 2X.$$

Then, we get:

$$E(Y \mid X) = 1 + 3X, \quad Mod(Y \mid X) \approx 2 + 5X, \quad Med(Y \mid X) \approx 1{,}67 + 4{,}34X,$$

$$E(\varepsilon) = 0, \quad Mod(\varepsilon) \approx 1, \quad Med(\varepsilon) \approx 0{,}67.$$

For a sample of size 120 and with 1,000 repetitions, information was collected on chosen accuracy measures for one-step ahead forecasts. The obtained values were the following:

- the MSE: 20,3467 for modal regression and 17,8375 for the least squares method,
- the loss function in modal estimation with the bandwidth parameter h set to an estimate of the asymptotically optimal value of h: 0,8531 for modal regression and 0,8977 for the least squares method,
- the rectangular loss function of the form:

$$L(x, y) = \ell(y - x) = \ell(e) = \begin{cases} 0 & \text{for} \quad |e| \le c \\ 1 & \text{for} \quad |e| > c \end{cases} \tag{12}$$

  with c defined as 10% of the mean value of Y: 0,8470 for modal regression and 0,9560 for the least squares method.

The above experiment confirmed that modal regression is a natural solution for a single-step computation of forecasts defined as values minimizing the zero-one loss or, more broadly, a symmetric and bounded loss function. Figure 1, on an example of the gamma distribution with the mean value of 6 and the modal value of 5, shows that this may occur, in particular, if the distribution of forecast errors is strongly unimodal, and the constant c in the loss function (12) does not take too large a value.

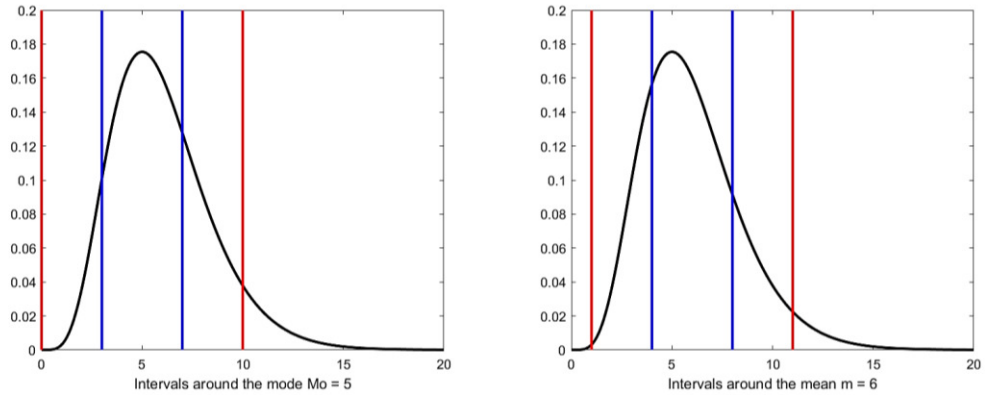


Figure 1. Symmetric intervals of the same width around the mode and mean.

Source: own elaboration.

5. Empirical modal regression models and their applications

Now, we will present two illustrative applications of the modal regression model based on certain real datasets. The first example application concerns modeling the nominal value of an industrial process, assuming that this value depends on the conditions characterizing this process, and more precisely, settings of the device used in the process. Also, we assume that the conditional distribution of the outcome of the process can be asymmetric and even multimodal, but it possesses a well-defined global mode. Under such circumstances, it is expected that modal regression can be employed to model the nominal value of the process in a way guaranteeing that the distribution of the outcome is highly concentrated around this nominal value.

In the example, we use a dataset available on the Kaggle webpade (Guetout, n.d.). It consists of 125 observations on four variables. The first is called 'roughness' (denoted further as R) and is considered an important outcome of a turning process since it impacts on the life cycle of the produced steel elements. Thus, this particular outcome of the production process remains of interest to the statistical process control and general quality management. In addition, the dataset includes variables describing the production process such as the cutting depth (X_1), feed (X_2) and cutting and turning speed (X_3).

On this dataset, we estimated parameters of three linear regression models, namely, the ordinary conditional mean equation (estimated by least squares), the quantile regression equation for quantile of order 0.5, that is, median regression (estimated by least absolute deviations), and the modal regression line (estimated as described in the previous sections). After removing the variable X_1, which turned out to be insignificant, the following estimation results were obtained:

$$\hat{R}_1 = \hat{E}(R \mid \mathbf{X}) = \underset{(\pm 0{,}362)}{4{,}135} + \underset{(\pm 1{,}618)}{11{,}570}\, X_2 - \underset{(\pm 0{,}002)}{0{,}020}\, X_3, \tag{13}$$

$$\hat{R}_2 = \hat{Me}(R \mid \mathbf{X}) = \underset{(\pm 0{,}595)}{2{,}910} + \underset{(\pm 1{,}774)}{7{,}667}\, X_2 - \underset{(\pm 0.004)}{0.011}\, X_3, \tag{14}$$

$$\hat{R}_3 = \hat{Mo}(R \mid \mathbf{X}) = \underset{(\pm 0{,}453)}{2{,}447} + \underset{(\pm 2{,}026)}{6{,}993}\, X_2 - \underset{(\pm 0{,}002)}{0{,}008}\, X_3, \tag{15}$$

where $\hat{R}_i$, i = 1, 2, 3, denote the theoretical values of R from the three models, and $\mathbf{X} = [X_1, X_2, X_3]$ is the vector of exogenous variables.

The estimation results show that the regression coefficients in the equation for the mean value (13) are about two times larger than those of the modal regression equation (15), whereas the corresponding coefficients in the median regression line (14) deviate from those in the equation (15) to a lesser extent. But even more important are the shapes of the error distributions in the estimated regressions. Figure 2 presents histograms of the residuals from the three equations, jointly with a histogram for the dependent variable R. The histograms indicate that

the residuals from the modal regression model are highly concentrated around zero, much more than in the case of least squares estimation and also more than in the case of median regression, confirming the expectation formulated at the beginning of this empirical study.

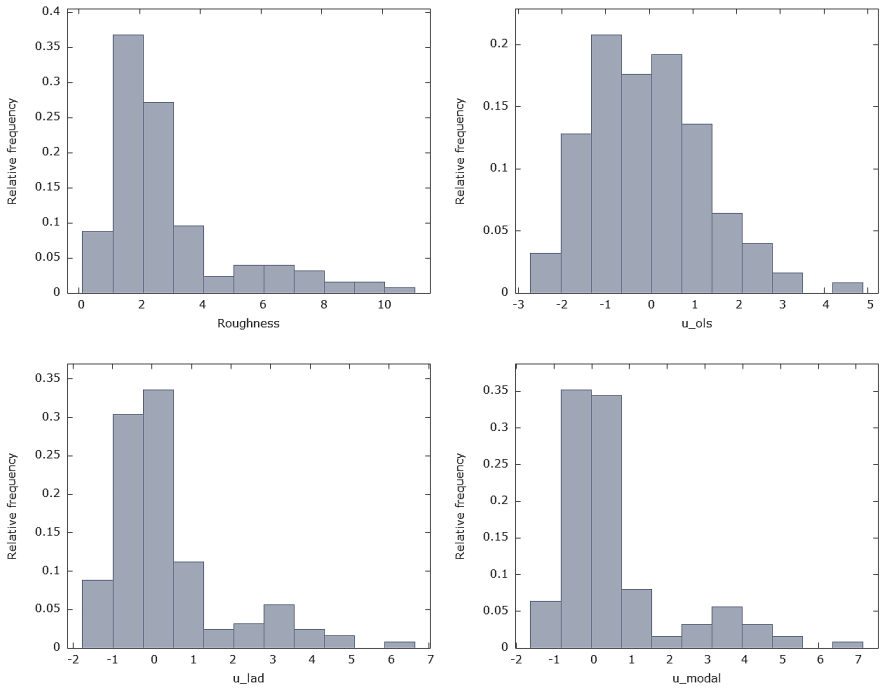


Figure 2. Histograms of the dependent variable and the residuals. Upper left panel – the dependent variable, upper right panel – residuals from least squares estimation, bottom left panel – residuals from median regression, bottom right panel – residuals from modal regression.

Source: own elaboration.

To confirm and quantify this observation, for each of the models, we also found the percentages of residuals with absolute values no greater than a certain constant c, that is, $\frac{1}{n}\sum_{t=1}^{n}\mathbf{1}\left\{\left|R_t-\hat{R}_{it}\right|\le c\right\}$. Such defined quantities can also be computed as $1-\frac{1}{n}\sum_{t=1}^{n}\ell(R_t-\hat{R}_{it})$, where $\ell(\cdot)$ is the loss function defined in (12). The results of these computations for selected values of c are presented in Table 2. The juxtaposition in Table 2 shows that, if the deviations from the nominal value of R which are less in magnitude than c enable classifying the output of the turning process as the highest quality product, the modal regression line, when used in the prediction mode, could be used to model the nominal value of the production process in a way guaranteeing the maximum share of products meeting the highest quality requirements in the total production.

Table 2.
Shares of residuals with absolute values less than c (in %)

c	Mean value regression	Median regression	Modal regression
0,25	17,6	25,6	33,6
0,5	26,4	45,6	52,0
0,75	41,6	62,4	67,2
1	56,8	72,0	78,4
1,25	65,6	80,8	80,8

Source: own computations.

The second discussed application of modal regression is inspired by the marketing mix concept. The dataset used in this empirical illustration comes from the Dominick's Finer Foods database maintained by the Kilts Center for Marketing at the University of Chicago's Booth School of Business, which part is available in the `bayesm` R package of Rossi (2019). From this package, we took the canned food dataset covering sales volumes of seven brands, jointly with the corresponding potential explanatory variables such as display activity (being a measure of the use of so-called display marketing), logarithms of retail prices, and logarithms of wholesale prices. The data have the form of (non-consecutive) weekly observations aggregated to the chain level. The number of available observation is 338. The estimation results presented here concern the brand no. seven (HH Chunk Lite 6.5 oz.). Figure 3 depicts the histogram of the sales volume of this brand, which shows that the examined distribution is strongly positively skewed. This is due to occasional bulk (wholesale) purchases.

Below we present the empirical marketing mix models for the brand analyzed, reduced to significant parameters. As in the previous example, three estimation methods were applied.

$$\hat{S}_1 = \hat{E}(S \mid \mathbf{X}) = \underset{(\pm 3,91)}{-28,667} \underset{(\pm 5,562)}{-46,090}\, P \underset{(\pm 5,973)}{-37,848}\, Pw, \tag{16}$$

$$\hat{S}_2 = \hat{Me}(S \mid \mathbf{X}) = \underset{(\pm 0,859)}{-23,921}\, P, \tag{17}$$

$$\hat{S}_3 = \hat{Mo}(S \mid \mathbf{X}) = \underset{(\pm 0,6034)}{2,9934} + \underset{(\pm 0,6316)}{3,5372}\, D - \underset{(\pm 2,2198)}{9,6421}\, P, \tag{18}$$

where S denotes the sales volume in thousands, D is a measure of the display activity, P is the logarithm of the retail price, Pw is the logarithm of the wholesale price, $\mathbf{X} = [D, P, Pw]$, and $\hat{S}_i$, i = 1, 2, 3, are the theoretical values from the regression models.

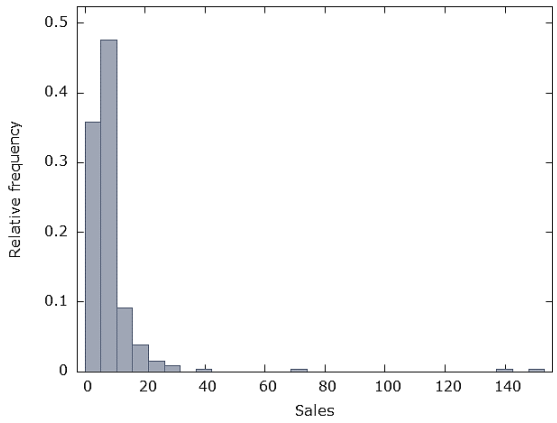


Figure 3. Histogram of the sales volume.

Source: own elaboration.

The estimation results show that the display activity variable is not significant in the equations for the conditional mean and median (16) – (17), whereas it is highly significant in the equation for the conditional mode (18), that is, it impacts on sales in a typical low demand week and can be used in explaining the largest part of the distribution of sales. By contrast, the wholesale price turns out to be significant exclusively in the equation for the mean, which says that this variable may be employed to describe the upper part of the distribution of sales.

The above analysis shows that modal regression makes it possible to build empirical marketing mix models without the need for market segmentation (in a sense, also saving degrees of freedom in estimation) since it naturally concentrates on the most typical sales volumes, reflecting the demand of the target consumer group.

In addition, the empirical modal regression model, such as that given in the equation (18), will make it possible to forecast the most likely volume of sales defined as that associated with the maximum of the conditional probability density function (for example Dimitriadis et al., 2024). Let us express such a forecast as $\hat{S} = a_0 + a_1 D - a_2 P$ for certain positive constants a_0, a_1, and a_2. Then, the corresponding modal forecast of the company's profit can be written as:

$$\begin{aligned} &Profit(D,P) = (P - c_1)\hat{S} - c_2 D - c_0 = \\ &= -a_2 P^2 + a_1 DP + (a_0 + a_2 c_1)P - (c_2 + a_2 c_1)D - a_0 c_1 - c_0, \end{aligned} \tag{19}$$

where c_0, c_1, and c_2 denote, respectively, the fixed cost of the marketing department, the unit production (or purchasing) and distribution cost of the goods, and the unit cost of the display activity. The function (19) has the following partial derivatives:

$$\left[\frac{\partial Profit}{\partial D}, \frac{\partial Profit}{\partial P}\right] = \left[a_1 P - c_2 - a_2 c_1, -2a_2 P + a_1 D + a_0 + a_2 c_1\right], \tag{20}$$

whereas its hessian is given as:

$$H(D,P) = \begin{bmatrix} 0 & a_1 \\ a_1 & -2a_2 \end{bmatrix}. \tag{21}$$

Since the hessian (21) is negative semidefinite, the function (19) is concave, and, thus, it attains its (unique) global maximum at the stationary point of the form:

$$P = \frac{c_2 + a_2 c_1}{a_1},$$
$$D = \frac{2a_2(c_2 + a_2 c_1) - a_1(a_0 + a_2 c_1)}{a_1^2}. \tag{22}$$

The solution (22) should be of help to the company in optimizing its marketing mix strategy in relation to the target consumer group.

6. Conclusions

The modal regression model, introduced by Kemp and Santos Silva (201) and Yao and Li (2014) and developed further, among others, by Kemp et al. (2020) and Ullah et al. (2022), is a statistical concept with a broad range of potential applications. However, to the best of our knowledge, empirical applications of this concept remain somewhat underdeveloped and are limited so far exclusively to certain macro- and microeconomic phenomena. In this paper, for the first time in the literature, we have drawn attention to some of possible uses of modal regression in enterprise management, and more precisely, in logistics and marketing management. As has been shown in the paper, the empirical modal regression model should help to develop decision instruments which can be utilized in demand forecasting (and logistics planning), managing the quality of industrial processes, and planning marketing mix strategies. This, however, certainly does not exhaust the topic. We believe that this direct statistical approach can be beneficial to managers in many areas of an enterprise and in many businesses. For this reason, it is recommended to include this tool in the managerial statistical toolbox.

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THE EVOLUTION OF ERGONOMICS – FROM THE CONCEPTS OF WOJCIECH BOGUMIŁ JASTRZĘBOWSKI TO ERGONOMIC POLICIES OF ENTERPRISES IN THE ERA OF INDUSTRY 5.0

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Purpose: The article presents the trajectory of change in ergonomic research, beginning with the pioneering 1857 publication by Wojciech Bogumił Jastrzębowski and continuing to the present day (2025). The aim is to trace the development of ergonomic theory and practice in the context of advanced information technologies characteristic of Industry 4.0 and 5.0. The study seeks to highlight how integrating ergonomics into modern industry has transformed the discipline and what future ergonomic approaches must entail.
Design/methodology/approach: The objectives of the paper were achieved through a conceptual and historical analysis combined with elements of critical literature review and foresight. Rather than conducting empirical research, the authors trace the evolution of ergonomics from its origins in the 19th century to contemporary challenges associated with Industry 5.0. The approach is interdisciplinary, drawing from ergonomics, systems engineering, neurocognitive science, and social philosophy. The paper critically examines transformations in the human–technology relationship, forecasting the future role of ergonomics in increasingly automated and AI-driven environments.
Findings: The analysis reveals that the nature of ergonomics must fundamentally change in response to new conditions of human interaction with intelligent technical systems using artificial intelligence. The study shows that contemporary ergonomics increasingly extends beyond traditional applications, evolving toward human-centered organizational design. Moreover, the integration of ergonomic thinking into the design of objects and workplaces enables the discipline to synergize with systems engineering, enhancing its strategic role within enterprises.
Originality/value: This paper offers a unique historical-to-futuristic perspective on ergonomics, identifying its shift from a human-as-operator paradigm toward human-as-central-agent within technological systems. The value of the article lies in its relevance to researchers, system engineers, and enterprise decision-makers seeking to understand and implement ergonomic policies in the era of smart industry and human-centric automation.
Keywords: Human-centered design; Ergonomics; Industry 5.0; Ergonomic policy; Human-machine interaction.
Category of the paper: Viewpoint.

1. Introduction

The question regarding the role and future of ergonomics in contemporary enterprises is directly associated with the title of the lecture "Quo Vadis, Ergonomics?" delivered by Alphonse Chapanis, professor at The Johns Hopkins University in Baltimore, USA. This lecture was presented during the plenary session of the 7th Congress of the International Ergonomics Association (IEA), held in Warsaw from August 27 to 31, 1979 (Chapanis, 1979a, pp. 109-122; Chapanis, 1979b). In the final part of his lecture, the author offered an answer in a similarly styled phrase: Urbi et orbi (to the city and the world). This indicated that ergonomics addresses both micro-level issues, such as individual workstations and other forms of human-technology interaction, and macro-level concerns, namely, the broader impact of technology on society, including its cultural, economic, social, and political dimensions. This second area of research has since become known as macroergonomics (Hendrick, 1987, 2000; Pacholski, Jasiak, 2011).

While microergonomic issues appeared relatively rational and well-defined, the ergonomics concept for complex systems seemed distant, even abstract. The perceived clarity of microergonomic challenges stemmed from the belief that workstations and practically all related work tools could be adapted to human needs through “common sense”. A lack of ergonomic design in such objects was often regarded merely as an oversight, rather than as a scientific or even engineering issue. The challenge of adapting technology to human needs, often referred to for years as the "humanization of work", has never been as critical as it is today. The question posed by A. Chapanis 45 years ago remains highly relevant, and today's answers often provoke concern, even fear, for the future of humanity.

Wojciech Bogumił Jastrzębowski was the first scholar in the world to propose developing knowledge about humans assisted in their work by technical means, and he coined the term ergonomics (Jastrzębowski, 1857). This idea remained forgotten for almost a century, likely due to its pioneering nature and the fact that societies of the time were not yet advanced enough to embrace it, relying on simple tools and ignoring the physical condition of workers. But didn’t our ancestors, Homo habilis (“handy man”), who began crafting and using hand tools made from stone, bone, and wood at least 2.5 million years ago, have to adjust their shapes to match the structure of their hands, movement capabilities, and strength? One might argue that “intuitive ergonomics” has been developing for 2.5 million years, while the past 80 years of consciously developed ergonomics represent only 0.0032% of that time, a statistically negligible period (Tytyk, 2019, p. 41).

As technical tools have become increasingly advanced and complex, methods of ergonomic diagnosis and design have also evolved. This is due to the need to meet new demands from people who create and use sophisticated technical products. Since the field’s inception, initially as a theoretical proposal (by W.B. Jastrzębowski in 1857), followed by practical applications (by engineers in the U.S. Army during World War II), through post-war industrial

reconstruction and development, to the current era of deep automation and robotics known as the Fourth Industrial Revolution (Industry 4.0) - ergonomic efforts have shown a clear trajectory. An analysis of these developments enables us to outline the path of ergonomic evolution in the context of the emerging Fifth Industrial Revolution (Industry 5.0), which we are now entering. This will undoubtedly be a different type of ergonomics than what we knew in the 20th century. The aim of this analysis is to forecast a vision for the development of ergonomic research methodology and methods during the era of Industry 5.0.

2. XXth Century Ergonomics

At the end of World War II, a pressing need emerged to adapt aircraft control systems and other military technologies to the capabilities of their human operators. Quite simply, people could no longer control the products of their own minds and hands. This marked the beginning of the "golden era of ergonomics," as it became clear that machines, hand tools, other technical devices, and the work environment, when adjusted to human abilities and limitations, enabled improved economic outcomes from human activity. At the foundation of ergonomic success, then (as now), was economics.

Ergonomics during this period was shaped by a symbiosis of physiology, psychology, medical sciences, anthropometry, acoustics, and optics. From the second half of the 20th century, ergonomics focused on individual workstations in industry, automated assembly lines, computer-based work environments, as well as the work of doctors, drivers, teachers, athletes, household activities, leisure-time tasks, persons with disabilities, and senior citizens. This era saw a surge of scholarly publications, research reports, and conference presentations both nationally and internationally. Ergonomic concerns were taken up by professionals across many sectors, including industry, agriculture, furniture manufacturing, architecture, urban planning, occupational safety, design, and management.

In Poland, as in other countries, research methodology in ergonomics developed in two main domains: corrective ergonomics, focused on ergonomic diagnostics (Pacholski, 1977), and conceptual ergonomics, aimed at ergonomic design (Tytyk, 2001). Practical and actionable methods for issuing standardized ergonomic recommendations for industrial products were also proposed, enabling the marketing use of ergonomic quality features (Górska, Tytyk, 2017, pp. 93-110). Furthermore, ergonomics was applied in situations involving shortages in human resources, such as among people with disabilities (Butlewski, 2018).

At the beginning of the 21st century, the topics presented at conferences, especially in Poland, began to suggest a depletion of new research ideas, sometimes even provoking confusion. While subjects like "kitchen or bathroom ergonomics" had legitimate merit from

a human–technology interaction standpoint, other topics, such as ergonomic considerations in necropolis architecture (including vertical burial systems!), elicited embarrassment.

Despite Poland being the homeland of the field's forerunner, W.B. Jastrzębowski, ergonomics still does not hold the status of an academic discipline in the country. A classic case of "the shoemaker's children go barefoot"? Since it has not been possible to attain academic promotion solely through work in ergonomics, the subject had to be "smuggled" into other academic disciplines, a task that was neither easy nor always convincing. As a result, young researchers, at the beginning of their careers, were discouraged from pursuing such a risky and interdisciplinary topic. Consequently, ergonomics has become an increasingly hermetic field, practiced by a small group of aging researchers whose academic achievements lie mainly in other disciplines. This led to hybrid professional identities, such as mechanical engineer–ergonomist, physiologist–ergonomist, physician–ergonomist, psychologist–ergonomist, and architect–ergonomist.

Despite these unfavorable academic conditions, ergonomic knowledge continued to prove its value in practical applications. Market dynamics demanded the incorporation of ergonomic principles in the design and production of goods, as poor ergonomic quality (by contemporary standards) discouraged buyers, who opted for competing products that offered a better balance between quality (including ergonomic quality) and price. This is clearly visible in the markets for passenger cars, certain furniture (especially for computer workstations), and hand tools. Ergonomic quality became a marketing and advertising asset, an argument for increasing the product price. This is, however, entirely rational: higher-quality products, whether in terms of design, execution, aesthetics, ergonomics, safety, or ease of maintenance, justify higher prices. It is an investment that eventually pays off, yielding above-average returns. Nevertheless, this practical and theoretical aspect of ergonomics has so far received little attention from economists and market researchers, a somewhat surprising oversight.

A further distinction must be made between ergonomics and occupational safety and health (OSH), or more formally, occupational safety engineering. The aim of both scientific and practical ergonomic work is the adaptation of technical objects to human capabilities and preferences, that is, the humanization of technology. This adaptation leads to more effective human performance, especially in professional work, while reducing excessive physical and mental strain. However, demonstrating the economic benefits of ergonomic interventions is not straightforward, which complicates efforts to persuade business leaders to invest in ergonomic technical and organizational solutions. Furthermore, ergonomic requirements are not legally binding in Poland, ergonomic standards can simply be ignored.

In contrast, OSH aims to ensure the safety of the human body and psyche by reducing the frequency and severity of work-related accidents (as sudden events) and limiting the occurrence of occupational diseases (as long-term effects of excessive strain and poor environmental conditions). The costs of accidents and occupational illnesses are relatively easy to quantify, and occupational safety and hygiene are enforced through mandatory legal regulations and

standards cited in ministerial and governmental ordinances. These obligations are also embedded in the Polish Constitution (Articles 24, 66, and 68) and the Labor Code, Chapter X.

Thus, we can say that the primary goal of ergonomics is the economics of human activity, whereas the main mission of OSH (or occupational safety engineering) is humanitarian. However, these two fields intertwine in such a way that ergonomics is sometimes seen as a continuation or extension of OSH, while in other interpretations, OSH encompasses ergonomic activities. In practice, however, safety solutions can be non-ergonomic (e.g., certain types of personal protective equipment), and ergonomically correct solutions may fail to ensure adequate safety (e.g., some powered hand tools).

3. Ergonomics at the turn of the 20th and 21st centuries

The dominant paradigm in ergonomics assumes that its subject of study is a system composed of a human (or humans) and technical objects (functional artifacts) used in conscious action. This implies a dual structure: two distinct and separate subsystems, the human and the technical. Today, this categorical division is no longer as evident. Are technical elements truly separate from the human being? Jan Jabłoński (Jabłoński, 2020) introduces the "mediated human" concept, a person whose actions are facilitated through technical intermediaries such as tools and machines.

No one is surprised by canes, crutches, walkers, wheelchairs, hearing aids, or corrective lenses. These external technical objects support human functioning, often making life easier or even possible. For nearly 3000 years, technical objects have been "embedded" in the human body to replace or imitate natural organs. As early as 700 BCE, the Etruscans in central Italy crafted partial dental prosthetics known as bridges (James, Thorpe, 1997, p. 44). Around the same period, both Europe and India began producing limb prostheses, often necessitated by war injuries (James, Thorpe, 1997, p. 46).

Today, such support for human life functions is insufficient without advanced medical technologies. Implants, dental, hip, and knee, as well as highly functional limb prostheses and pacemakers, are widely used. Modern prosthetics can be controlled via muscle bioelectric signals, providing functionality comparable to biological limbs. Does this fall within the scope of ergonomics? Undoubtedly, because these user artifacts must be fitted not only geometrically but also biochemically (e.g., avoiding toxicity or allergic reactions).

But how should we interpret technical solutions that become integral parts of the human body? This necessitates a redefinition of the ergonomic system to include a more integrated interpretation of the human–technical object relationship.

Modern health concepts extend beyond medical or psychological care. Alongside the desire to maintain overall health, defined by the WHO as a state of physical, mental, and social well-being, there is now an active pursuit to extend life, enhance cognitive capabilities (augmented cognition), and guide the course of human evolution toward improvement. While we are still in the early stages of engineering in this domain, we can now continuously monitor and respond to bodily parameters, repair joint and dental damage with implants, track internet activity and consumer behavior, and even perform facial recognition. These capabilities enable constant surveillance of individuals, ostensibly for their safety and benefit, but also for more dubious purposes, as evidenced in countries like China. The body is not the only site of technological intervention. Efforts are now underway to augment cognitive abilities through electronic brain implants, linking the brain to external computers and merging natural intelligence with artificial systems (e.g., Neuralink). This trajectory leads us toward human–machine hybridization, or cyborgization, birthing a new class of techno-human beings.

This direction of development has given rise to a philosophical movement known as transhumanism. Max More (More, 1990) defines it as "a class of philosophies that seek to guide us toward a post-human condition. Transhumanism shares many elements with humanism, such as respect for reason, science, and progress, but diverges in its openness (even eagerness) for radical changes to human nature through science and technology."

This resembles a dangerous "play at being God", a being who, in any religion, holds exclusive rights to create life yet is accountable to no one. From a Buddhist perspective, such enhancement might aim toward nirvana, while in other religions, it may equate to a heavenly state of eternal bliss. The danger, however, lies not in breaking taboos but in our still-fragmentary understanding of life itself, and our inability to foresee the consequences of such "play". Transhumanism (also labeled Humanism+) is based on the assumption that ancestral cultures have failed to resolve humanity's problems and instead have created new ones. Therefore, they should be abandoned in favor of engineering a new human being and a new society. Such socially-engineered projects, supported by relatively primitive technologies in recent history (e.g., eugenics), have had tragic consequences. We should not use technologies we don't fully understand, because the outcomes may be catastrophic.

Isaac Asimov foresaw these dilemmas in *The Complete Robot*, though he did not use the term transhumanism. In it, he formulated his famous "Three Laws of Robotics" (Asimov, 1993):

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given by humans, except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Despite their theoretical logic, these laws produced unexpected and often negative consequences in practice. Especially notable is the chapter "The Bicentennial Man" (pp. 407-466), which explores the transformation of a man into a robot, and vice versa.

Contemporary ergonomics is beginning to explore the goals and methodologies required to examine human cyborgization scientifically. In Poland, institutions such as the Jagiellonian University (Department of Neurocognitive Science and Neuroergonomics), the University of Information Technology and Management in Rzeszów (Laboratory of Neurocognitive Ergonomics), and Kazimierz Wielki University in Bydgoszcz (Tomaszewska, 2021) have begun addressing these topics. Neurocognitive ergonomics is considered a subdiscipline of ergonomics. It focuses on cognitive processes during human interaction with the environment, examined using neurocognitive methods such as EEG, EMG, eye-tracking, and neuroimaging. These tools are employed in studies of user preferences in human–computer interfaces, neuromarketing, attention management, decision-making processes, usability evaluation, mental overload, stress (or monotony), and human error during interactions with technical systems. These findings are critical in shaping the working conditions of Industry 5.0. At the 3rd National Ergonomics Congress (Gliwice, June 28, 2024), such topics were discussed.

Ergonomic challenges in the field of advanced automation and robotics, especially when integrated with artificial intelligence, concern the design of systems and components that are readily accessible, even intuitive, during mental operations performed by humans interacting with technical devices. At the same time, there is a growing need to adapt humans to this sophisticated, increasingly AI-driven technology. This requires targeted education and psychological preparation for working within such technical environments. One emerging concept in this context is cobotics, the close cooperation between humans and robots. It is telling that children enjoy playing with toys that are, in fact, increasingly functional robots resembling animals or even other children. In many schools and universities, starting in Switzerland and, since 2011, in various other countries, the autonomous humanoid robot Nao has been used for educational and research purposes (Nao Robot Power V6). The sight of a five-year-old child absorbed in a smartphone, barely responsive to the outside world, is becoming a common example of a cyber-child. This should serve as a warning about the risk of mental manipulation and indoctrination of young, impressionable minds. Is this already happening? We must ask ourselves. This raises a fundamental question within the context of this discussion: What role can ergonomics play in addressing these challenges?

Changes in professional activity are also being driven by the application of advanced technology. In 2019, it was predicted that 47% of existing professions could disappear within the following 10 years, replaced by robots and artificial intelligence. In turn, there will be a growing demand for skills in STEM fields (Science, Technology, Engineering, and Mathematics) (Hatalska, Trapp, 2019). This shift will trigger not only new ergonomic challenges but also issues in social policy, economics, and education. Structural unemployment may emerge, as well as the rise of the so-called "surplus citizens", individuals deemed

economically unnecessary, as Edwin Bendyk (Bendyk, 2018) calls them. Other side effects may include the growth of the precariat, and increased labor-related migration and emigration.

Ergonomists cannot solve these problems alone, but they can propose technical solutions to at least some of them. The ideal (following Abraham Maslow's hierarchy of needs) is a model of work organization known as "teal organizations", a concept coined by Frédéric Laloux (2016). This model envisions work undertaken freely, without coercion, aligned with a person's interests, qualifications, capabilities, and intentions. It is inherently linked with self-actualization, the highest need in Maslow's hierarchy. Will this be the future of work in a world dominated by Artificial Intelligence (AI) and the Internet of Things (IoT)? We can already observe that the role of humans in relation to machines is evolving in a specific direction: from system operator to supervisor of autonomous technical systems. There are valid concerns that this shift may not universally lead to the "teal" model of work, but perhaps a select group of people, high-level AI and IoT experts, will have the opportunity to experience it. These individuals will hold esoteric, almost shamanic knowledge, inaccessible to most others. The majority will remain users of technical devices whose inner workings they neither know nor need to understand. These complex and mysterious technologies will shape the living and working conditions of the majority, creating a dependency on the knowledge and ethics of a narrow group of technology creators. In an interview with Jacek Żakowski for Polityka, Bulgarian political scientist Ivan Krastev stated with bitter clarity: "We are no longer trying to build great societies. We are simply trying to save them from the apocalypse" (Polityka, 29/2020, p. 19). Similarly, in an interview with Tonje Hessen Schei, director of the documentary iHUMAN about artificial intelligence, the CEO of Microsoft warned: "We must decide not what technology can do, but what it should do" (Polityka, 36/2020, p. 77). Such statements, echoed by other influential thinkers, indicate a growing awareness of the long-term consequences of today's technological decisions, far beyond immediate economic and political gain. AI is now the foundation for developing autonomous transportation systems, road, rail, maritime, and air, that do not require human operation. For years, passenger aircraft such as the Boeing 737 and Airbus A320 have included Flight Management Systems (FMS), which are capable of partially autonomous flight control. In 2019, a fully automated take-off of an Airbus A350 was successfully tested at the Toulouse airport in France. Clearly, knowledge in building and managing autonomous transport has been accumulating for some time.

In Poland, interest in such innovations is growing, for example, the BB-1 Blees autonomous bus is currently being tested in Gliwice. In passenger transport, people are treated as passive cargo to be moved from point A to B under full digital control. Such solutions are already commonplace in major airports (e.g., terminal shuttles) and in subway systems in large cities.

There are also ongoing experiments with autonomous freight transport, air taxis, and even combat drones. Extensive experience has already been gathered in designing unmanned spacecraft, drones, and naval vessels, as illustrated by recent warfare in Ukraine.

These developments demonstrate a tendency to eliminate the human element, considered the most fallible and costly part of the system, in favor of automated solutions.

However, in atypical, unpredictable, and emergency situations, the human being remains irreplaceable. Unlike machines, humans can act on intuition and instinct, not merely through pre-programmed routines. Yet this raises another issue: legal and moral responsibility. Who, or what, will be held accountable for an accident involving an autonomous vehicle or aircraft? What consequences should be imposed? Clearly, technological progress in autonomous transport introduces new legal, economic, and social challenges. From the perspective of human–technology interaction, one can identify fertile ground for the further development of neurocognitive ergonomics.

4. The need for new ergonomics

In the contemporary context, it is essential to ask what form modern and future ergonomics will take. Is the traditional version of ergonomics, focused on human–technology interaction as it has been understood since the mid-20th century, facing its natural decline? This seems to be a rational and increasingly accurate conclusion, especially in technologically and economically advanced societies. The cause of this transformation lies in civilizational progress itself, which has led to the emergence of a customer-driven market. In such a market, the oversupply of manufactured goods coexists with a limited pool of buyers. Consequently, producers must compete for consumer attention and loyalty, offering products that are attractive in both price and quality.

To stand out, companies increasingly turn to sophisticated marketing strategies, including neurocognitive techniques, known as neuromarketing. Yet these methods alone are insufficient to generate demand; objective product features, especially the price-to-quality ratio, remain decisive. Among product quality factors that shape consumer preferences, ergonomics, defined as the degree to which a product satisfies human-centered design criteria, plays a crucial role. Though the term itself may seem technical, more accessible alternatives, such as user-friendly, are commonly used. Manufacturers who neglect ergonomic quality risk market exclusion by competitors who, even without directly referencing ergonomic design, produce products that better fit user needs. Thus, ergonomic excellence not only justifies higher prices but also underpins business success.

Despite its practical significance, ergonomics as a discipline must now seek new fields of inquiry. These may lie in the development of artificial intelligence (AI), the Internet of Things (IoT), virtual and augmented reality (VR/AR), and advanced machine learning tools such as ChatGPT. Indeed, global trends in industry and human activity provide promising directions for ergonomics, particularly through the concept of Industry 5.0. Unlike Industry 4.0, which

emphasized the integration of AI, IoT, and data analytics into autonomous systems, Industry 5.0 focuses on collaboration between humans and machines. This shift necessitates not only technological innovation but also psychological and emotional adaptation on the part of human workers.

The overarching goal is to develop intelligent, autonomous production systems that improve efficiency and flexibility while cooperating with humans, who, although error-prone, remain essential participants in complex processes. This new paradigm opens substantial research potential for ergonomics, particularly in understanding how humans interact with automated systems. Areas of growing relevance include collaborative robotics (cobots), immersive technologies (VR and AR), and next-generation connectivity like 6 G. VR and AR, for example, allow for realistic simulations of workplace environments, thereby enhancing ergonomic prototyping and testing.

In parallel, the field of neuroergonomics, which explores the interaction between the human brain and technology, is expanding. Research focuses on cognitive processes such as sustained attention, decision-making, stress management, and error prevention in technologically intensive environments. These concerns are particularly relevant in the face of mass product personalization, which demands flexible workstation and tool design. Traditional ergonomic approaches based on predefined measurement frameworks may soon be replaced by dynamic adaptation to specific user groups. This shift poses significant challenges in terms of flexible production system design, but also opens possibilities for interactive, personalized products tailored to innovative user needs.

Such innovation is increasingly extending into domains previously considered less dynamic, such as gerontechnology. This field transcends basic telemedicine and seeks to develop technology with and for older adults, framing them as “innosumers”, innovative consumers (Peine, Rollwagen, Neven, 2014). Rather than merely responding to stated user needs, future ergonomic design will anticipate potential needs and adapt in real time. This anticipatory, personalized model of ergonomics aligns with broader societal and technological trends, including sustainability and workforce resilience.

Indeed, principles of sustainable development and production system resilience demand that organizations address the mental well-being of employees, an area that increasingly intersects with ergonomic research. While well-being has a psychological component, achieving it will also require engineering efforts aimed at shaping how individuals function in their work environments. As such, ergonomics will play a vital role in social responsibility (SR), one of the key pillars of ESG (Environmental, Social, and Governance) reporting. Although ESG standards remain under discussion in early 2025, they will eventually integrate environmental, social, governance, and ethical dimensions. Ergonomics fits seamlessly within this framework by promoting better working conditions and employee well-being, supporting human health and organizational performance (Butlewski, Czernecka, 2024).

Moving forward, integrating emerging technologies and adopting interdisciplinary approaches will be essential to the evolution of ergonomics, particularly within the context of Industry 5.0 and sustainable development. The classical ergonomic concern with human–technology systems must now address increasingly autonomous technologies, such as robotics and automation, which minimize direct human intervention. The role of humans is shifting toward coordination, supervision, calibration, and maintenance. As technologies advance, so too does the importance of maintenance professionals, who must possess specialized knowledge and specific psychological aptitudes. Designing appropriate work environments for these professionals requires refined ergonomics, especially neuroergonomic expertise.

Meanwhile, service-sector occupations, such as retail, banking, tourism, education, and research, present entirely different ergonomic challenges. These roles typically involve intellectual labor and interpersonal interaction rather than constant engagement with technology. Here, ergonomic concerns are shaped less by engineering and more by psychology and sociology. Nonetheless, they remain firmly within the purview of modern ergonomics.

5. The need for ergonomics policy in enterprises

Given the aforementioned circumstances, particularly two elements: the increasing humanization of technical means and the growing number of such means in the human environment, a key question arises. Should workplaces be subject to special protection or intervention from employers, in light of the environment's impact on employees on one hand, and the continuous improvement of these systems' ergonomic efficiency on the other? Can a perfect work system emerge spontaneously, or should it be developed similarly to a digital twin of the entire enterprise? As explained in the first part of the article, ergonomic efficiency accounts for the long-term ability of an employee to contribute added value, so is it not justified to model this value? Are current efforts in this field, primarily involving production process modeling and occupational risk management with a touch of ergonomics focused on musculoskeletal disorders, sufficient? The necessity of addressing these questions becomes increasingly evident, as illustrated by the growing attention to employee well-being. The ergonomic quality of a workstation results from long-term activity, where the worker’s well-being may be threatened by prolonged exposure to negative factors in both the technical and social work environment (e.g., fatigue, illness, burnout, reduced performance).

It can therefore be concluded that modern workplaces are undergoing dynamic changes driven by technological progress, automation, and the implementation of artificial intelligence. Accordingly, ergonomics faces multiple challenges that are crucial for businesses to address. One of the major areas is the integration of humans with systems powered significantly by decision-making algorithms based on machine learning and automation. This raises issues such

as the need to adapt work interfaces to employees' cognitive and physical capabilities while accounting for human error; the necessity to supervise decision-support systems in a way that avoids dehumanization (for instance, credit decisions should not rely on black-box processes, as the individual decision variables must be traceable); and the risk of "mental deactivation" among employees who merely oversee automated processes and may lack the cognitive readiness to act when intervention is required, an issue known as the "back in the loop" effect (Inagaki, 2008).

Another area of concern is cognitive ergonomics and the prevention of mental overload, which manifests in practice through potential challenges such as burnout caused by the pace and nature of work; the need to design systems that reduce informational stress and support effective attention management in today's attention economy, where being constantly online and responding swiftly to messages is equated with productivity, even though it may, in fact, be counterproductive; and the development of ergonomic work environments that promote focus and creativity, while addressing deficits in modern workplaces, such as a lack of interpersonal interactions.

A further domain involves the implementation of work hygiene and, more broadly, an ergonomic approach to hybrid and remote work. This includes designing ergonomic home workstations to minimize health risks (e.g., back or wrist pain, occupational hazards); optimizing digital tools to support effective communication and collaboration while meeting the criteria outlined above; and separating work and private life, not only to support employee well-being (including family life), but also to ensure work efficiency and avoid environments that encourage procrastination.

Additionally, efforts are needed to counteract health threats stemming from digital environments. This includes preventing physical and mental health issues associated with sedentary lifestyles and limited physical activity, a phenomenon increasingly resembling an epidemic, affecting both the musculoskeletal and peripheral nervous systems as well as mental health (e.g., work-related depression).

Integrating ergonomics and neuroergonomics into enterprise processes is another important area, particularly through the use of biosensors. This includes deploying biometric sensors and monitoring systems to track body posture during work, fatigue levels, or stress; intelligent office components that adapt to users or their current needs (prompting specific behaviors); and personalized system settings tailored to individual users and their physiological or psychological states.

Ergonomics can be a valuable tool in implementing company strategies, supporting both ethical and social dimensions of work in the digital era. It can help strike a balance between digital quality control and the protection of employee privacy, aiming for efficient management without compromising worker autonomy. Moreover, well-designed work systems can remove barriers related to age, digital skills, or disabilities, fostering more inclusive workplaces focused on performance. In this context, ergonomics enables the de-ideologization of inclusion

processes, i.e., inclusion is not pursued solely for its own sake. Companies can use ergonomic design to support the learning of new technologies among digitally inexperienced individuals and to implement solutions that encourage prolonged professional activity. Despite the outlined development challenges, ergonomics still holds significant potential, not only to enhance comfort and efficiency at work but also to promote sustainable and responsible work environments.

The development of ergonomics in contemporary workplaces requires an interdisciplinary approach that combines technology, psychology, occupational medicine, and human resource management. The primary objective is to ensure working conditions that support employees' health, effectiveness, and well-being while seamlessly integrating them into rapidly evolving work systems.

6. Conclusions

The above considerations, which concern the historical evolution of ergonomics methodology, authorize the formulation of several cardinal questions that demand rational and evidence-based answers. First, which areas of the interdisciplinary field known as ergonomics should be further developed, and is it necessary to redefine its goals and the scope of its research and practical activities? Second, what is the role of ergonomics within an enterprise, and how can its principles contribute to improving work efficiency, employee well-being, and organizational innovativeness, an issue closely tied to the first question?

Third, will ergonomics, as a distinct scientific discipline developed for over 80 years, become obsolete in the future, having exhausted its developmental potential and become absorbed by technical, organizational, and economic knowledge? This question leads to a further one: is there any value in distinguishing ergonomics as a separate discipline, or should it instead be integrated into existing academic fields and appropriately subdivided among them?

Fourth, how should we conceptualize the science (or knowledge) of the system comprising humans and technical objects, especially when the human is increasingly functioning as such a system, for example, when decision-making is significantly influenced by suggestions from a personal assistant embedded in a mobile device? In connection with this, should we not pursue the development of knowledge at the intersection of systems engineering and ergonomics?

Another important question arises: how can we define ergonomic problems when technical objects become essential parts of the human body, and the human-cyborg collaborates with robots equipped with artificial intelligence (AI), exchanging information via the Internet of Things (IoT)? This leads to yet another, perhaps the most radical, inquiry: will the physical capabilities and intelligence of humans, rendered irrelevant and unnecessary, ultimately be replaced by infallible and dehumanized technical environments?

While these questions are philosophical in nature, they also carry substantial practical implications. For instance, the issue of human capacity in the context of technical support systems is becoming increasingly significant, as the combined capacity to perform tasks will determine work outcome assessments. Consequently, the competency profile required in Industry 5.0 enterprises is undergoing a profound transformation.

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URBAN TRANSPORT INTEGRATION AS A CHALLENGE FOR TRANSPORT POLICY IN POLAND'S URBANIZED AREAS

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Purpose: Transport in Polish cities is primarily based on private car usage. The increasing number of vehicles creates numerous challenges, making it essential for city authorities to integrate various modes of transport within a multimodal urban travel system. Promoting public transport and other environmentally friendly forms of mobility through transport integration is crucial. This article aims to identify barriers to transport integration in urban areas and propose potential transport policy solutions.
Design/methodology/approach: The analysis employed qualitative content analysis of transport documents, a critical review of the literature, and a case study of selected European cities with high levels of transport integration.
Findings: The research conducted allows us to conclude that passenger transport in Poland remains poorly integrated and that the implemented solutions are fragmented. Therefore, it is proposed to adopt selected European solutions that could enhance the integration of urban transport in Poland's urban areas.
Research limitations/implications: It is important to emphasise the study's limitations, as it focuses on the qualitative analysis of documents and case studies. Consequently, the analysis does not fully address the identified research gap.
Originality/value: The topics discussed in the article are relevant from the perspective of urban decision-makers, as they critically examine the assumptions of city planning documents and juxtapose them with examples of transport integration solutions in selected European cities. The analysis has enabled the proposal of necessary solutions for implementation in Polish cities to enhance the level of integration.
Keywords: urban mobility, transport integration, transport policy, urbanised areas.
Category of the paper: Research paper.

1. Introduction

Urban development is inextricably linked to mobility needs. Demographic and social changes influence transport behavior, leading to an increasing preference for private cars. Their excessive number contributes to congestion, pollutant and noise emissions, and infrastructure degradation, particularly of roads (Hundert, 2018). A shortage of parking spaces in city centers, combined with car ownership, encourages suburban settlement and, consequently, urban sprawl (Baginski, 2011). Mobility issues extend travel times and heighten residents' dissatisfaction (Guzman et al., 2021). Therefore, promoting public transport (PT) as an environmentally friendly and relatively cost-effective mode of transportation is a reasonable approach.

Nevertheless, it is important to emphasise that PT often does not adequately serve suburban areas, and its schedules are not always adapted to individual user needs. In such cases, multimodal travel, which allows users to combine multiple modes of transport, presents a viable solution (Sakib et al., 2018). This approach better addresses transport needs and encourages a shift away from private car use. However, cross-modal integration is only possible with appropriate infrastructure and suprastructure, including Park & Ride (P&R) and Bike & Ride (B&R) facilities, transport interchanges, and well-developed shared mobility solutions (Matyas, 2020). Transport integration remains a key challenge for authorities in transport policy-making and investment planning.

The aim of this article is to identify barriers to transport integration in urbanised areas and to propose possible transport policy solutions. The authors have structured the article into several sections. First, the concepts of multimodal travel and transport integration are discussed in detail. This is followed by a presentation of the research methods employed, along with a justification for their selection. The subsequent section presents the results of the conducted analyses, compared with the findings of other researchers. Finally, the most important conclusions are summarised.

2. Literature review

Transport integration refers to the combination of different modes of transport, often collective PT, with individual means of transportation such as bicycles, scooters, or mopeds (Dyr, 2013). In recent years, shared mobility solutions such as car-sharing, car-pooling, and micromobility have been increasingly incorporated into everyday travel (Borkowski, Jażdżewska-Gutta, Szmelter-Jarosz, 2021). These solutions gained popularity during the COVID-19 pandemic, when access to collective PT was limited in many cities. This trend is

confirmed by data on the use of different modes of transport between 2014 and 2022 (Figure 1).

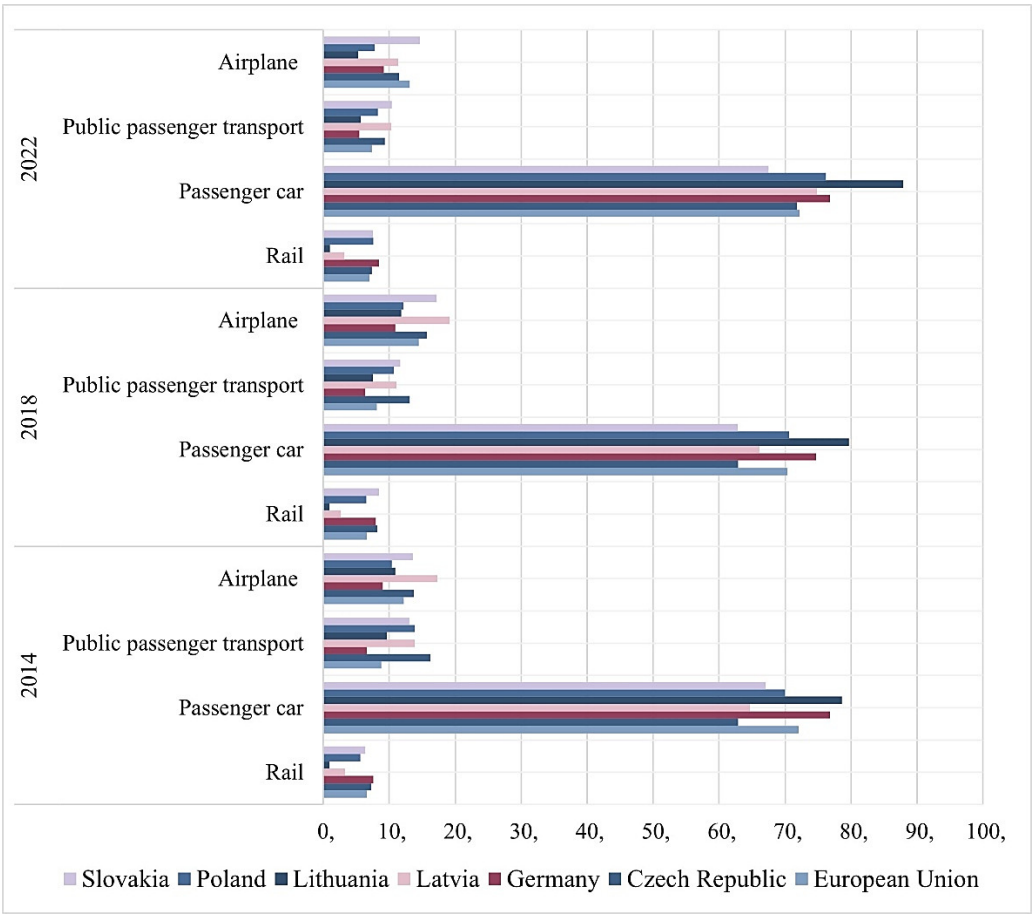


Figure 1. Modal split of transport usage in selected European countries between 2014 and 2022 (in %).
Source: Eurostat, https://ec.europa.eu/eurostat/databrowser/view/tran_hv_ms_psmod__custom_14790079/default/table?lang=en, 23.12.2024.

In 2022, the share of users employing private passenger cars increased by 1.8 percentage points across the European Union compared to 2018, with a rise of 5.6 percentage points observed in Poland. Likewise, the use of collective transport increased by 0.7 percentage points in the European Union and by 2.4 percentage points in Poland relative to 2018. The distribution of transport usage depends on several factors, including the urban transport management system (Hirschhorn, Veeneman, van de Velde, 2019), the transport policies and strategies implemented for urban planning and public transport promotion (Mouratidis, Ettema, Næss, 2019), perceptions of safety and ease of travel (Singh, 2020), and the needs and expectations of users (Scerri, Attard, 2023).

Intermodal integration remains insufficient to ensure seamless multimodal travel. Passenger information systems, fare-ticketing systems, and timetables should also be harmonised (Koźlak, 2020). The integration process requires stakeholder education and involvement at all planning stages. Research indicates that residents with lower levels of education and those living in suburban areas tend to be more sceptical about integration solutions (Strebel, 2022). Barriers to

integration include complex fare structures and the lack of convenient ticketing options (Gambetta, Barić, 2020), as well as underdeveloped infrastructure (Bryniarska, Żakowska, 2017). From a user perspective, transport interchanges should facilitate a quick and convenient mode transfer (Nielsen et al., 2021). A crucial aspect of integration is the availability of diverse transport modes, including on-demand transport (Franco, Johnston, McCormick, 2020), which can help reduce private car usage in areas not served by collective PT.

3. Research methods

This paper employs three research methods (see Figure 2) to conduct a detailed analysis of the barriers to transport integration and to identify solutions that could enhance the level of transport integration in Polish cities and urban areas.

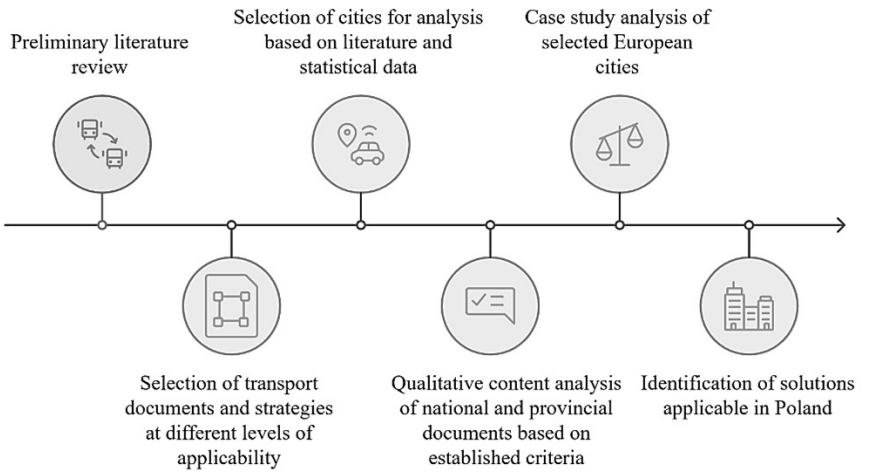


Figure 2. Research procedure.

Source: own elaboration.

The literature review was conducted using the supportive desk research method (Bednarowska, 2015). The application of this method was driven by the need to outline the general context of the transport integration process and to define the criteria for the qualitative content analysis of documents. Subsequently, transport documents of a strategic nature at the national and provincial levels were selected for detailed analysis (Table 1). The analysis excluded documents from the Lower Silesian (2014) and Podlaskie (2013) voivodeships, as they were deemed outdated by the authors.

Table 1.
List of analysed strategic documents

Document Name	Abbreviation	Provincial (P) or National (n) Scope	Year	Perspective
Sustainable Transport Development Strategy until 2030	STDS PL	N	2019	2020-2030
Transport System Development Strategy of the Silesian Voivodeship	Silesian TSDS	P	2014	2015-2030
Transport Plan of the Opole Voivodeship 2030	Opole TP	P	2024	2024-2030
Transport Plan of the Warmian-Masurian Voivodeship until 2030 (with a perspective until 2050)	Warmian-Masurian TP	P	2023	2023-2050
Strategic Transport Development Program of the Lublin Voivodeship until 2030 (with a perspective until 2040)	Lublin STDP	P	2021	2021-2040
Strategic Transport Development Program of the Podkarpackie Voivodeship until 2030	Podkarpackie STDP	P	2024	2021-2027
Regional Transport Plan for the Greater Poland Voivodeship with a perspective until 2030	Greater Poland RTP	P	2023	2023-2030
Regional Transport Plan of the Kuyavian-Pomeranian Voivodeship for 2021-2027	Kuyavian-Pomeranian RTP	P	2024	2021-2027
Regional Transport Plan of the Łódź Voivodeship	Łódź RTP	P	2024	2024-2050
Regional Transport Plan of the Lesser Poland Voivodeship for 2021-2027 with a perspective until 2030	Lesser Poland RTP	P	2024	2021-2030
Regional Transport Plan of the Masovian Voivodeship with a perspective until 2030	Masovian RTP	P	2022	2022-2030
Regional Transport Plan of the Świętokrzyskie Voivodeship	Świętokrzyskie RTP	P	2023	2021-2030
Regional Transport Plan of the West Pomeranian Voivodeship until 2030	West Pomeranian RTP	P	2023	2021-2027
Regional Strategic Program for Mobility and Transport	Pomeranian RSP	P	2022	2022-2030
Regional Transport Development Program of the Lubuskie Voivodeship with a development forecast until 2030	Lubuskie RTDP	P	2023	2021-2030

Source: own elaboration.

The criteria for the qualitative content analysis include challenges related to transport development in urbanised areas, planned investments, references to transport integration, and the consideration of different transport modes. The document analysis enabled the identification of key objectives set by provincial governments and provided insights into the direction of transport development at the national level (Mróz-Jagiełło, Wolanin, 2013).

Based on desk research, European cities with a high level of transport integration in urban areas were identified. This selection was informed by the experiences of researchers who have analysed these cities in their studies. The case study method enables an examination of applied practices that may also prove effective in other cities, while considering their specific characteristics (Krehl, Weck, 2020; Lavarda, Bellucci, 2022). The analysis of challenges and

solutions implemented in European cities facilitated the identification of specific measures applicable to Polish urbanised areas. According to the authors, these solutions best address the needs of local communities and are feasible in financial, organisational, and spatial terms.

4. Results

An analysis of transport documents at the national and provincial levels has shown that integration is a key component of transport system development. This is evidenced by the fact that the word "integration" appears in every document. It is most frequently mentioned in the Masovian RTP (52 times), the Greater Poland RTP (53 times), and the Lesser Poland RTP (60 times). The term refers to various forms of integration (Figure 3).

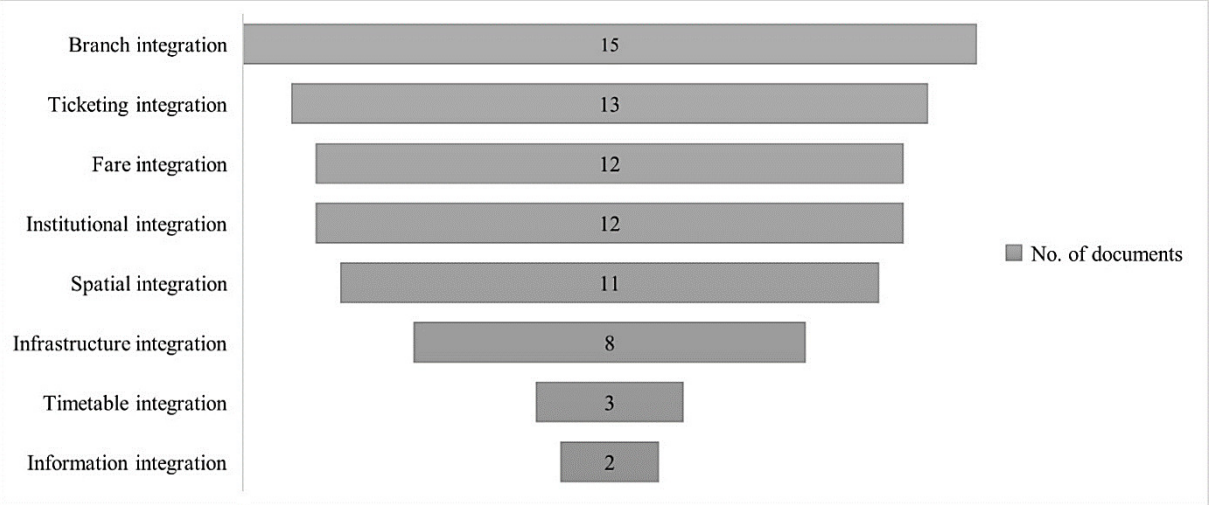


Figure 1. Types of integration included in documents.
Source: own elaboration.

It is noteworthy that the STDS PL considers only branch, fare, ticketing, and institutional integration. All analysed documents reference branch integration, understood as the coordination of different modes of transport. Ticketing and fare integration were equally prevalent, appearing in 13 and 12 documents, respectively. The least frequently mentioned forms of integration were infrastructure integration (8 documents), timetable integration across different transport modes (3 documents – Małopolskie RTP, Lubuskie RTDP, and Pomeranian RSP), and passenger information system integration, which was included in only two documents (Masovian RTP and Warmian-Masurian TP).

From the passenger's perspective, an integrated information system is crucial for seamless mobility, facilitating quick transfers and efficient trip planning. However, provincial authorities rarely prioritise passenger information system integration in their development plans, failing to take steps to improve it. The lack of integration also affects timetable coordination, which can

hinder smooth transfers and force passengers to endure long waiting times for a convenient connection.

The analysed documents also considered different transport modes (Figure 4). However, the STDS PL did not account for all types, omitting trolleybuses, scooters, and micromobility solutions.

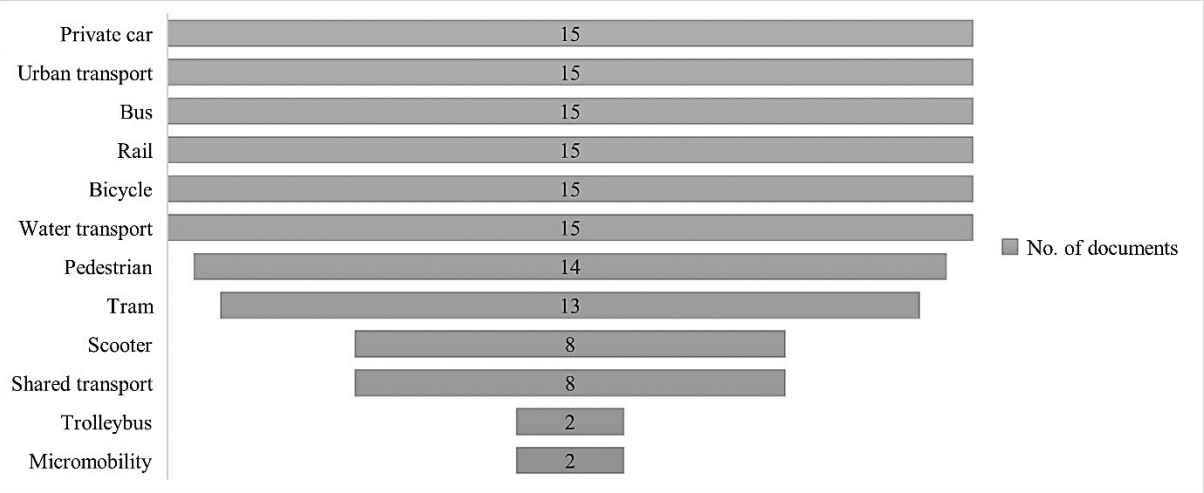


Figure 2. Means of transport included in documents.

Source: own elaboration.

Private cars, urban transport, buses, rail transport (agglomeration, regional, and long-distance), bicycles, and water transport are included in all analysed documents. However, pedestrian transport is not addressed in the Silesian TSDS, and trams are not mentioned in the Warmian-Masurian TP or the West Pomeranian RTP. Trolleybuses operate in only three Polish cities—Gdynia, Tychy, and Lublin—and are therefore included in the Pomeranian RSP and Silesian TSDS, but not in the Lublin STDP. Micromobility, on the other hand, is referenced in the Opole TP and the Podkarpackie STDP. Both micromobility—defined as the use of non-fuel-powered lightweight vehicles for travel—and shared mobility, which involves sharing transport modes with other users instead of owning them, are rarely addressed in mobility strategy documents.

A number of challenges related to transport integration have been identified in the analysed documents. These challenges have been classified into six categories (Figure 5).

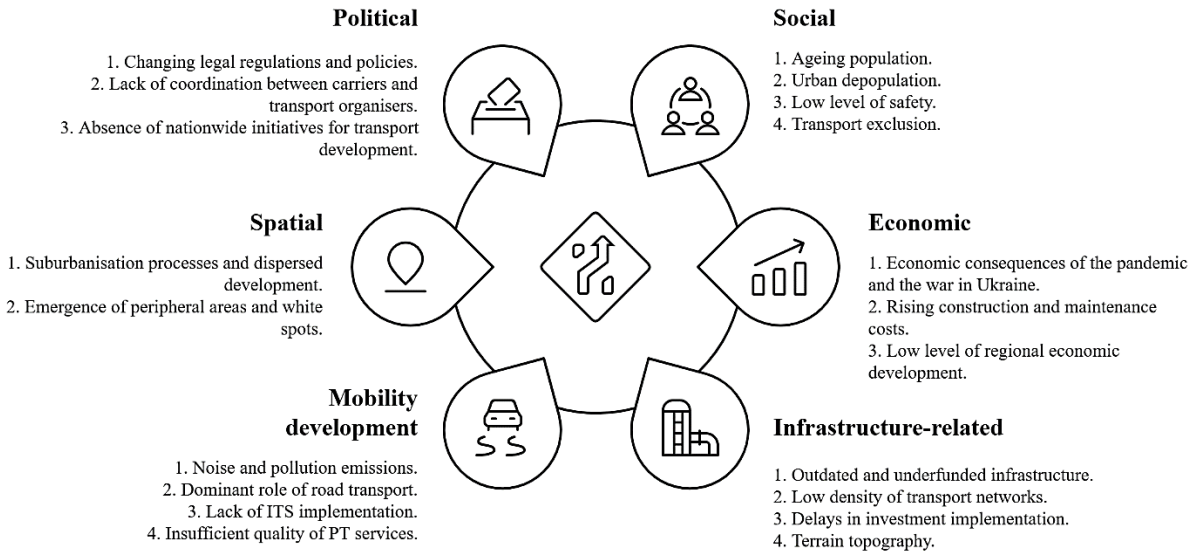


Figure 3. Challenges of transport integration.

Source: own elaboration.

The main social challenges include an ageing population and low fertility rates, which necessitate adapting infrastructure and suprastructure to the needs of people with reduced mobility. Another key issue is the existence of peripheral areas that are poorly connected to county towns or voivodeship capitals. This challenge was highlighted in several documents, including the Podkarpackie STDP and Greater Poland RTP. The problem of urban depopulation was noted in multiple documents, particularly in the Masovian RTP and Greater Poland RTP. The Lublin STDP identified the lasting effects of historical partitions, which are still evident in the voivodeship's poor connectivity with the rest of the country. Additionally, the Masovian RTP and Warmian-Masurian TP addressed the social consequences of the COVID-19 pandemic. Economic challenges include the low level of regional economic development and the impact of economic crises. The documents highlight the high and rising costs of modernising, constructing, and maintaining transport infrastructure. The main challenges in this area stem from underinvestment, particularly in less developed voivodeships such as Podlaskie and Lubelskie. The documents also emphasise the low quality of transport services, including low service frequency and the lack of intermodal integration. The limited use of Intelligent Transport Systems (ITS) further increases PT travel times and compromises safety. It is also important to consider political challenges, particularly those related to legislative and regulatory changes at the European Union level.

In response to the integration challenges identified, the most significant investments aimed at increasing the degree of transport integration in urbanised areas have been outlined. These were compared with key measures implemented in selected European cities that exhibit a high level of transport integration (Table 2).

Table 1.
Proposed measures for implementation in Poland

City	Key actions of European cities	Actions Possible for Implementation in Poland
Amsterdam (Netherlands)	• Pilot program *Mokumflex* – free on-demand transport. • Full ticketing integration within the national smart electronic card system. • Close cooperation between local governments and operators while maintaining service design flexibility. • Implementation of the *Mobility-as-a-Service* concept (*Whim* i *Tranzer*). • Adoption of transport and mobility development strategies, including the Transport Act.	• Implementation and expansion of door-to-door and demand-responsive transport (DRT) in suburban and rural areas, integrated with PT. • Further ticketing and fare integration at the regional level, followed by nationwide integration. • Development of nationwide principles for cooperation between operators and local governments. • Implementation of mandatory transport policies.
Seville (Spain)	• Construction of segregated bicycle lanes in urban and suburban areas. • Expansion of B&R and P&R systems. • Development of high-speed rail within the Madrid-Seville metropolitan area. • Connection of the city and airport via PT. • Designation of Metropolitan Parks as protected, non-developable areas.	• Promotion of cycling through educational initiatives and infrastructure improvements. • Development of metropolitan and high-speed rail networks. • Implementation of the *Mobility-as-a-Service* concept in cities and suburban areas. • Protection of natural green spaces.
Helsinki (Finland)	• Systematic integration of transport development, spatial planning, and urban development. • Pilot project for micromobility development – *Kutsuplus*. • Implementation of the *Mobility-as-a-Service* concept. • Expansion of P&R and B&R systems near railway stations. • KUHA project – small-scale investments to enhance pedestrian and cycling infrastructure.	• Integration of mobility, spatial planning, and urban development in strategic and planning documents. • Development of micromobility and shared transport within the *Mobility-as-a-Service* concept. • Small-scale investments to improve pedestrian and cycling infrastructure.

Source: own elaboration based on dispersed materials.

The reviewed documents are predominantly focused on objectives such as implementing low-emission transport, constructing and modernising infrastructure—including interchanges—increasing the level of integration, long-term transport development planning, and expanding the use of ITS. At the same time, the most significant planned investments include the construction of bypasses and new roads, the modernisation of regional and local railway lines, the development of interchanges with B&R and P&R facilities, the procurement of low-emission rolling stock, the creation of so-called 'green stops,' and educational initiatives targeting transport users. These investments align, at least in part, with measures implemented in European cities. However, Polish local governments continue to prioritise road transport development, while initiatives to enhance pedestrian and cycling infrastructure remain insufficient. For example, micro-investments that could be implemented through public-private partnerships or Civic Budgets are largely absent. Additionally, on-demand transport systems, which serve as a complement to the PT network in peripheral areas, remain underdeveloped in Poland.

Conclusion

Transport integration is one of the most crucial factors in enhancing regional accessibility. Urbanised areas face numerous challenges related to transport and mobility, which can significantly impact the quality of life. Consequently, regional authorities strive to improve transport integration, primarily focusing on intermodal and ticketing integration. However, these measures remain insufficient given the increasing transport demands that extend beyond individual provinces. Therefore, national authorities should impose stronger obligations on municipalities to implement transport strategies that are fully integrated with urban planning and construction policies. The examples of Helsinki and Amsterdam demonstrate that well-designed transport policies can yield tangible benefits.

Transport integration requires a systemic approach to management, including investment planning. The PT network in the provinces is unevenly developed, primarily concentrated in large cities, which contributes to the emergence of peripheral areas and transport "white spots". Their elimination should be based on the development of alternative mobility solutions, such as micromobility, DRT, or shared mobility. The analysed documents suggest that improving accessibility is primarily associated with the expansion of road transport. However, based on the examples of Seville and Helsinki, regional authorities should prioritise enhancing pedestrian and cycling infrastructure and integrating it more effectively with PT. This, in turn, would provide residents with greater opportunities to reduce reliance on private cars.

The study focused on a qualitative content analysis of strategic documents at the national and voivodeship levels; therefore, the results cannot be interpreted in the context of local policies. In the future, the research should be expanded to include an analysis of documents at the regional and municipal levels. The applied methodology was based on document analysis and a review of the relevant literature. Future studies should incorporate quantitative research methods to complement the findings.

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CROSS-BORDER, INNOVATION – SUPPORTING NETWORKS WITHIN THE EU STRATEGY FOR THE BALTIC SEA REGION. CONCLUSIONS FOR POLAND

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Purpose: Innovation systems research has expanded significantly, yet it often overlooks the social processes and mechanisms that underpin the innovative capacity of specific systems. This paper addresses this gap by analysing the dynamics, key processes, and relationships shaping the cross-border innovation environment in the Baltic Sea Region, enhanced by the EU Strategy for the Baltic Sea Region (EUSBSR).
Design/methodology/approach: The author uses a mixed-method approach, combining quantitative analysis based on Eurostat and the European Innovation Scoreboard with qualitative insights from document and network analysis. The author identifies key innovation networks within the EUSBSR, and analyses Poland's role and benefits within these networks, guided by theoretical frameworks on innovation, regional development, and competitiveness.
Findings: The EUSBSR has significantly advanced regional innovation by promoting knowledge transfer, cross-border collaboration, and technology commercialization through flagship projects and innovation platforms. Poland, as co-coordinator of Policy Area Innovation (PA INNO), has strengthened its innovation capacity, particularly in green technology, digital transformation, and bioeconomy. However, challenges remain, including funding cuts and the need for better alignment between EUSBSR goals and national/regional development strategies.
Research limitations/implications: The study's reliance on publicly available data limits primary data depth. Future research could explore the long-term impact of EUSBSR on national innovation policies and the role of non-EU countries in the region. Further analysis of specific flagship projects' effectiveness could offer more detailed insights.
Practical implications: The study suggests that Baltic Sea Region countries should continue fostering innovation ecosystems through cross-sector collaboration, SME support, and better alignment of national policies with EUSBSR objectives.
Social implications: The paper highlights how transnational innovation cooperation can promote sustainable economic growth, address regional challenges (e.g., climate change), and enhance social resilience through innovation-driven job creation and reduced regional disparities.
Originality/value: This paper offers a case study of the EUSBSR as a transnational innovation ecosystem, providing insights into the interplay between governance structures, innovation networks, and regional competitiveness, particularly for newer EU member states like Poland.
Keywords: Innovation Ecosystem, EU Strategy for the Baltic Sea Region, Transnational Cooperation, Regional Competitiveness, Poland, Innovation Networks.
Category of paper: Research paper.

1. Introduction

The European Union (EU) has long recognized the critical role of innovation in achieving global competitiveness and driving economic development, both at the level of individual member states and the Union as a whole. This recognition culminated in the integration of innovation as a key component of competitiveness in the Lisbon Strategy (Council of the European Union, 2000). In its renewed iteration, innovation was not only maintained as a central element but was complemented by the inclusion of knowledge as a fundamental driver of economic growth. According to the revised strategy, EU member states could only secure a competitive edge in the global arena through the strategic application of knowledge, innovation, and education (European Commission, 2020).

In 2010, the "Innovation Union" initiative was launched as part of the Europe 2020 strategy. Its primary goal was to enhance the competitiveness of EU countries by leveraging their respective strengths and addressing weaknesses in innovation. This initiative aimed to increase innovation output across the European Union, fostering economic development and international competitiveness.

The EU's extensive policy measures to support innovation at both the national and regional levels have led to the establishment and implementation of various strategic undertakings, dedicated policies and funding programs, such as the European Innovation Council, Horizon 2020 (and its successor, Horizon Europe), Digital Single Market as well as initiatives funded by the Structural Funds (Rossi, 2022).These efforts have contributed to the economic growth of individual member states, generating employment opportunities, improving citizens' quality of life, and facilitating the adoption of technologies that reduce material and energy consumption. Consequently, these advancements have supported the transition toward cleaner and more socially responsible production practices (Dziallas, Blind, 2019).

However, despite substantial investments and policy measures aimed at promoting innovation within the EU, significant disparities persist across member states in terms of their innovative capacities (Brodny et al., 2023). This variance underscores the need for more refined assessments of the innovation levels across the EU. To measure national innovation performance, the European Innovation Scoreboard (EIS) is commonly employed. The EIS ranks countries based on the Summary Innovation Index, which is calculated as the arithmetic average of several sub-indices. However, this approach has been critiqued for its lack of a solid theoretical foundation, an overemphasis on high-tech sectors (neglecting innovation in other fields), challenges related to data availability and completeness, and concerns over collinearity between certain indicators. Additionally, the EIS methodology is largely oriented towards research and development (R&D) activities (Schibany, Streicher, 2008). These limitations highlight the need for alternative approaches to assessing the innovation capacities of R&D ecosystems and projects as such (Albuquerque 2024) but also EU countries in general, which

could offer a more comprehensive and nuanced understanding of innovation performance (Aytekin et al., 2022, Brodny et al., 2023).

In light of the importance of accurately assessing innovation levels in EU countries and the validity of developing alternative evaluation frameworks, this article proposes an approach to enrich the issue by providing a case study of the innovation ecosystem created and enhanced within EU Strategy for the Baltic Sea Region.

The Baltic Sea Region was selected as the subject of the analysis since by investigating its institutional setup, created by the EU Strategy for the Baltic Sea Region and involving multiple multi-level and cross-sector stakeholders, it is possible to contribute to the broader discourse on transnational innovation environment and transnational innovation-supporting networks. Understanding how such transnational innovation ecosystem, encompassing countries of different level of development but also innovativeness, evolves and function, can provide a wider perspective and develop new knowledge of their contribution, not only to overall regional innovativeness but also to regional competitiveness and development.

The countries in the Baltic Sea Region vary in terms of geography, politics, economy, and society, which has posed and continues to pose challenges in creating a unified "Baltic" strategy and its macroregional innovation ecosystem. On one hand, there are the highly developed Nordic countries and Germany, which rank among the world's top in economic and social development, as evidenced by GDP per capita and indicators such as HDI or more subjective- the life satisfaction index (Eurostat, 2024) but also are perceived as top-innovators by i.a. European Innovation Scoreboard (EIS, 2024). On the other hand, there are post-communist countries that joined the EU in 2004, which although still lagging behind, managed to decrease significantly the income gap. In fact, the degree of convergence in this region has been much faster than in other parts of Europe.

The primary objective of the research is to analyze the transnational innovation ecosystem, concentrating on innovation-supporting networks in the EU macroregional context over the period from 2009 to 2024 and assess the opportunities, streaming from this cooperation for a country from the ‘new EU’, lagging behind the ‘old EU’ members in terms of socio-economic and innovativeness indicators.

The research is inspired by the notion that the innovation-friendly ecosystem is not only determined by economic and financial variables but also institutional, cultural and socio-psychological factors (Costantiello et al., 2023, AlMalki, Durugbo, 2023), and it is guided by three key research questions, which help to structure the investigation, organize the analysis, and provide insights into the results, conclusions, and potential directions for future research:

RQ1: What is the EUSBSR approach to innovativeness and how it evolved from the Strategy’s inception in 2009 until now?

RQ2: What are the key transnational, innovation-supporting networks within the EUSBSR?

RQ3: How Poland, a country that represents the ‘new EU’ members, benefits from the EUSBSR innovation-supporting ecosystem?

To address these questions comprehensively, the research employed a methodology that integrates both quantitative and qualitative approaches, using a basic Eurostat and European Innovation Scoreboard-based set of indicators to analyze the innovation landscape across the Baltic Sea Region as well as desk review, document analysis and network analysis focused on innovation ecosystem of the EUSBSR, based on official documents of the European Commission concerning macroregional policies, EUSBSR, Action Plan, reports on implementations of macroregional strategies and the information and data published on the official EUSBSR website.

2. Literature review

The key role of innovation, innovativeness, and institutional frameworks in driving entrepreneurship and development of enterprises, but also their impact on economic development of countries and regions resulted in widespread popularity of these issues in academic literature. The presents review sketches only some of the research and underlines only selected concepts related to innovation and innovativeness their role in fostering economic development, and the notion of Institutions' impact on innovation-led development, which serve as theoretical background for the case study of the Baltic Sea Region transnational innovation ecosystem.

2.1. Defining Innovations and Innovativeness

Innovation is a multifaceted and interdisciplinary concept, with various definitions depending on the discipline and context. In the realm of economic development, the term "innovation" was first coined by Joseph Schumpeter in 1934. Schumpeter's perspective primarily emphasized technological innovations, defining them as the introduction of new or significantly improved production processes, products, market structures, or organizational methods (Śledzik, 2013, p. 90). He conceptualized innovation as a key driver of economic evolution, contributing to a process of "creative destruction" wherein new innovations replace outdated technologies and systems. Central to Schumpeter's definition is the notion of "newness," which implies that innovations disrupt and replace existing economic structures with more efficient ones (Brodny et al., 2023).

Subsequent researchers, expanded the scope of innovation by categorizing it into various forms, including technical innovation (e.g., novel production methods), non-technical innovation (e.g., new market development or organizational restructuring), product innovation (e.g., new products or services), and process innovation (e.g., improved production techniques) (Brodny et al., 2023). These distinctions reflect the growing complexity of the innovation process and the widespread in the topic by scholars, practitioners, and policymakers.

More recent definitions, such as those by Knowles et al. (2008) and Rogers (2003), have evolved further. Knowles et al. (2008) define innovation as the creation of new products, processes, or business systems, while Rogers (2003) highlights the perception of novelty, defining innovation as an idea, practice, or object that is perceived as new by an individual or organization. The Eurostat offers a more formal definition, describing innovation as the implementation of a significantly improved product or process, a new marketing method, or a new organizational approach in business practices (Eurostat, 20.12.2024).

Innovativeness, often linked with innovation, refers to the ability of an entity—whether a country, region, or company—to generate, adopt, and implement innovative solutions. Wang and Ahmed (2004) define it as an organization's capacity to introduce new products or markets through innovative behaviour and processes. Subramanian (1996) describes it as an enduring trait exhibited by firms over time, suggesting that a valid measure must account for this temporal dimension. Nasierowski (2010) distinguishes between two perspectives on innovativeness: the macro-economic, which focuses on large companies and uses composite indexes to measure inventiveness, and the micro-economic, which emphasizes the commercialization of ideas. While these perspectives reflect different drivers—state policies and internal company dynamics—they should be reconciled for improved innovativeness, as both are critical for economic development and competitiveness (Nasierowski, Arcelus, 2012).

2.2. The Role of Innovations in Enhancing Economic Development

Innovation plays a crucial role in the economic development of nations and organizations, as it is directly linked to productivity growth, competitiveness, and sustainability (Ketels, Porter, 2021). According to the neoclassical theory of economic growth, technological progress—often a product of innovation—is a key determinant of long-term economic growth. Solow (1956) argued that technological advancements, driven by innovation, are essential for sustaining per capita income growth, as they enable economies to develop more efficient production methods and improve overall productivity.

The connection between innovation and economic growth has been further explored through empirical studies. Researchers such as Aghion and Howitt (1992), Grossman and Helpman (1991), and Romer (1990) have demonstrated that technological capital, primarily driven by innovation, is positively correlated with economic growth. Their findings underscore that investment in research and development (R&D) is fundamental to fostering innovation, which in turn fuels economic expansion. Furthermore, there are many studies on innovation, underlining that high R&D activities lead to innovative products enabling enterprises to reach competitive advantages and to gain market shares (Armbruster et al., 2008).

Many studies on non-technical innovations and factors that contribute to broader societal benefits, demonstrated that the rate of innovation affects not only economic growth but also factors such as life expectancy, health outcomes, literacy rates, and social equity (Guzel et al.,

2021; Lin et al., 2012). This highlights the broader implications of innovation for sustainable development, suggesting that innovation is integral not just to economic prosperity but also to improving the quality of life and addressing global challenges such as poverty, health disparities, and environmental sustainability.

In the context of the European Union (EU), fostering innovation is perceived as central to enhancing global competitiveness (Rossi, 2022). The EU's approach to innovation is seen not only in its strategies and policies but also in funding programs like Horizon 2020 and Horizon Europe, emphasizes the importance of innovation as a driver of economic development. By investing in cutting-edge research, the EU aims to support the creation of new technologies and solutions that can position its member states as global leaders in knowledge and innovation-based economies. This approach is mirrored in macroregional strategies, which considering the specific conditions, socio-economic contexts and common challenges, aim at enhancing competitiveness and increase prosperity via specially dedicated instruments in a given, geographically-constraint area (Czarnecka-Gallas, 2019).

3. Method

The article is based on a case study methodology, which according to Yin (2009), is suitable for understanding a real-life phenomenon in depth. A case study was selected as a methodology for this study, because its aim was to gain rich and holistic picture of transnational innovation environment in the Baltic Sea Region. One of the reasons for selecting the Baltic Sea Region as a subject of the case study for transnational innovation ecosystem and innovation networks, in the same being its distinctive features is the economic convergence between the Nordic countries and Germany, often classified in the relevant literature as the ‘old EU’ and Poland the Baltic States, representatives of the ‘new EU’ (Brodny et al., 2023), for many years much faster than in other regions within the EU. This is evident in i.a. income convergence, impressive when we compare the current figures of the GDP per head in PPS with those from 2004, when the value for Estonia, Latvia, Lithuania and Poland were respectively only 50, 48, 43 and 47 per cent of those of the EU average (Eurostat database, 2024).

A case study relies on multiple sources of evidence (Yin, 2009). In this study, the data was collected from various secondary data sources (like Eurostat, European Innovation Scoreboard, keep.eu - European projects databases, Interreg projects databases), policy papers – mainly the EU Strategy for the Baltic Sea Region documents and the Internet -especially in terms of concrete examples of innovation-supporting networks- Policy Area Innovation and the relevant projects or projects’ clusters, combing both quantitative and qualitative data. Setting the institutional and economic context for the EUSBSR transnational innovation environment, a comparative analysis of the approach to innovativeness is carried out, illustrating its evolution

from the initial years of the EUSBSR to its current form, by comparing the first and latest EUSBSR Action Plans.

4. Discussion and Findings

As empirical studies confirm that institutions play a critical role in national innovation systems (Bentzen et al., 2021; Ventura et al., 2020; Rodríguez-Pose, Zhang, 2020; Kang, Jiang, 2020) and provide many examples confirming the impact of the institutions and governance structures on innovativeness a country, policymaker should aim at creating innovation-friendly ecosystem. According to the study by Costantiello et al. such an environment is found to be positively associated with "Basic-school entrepreneurial education and training", "Government procurement of advanced technology products", "Employment share Manufacturing", "Finance and support", "Human resources" (Costantiello et al, 2023). Therefore, it seems reasonable to concentrate on these aspects, while designing innovation-supporting policies and mechanisms.

Institutional innovation drives economic growth by enabling new organizational models and adapting to technological, political, and economic changes (Ruttan, Hayami, 1984). In the Baltic Sea Region, which constitutes the EU's first macro-region, having its own Strategy, it can be claimed that there is a favorable transnational innovation-supporting ecosystem, encompassing all its member countries. Since its founding in 2009, the EUSBSR has developed to play a significant role in strengthening innovative cooperation and regional innovation in the Baltic Sea Region. Through its mechanisms and actions, EUSBSR creates frameworks for knowledge transfer, technology exchange, and best practice sharing while facilitating access to funding and networks. Poland, as an active participant in the EUSBSR structures, also as a co-coordinator of the Policy Area Innovation (PA INNO), benefits from these opportunities to enhance its own innovativeness.

The comparison of the two Action Plans of the EUSBSR, the one from 2009 and the most recent one, updated in 2021, analysed for the purpose of this article show that the approach of the macroregional policy for the Baltic Sea Region has shifted from identifying and overcoming challenges and barriers of the Region's competitiveness to implementing targeted, cooperative, and inclusive strategies that enhance competitiveness, which have had a strong impact on designing and supporting EUSBSR innovation ecosystem and its transnational innovation-supporting networks. The 2009 Action Plan was largely market-oriented, focusing on removing barriers to integration. Its primary strategy centred on regulatory and institutional reforms to improve cross-border market access, particularly for SMEs. The focus was on expanding markets by reducing administrative burdens, and enhancing cooperation in sectors like agriculture, fisheries, and forestry, with sustainability considered within individual sectors. Labor market goals revolved around increasing mobility, while innovation systems were

underdeveloped with limited transnational cooperation. Competitiveness was mainly used in sectoral contexts, and relatively small attention was given to overall, macro-regional competitiveness as well as international competitiveness of the Baltic Sea Region (EC, 2009, pp. 49, 63, 31). In contrast, the 2021 Action Plan is much more innovation-driven, with a strong emphasis on promoting sustainability. Competitiveness is advanced through disruptive, challenge-driven innovation in sectors such as the bioeconomy, tourism, and cultural industries but also an outcome of the whole macro-regional cross-sector and multi-level cooperation. Support for SMEs has shifted toward fostering startup ecosystems and creating co-creation platforms. Sustainability is a central theme, with a focus on the bio-based economy, green tourism, and climate resilience. Labor markets are addressed through upskilling, reskilling, and preparing for a digital future. Innovation systems are stronger, with more emphasis on digital transformation (e.g., AI, IoT), and cross-sector collaboration is more integrated, involving multiple industries.

The findings are organized around the issues of analysis of the innovation ecosystem and innovation-supporting networks concentrated around the Policy Area Innovation, and the analysis of Poland's participation in the EUSBR innovation ecosystem and its main innovation-supporting networks.

4.1. The innovation ecosystem and innovation-supporting networks concentrated around the Policy Area Innovation

One of the main goals of transnational cooperation in the Baltic Sea Region is to increase the Regions prosperity i.e. via enhanced innovativeness. Although this objective is to be achieved by interlinked and multiple EUSBSR Policy Areas, some of the crucial Strategy's mechanisms and actions contributing to this goal are grouped within the Policy Area Innovation (PA INNO), serving as a specific sub-governance structure that stimulates innovation in the Baltic Sea Region. Interregional collaboration through Smart Specialization, cooperation platforms, and flagship projects provides the cooperating countries and regions with access to knowledge, funding, and networks, while supporting technology transfer and the commercialization of research.

PA INNO is managed and coordinated by a network of key actors across the BSR with the main Coordinator, Baltic Institute of Finland and Co-coordinators: Estonian Ministry of Economic Affairs and Communications and Polish Ministry of Science and Higher Education. Moreover, it has the Steering Group (SG) including representatives from national and regional governments within EUSBSR member states. It also invites non-EU neighbouring countries, such as Norway and Iceland, to participate. The Steering Group ensures that Smart Specialisation principles guide innovation activities, addressing local and subregional needs by involving local level representation. A representative from the European Commission's Directorate-General for Regional and Urban Policy (DG Regio) also provides strategic advisory support (PA INNO on clustercollaboration.eu; retrieved on 02.02.2024).

By working through this governance structure, PA INNO ensures that innovation actions are well-coordinated, relevant to regional priorities, and aligned with broader European and global objectives. The 2021's Action Plan underlines several EU, regional, and international strategies aimed at advancing innovation, that constitute a vital reference point for the PA Innovation. They include European Strategic Cluster Partnerships (COSME), Smart Specialisation Strategy, Digitizing European Industry, with particular focus on supporting Digital Innovation Hubs for SMEs' digital transformation, Cultural and Creative Industries Support, Digital Single Market, EU Blue Bioeconomy Roadmap and Bioeconomy Strategy, Horizon Europe Policy Goals, Circular Economy Action Plan for a Cleaner and More Competitive Europe (PA Inno on clustercollaboration.eu). Moreover, PA INNO is directly connected to the European Green Deal and its associated initiatives, such as the new industrial strategy, the circular economy action plan, and the farm-to-fork strategy, which all emphasize sustainability, innovation, and the circular economy (EUSBSR Action Plan, retrieved on 02.02.2024).

The "Innovation" Policy Area (PA INNO) within the EU Strategy for the Baltic Sea Region (EUSBSR) aims to foster sustainable economic growth by strengthening the innovation ecosystem and enhancing regional cooperation. Its main objectives include promoting the region's global competitive position in innovation, supporting entrepreneurship, business development, and scientific progress, and facilitating knowledge exchange and transfer. PA INNO also focuses on creating and strengthening networks across the Baltic Sea Region, adapting resources and regulations, such as coordinating funding sources, and fostering joint programs and investments to address shared challenges. Additionally, the policy area seeks to increase the region's attractiveness as a partner in international innovation cooperation. (EUSBSR Action Plan 2021, retrieved on 22.12.2024; PA Inno website, retrieved on 22.12.2024). The 2021 Action Plan for the EU Strategy for the Baltic Sea Region (EUSBSR) outlines three key focus areas for the "Innovation" Policy Area (PA INNO). The first, Challenge-Based Innovations, aims to drive breakthrough innovations that address pressing 21st-century challenges, including climate change, resource efficiency, demographic shifts, and environmental issues in the Baltic Sea, with a strong emphasis on smart specialization (S3) and interregional cooperation to align regional priorities and innovation investments. The second, Digital Innovations and Transformation, focuses on leveraging emerging technologies like AI, VR/AR, blockchain, robotics, and IoT to tackle societal challenges and unlock new business opportunities, supporting smart cities, start-up ecosystems, and the digital transformation of SMEs. Finally, Co-Creation-Based Innovations seeks to strengthen innovation ecosystems in the region by fostering collaboration among entrepreneurs, scientists, and public institutions to address gaps in knowledge, skills, and market access, while promoting cross-border cooperation in research, technology transfer, and joint public procurement for innovation (PA Inno website, 23.12.2024).

The analysis of the EUSBSR Action Plan and the data published on PA Inno website, which serves as the main communication hub of the network, revealed two mechanisms supporting innovation that are particularly vital in this ecosystem: flagship projects and platforms, and collaboration platforms and networks. While the first ones address specific regional challenges, testing and implementing innovative solutions with the involvement of multiple stakeholders (and are funded with relevant EU Programmes, e.g. Interreg), the second ones, are more general, and encourages the creation of platforms that bring together stakeholders to exchange knowledge, share best practices, and support technology transfer. The Flagships may transform into a regular collaboration platform and function beyond the funding period, which was the case of e.g. ScanBalt project.

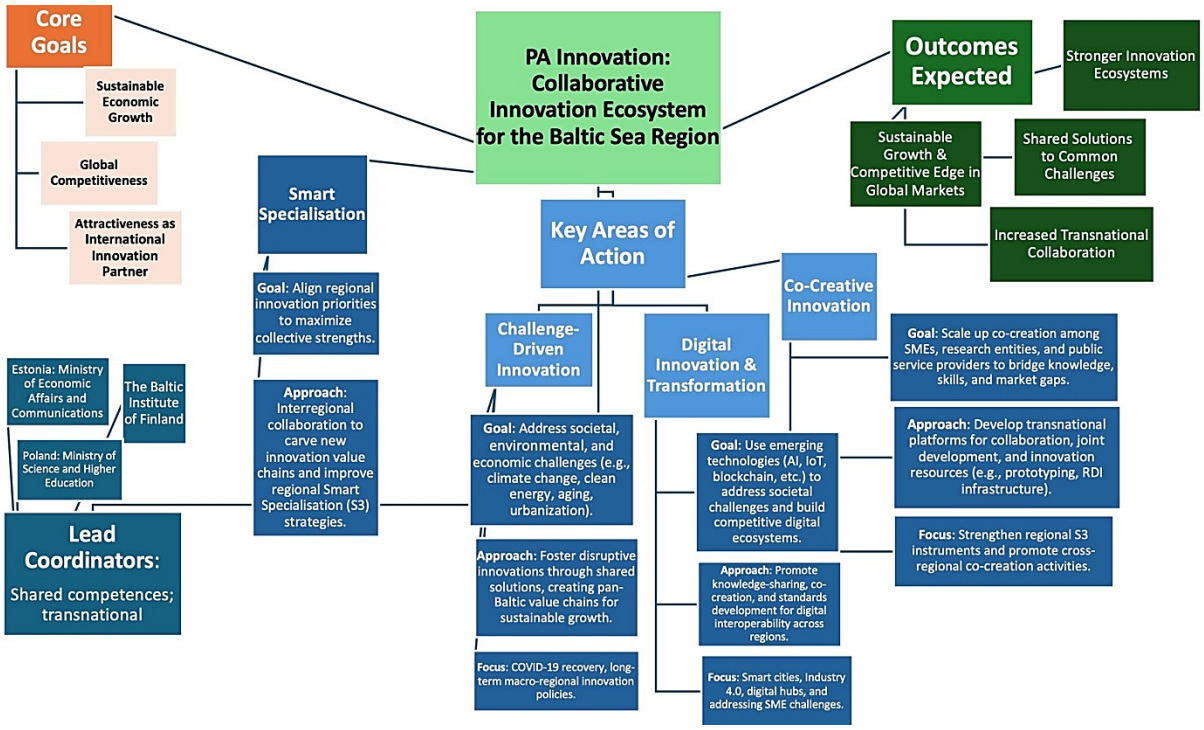


Figure 1. PA Innovation as a collaborative innovative ecosystem in the Baltic Sea Region.

Source: Own conceptualisation on the basis of the EUSBSR Action Plan 2021 and EUSBSR website (PA Innovation), retrieved on 22.12.2024.

4.2. Poland's participation in the EUSBR innovation ecosystem and its main innovation-supporting networks

As a central member of the Baltic Sea Region, Poland plays a significant role in the regional cooperation framework. The EUSBSR has strengthened Poland's collaboration with neighbouring Baltic states fostering cross-border initiatives that enhance trade, investment, and shared infrastructure. Poland's benefits from the region's focus on infrastructure projects, such as Rail Baltica, improved transport and energy networks but also the R&D and innovation cooperation, to give only some examples.

Experiencing one of the fastest growth rates in GDP, GDP per capita and other economic indicators among the EU member, Poland benefits from various types of advantages connected with deeper integration within the Baltic Sea Region. While the Region's economy is much shaped by Germany and the Nordic states, Poland has made significant economic strides, and the EUSBSR supports convergence by integrating the country more closely with the more advanced economies of the northern Baltic region, which reduces regional disparities and helps Poland improve its economic competitiveness on a European and global scale.

Considering that innovativeness theory but also theories associated with regional development as well as regional competitiveness put much emphasis on the role of the innovations and clusters in increasing the productivity and leading to higher value creation, the EUSBSR cooperation framework that since the beginning highlighted the need for common Baltic R&D and innovation strategy has created or least aspired to create a highly innovative, cross-sector and dynamic environment. The Strategy's focus on creating co-creation platforms and start-up ecosystems can support the development of SMEs in Poland. The shift from earlier focus on regulatory reforms to supporting innovation and entrepreneurial ventures gives Polish businesses more opportunities to engage in high-growth sectors. Moreover, as the EUSBSR places a strong emphasis on innovation-driven growth, particularly in sectors such as the bioeconomy, digital transformation, and green technology, Poland, which has been traditionally strong in sectors like agriculture and manufacturing, now can further diversify and enhance its competitiveness by fostering start-ups, tech innovation, and digital solutions. Moreover, pan-Baltic initiatives supporting AI, IoT, and digital platforms provide Poland with the tools to upskill its labour force and transition into high-value sectors. This is crucial for Poland as it seeks to remain competitive in a rapidly digitizing global economy. The cooperation within scientific networks and clusters in the Baltic Sea Region that have been strongly supported within the EUSBSR has given an opportunity for Polish stakeholders to participate in knowledge and innovation transfer, not only in the academic but also other economic sectors. For example, there have been a fruitful cooperation within public sectors representatives from different administration levels across the Baltic Sea Region. One of the examples of topics that was the subject of such processes was the intelligent specialization of the regions, but the cooperation was successful across themes from enhancing tourism services to infrastructural projects.

As the PA Innovation- supported and promoted innovation ecosystem concentrates i.e. around transfer of innovations within e.g., flagship projects and processes, Poland has been an active member of such initiatives. Moreover, as one of the coordinators of PA INNO, Poland plays a significant role in this process, benefiting from the opportunities offered by EUSBSR to enhance the innovation potential of its regions.

From the flagships, enlisted in the 2021's Action Plan under the Policy Innovation, namely: BSR S3 Ecosystem Platform, BSR Stars Platform, Submariner network, ScantBalt, Baltic Science Link and Baltic Sea Region Digi co-lab, Polish stakeholders are the official partners in

four out of six networks (PA website, EUSBSR Action Plan, retrieved 22.11.2024). More and more Polish stakeholders participate in innovation-oriented projects, although this increase is faster in the ones funded by Structural Funds than the ones centrally managed by the EU Commission.

There are also direct financial benefits to Polish stakeholders by their involvement in EUSBSR -supporting projects, mainly funded from Interreg funds, for example the Baltic Sea Region and South Baltic Programmes. Poland has been very active in participating in transnational and cross-border EU projects. Comparing number of realized projects, it is behind Germany, Sweden and Finland, but ahead of other Baltic Sea Region countries, with a number of approximately 1,5 thousand projects from the area of transnational and cross-border cooperation (data retrieved from Keep.eu accessed on 12.10.2024). Germany remains Poland's primary project partner, considering all funds available for Polish stakeholders. On the other hand, Poland faces some challenges from reduced EU Funding as it needs to adapt to funding reductions. With a 20% reduction in the Interreg budget and a lower co-financing rate (80% from the previous 85%), Poland will need to find ways to maximize the impact of EU funds while mobilizing more national and regional resources. This could place pressure on local and national authorities to align their priorities more closely with EUSBSR goals. Therefore, Poland must ensure that the priorities of the EUSBSR—such as innovation, sustainability, and digitalization—are embedded in its national and regional development programs to access and mobilize EU funding more effectively. The projects funded from these programmes are particularly aligned with the EUSBSR's objectives, especially after the Strategy's revision and within the new financial period from 2021-27.

Poland is in a strong position to capitalize on the evolving macroregional strategy for the Baltic Sea Region. By embracing innovation, digital transformation, and sustainability, Poland can further enhance its regional competitiveness. However, this will require a continued focus on upskilling, cross-sector collaboration, and the alignment of national priorities with EUSBSR objectives to ensure the effective use of available funding and resources. At the same time, addressing geopolitical risks and ensuring regional stability will remain crucial for long-term success in the Baltic Sea Region.

5. Summary and conclusions

The evolution of the EUSBSR's approach to regional competitiveness from 2009 to 2021 reflects a significant shift in the region's development strategy. Initially focused on market integration and sectoral improvements, the strategy has matured into a more comprehensive, innovation-driven approach that emphasizes cross-sectoral collaboration, sustainability, and digital transformation. The role of PA Innovation has been central to this transition, helping

to foster innovation networks and enabling the region to respond proactively to global challenges. As the EUSBSR continues to evolve, the integration of these innovation-driven strategies will be crucial for enhancing the region's competitiveness in an increasingly interconnected and competitive global economy.

The research emphasizes the importance of a transnational innovation-supporting ecosystem, which not only involves technological and economic aspects but also institutional, cultural, and socio-psychological factors. It discusses the mechanisms that have been crucial in advancing innovation, such as flagship projects and cooperation platforms, which are designed to tackle regional challenges and promote knowledge exchange. These mechanisms support sectors like SMEs, AI, and digital transformation. Moreover, transnational cooperation through initiatives like the EUSBSR plays a crucial role in fostering sustainable economic growth, enhancing regional competitiveness, and reducing disparities in innovation capacities across the EU.

The analysis reveals that Poland has benefitted from this innovation framework, which has allowed the country to strengthen its participation in EU-funded projects, engage in technology transfer, and collaborate with more advanced economies in the region, particularly the Nordic countries and Germany. Despite these opportunities, Poland faces challenges related to funding reductions in the new EU budget period and must align its national development priorities more closely with the EUSBSR's innovation goals to maximize the benefits of available resources. Poland has made significant progress in utilizing these cross-border innovation networks, which have contributed to its socio-economic convergence with more developed EU regions. However, Poland must continue focusing on creating innovation-friendly environments, particularly in entrepreneurship, smart specialization, and digitalization, while addressing the challenges posed by reduced funding and evolving EU policies.

The study's reliance on publicly available data and documents limits the depth of primary data. Future research could explore the long-term impacts of EUSBSR on national innovation policies and examine the role of non-EU countries in the region. Additionally, further investigation into the effectiveness of specific flagship projects and platforms in promoting innovation could provide more nuanced insights, also in terms of their role in decreasing innovation- and competitiveness-related disparities between the best performing countries in the Baltic Sea Region, included in the group of the 'old EU' and the 'new EU members': Poland the Baltics. Additionally, future research on transnational innovation-supporting networks should focus on comparative studies between the EU and integration blocs e.g. in North America or Asia. By examining how innovation policies differ in regions such as the U.S., Canada, but also China and the Asian tigers, researchers can identify effective strategies and best practices that could be adapted to the EU context. Key areas of comparison should include policy design, implementation, and outcomes, as well as the influence of regional factors on innovation performance. Additionally, research should explore international collaborations and partnerships, investigating how global networks, cross-border investments,

and technology transfers contribute to innovation. This will help uncover ways for the EU to better leverage these opportunities within its own innovation ecosystem.

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THE CONCEPT OF MEASURING ENTERPRISE EFFICIENCY IN SUPPLY CHAINS

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Purpose: A company that is a member of supply chains cooperates with its suppliers and customers in a more intensive and diverse way than in the case of ordinary transactional relationships. This cooperation generates externalities for supply chain partners, which are not always adequately compensated. This distorts the actual efficiency of the company from the point of view of the entire supply chain. Active supply chain management requires objective information about the efficiency of its individual members. The aim of the article is to propose a method for objective measurement of enterprise efficiency in supply chains.
Design/methodology/approach: The study used the system analysis method for the interactions of supply chain participants. Various forms of effects of mutual interaction between the company and its first-tier suppliers and customers were identified. Next, the principles for including these interactions in enterprise efficiency measures were indicated.
Findings: The proposed method involves proper correction of the efficiency measures recorded in practice concerning the effects of the mutual interaction of the enterprise with its suppliers and customers.
Research limitations/implications: The effectiveness of this method depends on the scope of identification and accuracy of quantification of externalities.
Practical implications: The application of this method in practice can support supply chain management by objectively examining the contribution of a given enterprise to the efficiency of the entire supply chain.
Originality/value: The proposed concept for measuring the efficiency of the enterprise includes externalities, which allows for a more objective assessment of the contribution of the enterprise to the final outcomes of the supply chain.
Keywords: efficiency, externalities, enterprise, supply chain.
Category of the paper: Research paper.

1. Introduction

The purpose of supply chains is to create maximum added value for the final customer, entire supply chains, individual members and stakeholders (Witkowski, 2003). However, the most essential thing in supply chains is the benefit delivered to the end consumer.

That determines the demand for products and influences the added value of supply chains (understood as the difference between the total sales value and the value of purchased materials and services of all its members). The issue of the distribution of added value between participants in a specific supply chain is secondary but still crucial for managing the entire supply chain.

In supply chains, benefits/losses generated by one company are often transferred to another unit in the chain. This is due to the peculiarities of supply chains (trade-off dependencies, sub-optimization phenomena) that are the result of cause-and-effect relationships in the flow of goods processes. In supply chains, companies cooperate more closely with each other than in ordinary transactional relationships. They implement various strategies to integrate their activities, which affects the need to share costs and benefits. Incomplete compensation for the effects of such cooperation generates externalities that distort the actual efficiency of the enterprise in the supply chain.

The literature provides examples of many methods and their combinations used for measuring broadly understood supply chain efficiency, such as: balanced scorecard, SCOR model, AHP, DEA, benchmarking, among others (e.g. Reddy, Rao, Krishnanand, 2019; Mbang, 2013; Liang, 2006). A comprehensive measurement system should include both integrated measures and criteria for assessing individual chain elements so that it is possible to fully identify where problems arise and to take quick corrective steps (Tarasewicz, 2014).

The aim of this study is to propose a method for measuring the efficiency of an enterprise as a participant in a supply chain (considering interactions with a selected first-tier supplier and customer) or a supply network (considering interactions with many first-tier suppliers and customers). This method is designed to indicate the objective contribution of an enterprise to the efficiency of supply chains (its added value, resources used, costs incurred) by eliminating from its business results (recorded in practice) the effects of the impact of suppliers and customers on the enterprise (outside externality) and the impact of the company on suppliers and customers (own externality).

2. Interactions in supply chains

Companies operating in supply chains interact with each other, generating externalities. In the literature on this subject, externalities are defined as follows:

- an externality is the result of actions by a given entity affecting the level of well-being of another entity (Kisperska-Moroń, Płaczek, Piniecki, 2002),
- an externality occurs when someone's action affects the welfare of outsiders, and no one pays or receives compensation for it (Mankiw, Taylor, 2009),

– externalities occur when production or consumption activity has a side effect on the utility function or production function of another entity. The term "side effect" means that this effect is not the subject of exchange, and this transaction is not characterized by a specific price (Pawłowska, 2000).

The causes of externalities vary and depend on the specificity of a given activity. An enterprise in supply chains may deal with two groups of sources of externalities. The first group concerns every enterprise operating on the market. The most important causes of externalities include: production technology, technological progress and innovation, synergy effects, complementarity of goods, network effects, common resources (Mankiw, Taylor, 2009; Stiglitz, 2004; Droniak, 2002).

The second group of causes of externalities is related to the active management of activities performed within supply chains and the relationships between individual companies. The main assumptions of the supply chain management concept come down to cooperation between suppliers and customers, integration of business processes and focus on serving the end consumer to achieve their satisfaction (Szymczak, 2015). The supply chain management concept is dominated by a philosophy based on widespread cooperation leading to close integration between individual entities and the principle of reciprocity (sharing risks and benefits).

Cooperation between members of supply chain can be implemented on two different levels: stimulating and supporting the development of suppliers by the enterprise and engaging the potential and knowledge of suppliers in improving the competitiveness of the enterprise. Analogous relations occur between the entrepreneur and the customers.

An enterprise can influence the development of suppliers in various ways (Dąbrowski, 2015). Indirect methods involve the use of market mechanisms and economic tools to stimulate the development of suppliers (e.g. competitive pressure, supplier assessment and certification system, motivation system). Direct methods involve the enterprise's investment involvement in the activities of suppliers. Among the activities that can potentially generate externalities, the following should be mentioned:

– investments in tangible assets. They consist of investing the company's financial resources in the purchase of suppliers' assets that improve the production process, implementation of new technologies, reduction of resource consumption standards, compliance with environmental standards by suppliers;
– financial investments. The scope of these investments can be very diverse: from advances on future deliveries, granting loans, guaranteeing credits, to the purchase of bonds and other debt securities of the supplier;
– investments in intangible assets. These primarily include training the supplier's employees, visits of the company's specialists to the supplier to solve various problems, joint research and development projects, sharing know-how.

In turn, supplier involvement in the company's operations can be manifested through (Dąbrowski, 2015):

- early supplier involvement. This involves the company engaging suppliers in the process of developing new products or modifying existing products at the initial stages of their design or while introducing changes;
- supplier suggestion programs. Suppliers can contribute to the improvement of production, logistics, supply, and distribution processes, quality improvement, and even to the growth of the company's sales thanks to the improvement proposals they formulate;
- buyer-seller improvement teams/projects. The knowledge of suppliers participating in projects improving the company's operations is particularly useful in terms of reducing costs, inventory, improving quality, and reducing delivery times in areas where they cooperate on an ongoing basis;
- on-site supplier representative. Permanent supplier representatives can help manage inventory, transport, and purchases and provide technical support for the company's operational activities.

Analogous to the forms of cooperation between a company and its suppliers presented above, there are relationships between an enterprise and its customers. The success of such programs depends on a fair distribution of effects between the company and its suppliers and customers.

All mutual impacts can lead to contribute to the creation of outside and own externalities of the enterprise (Figure 1).

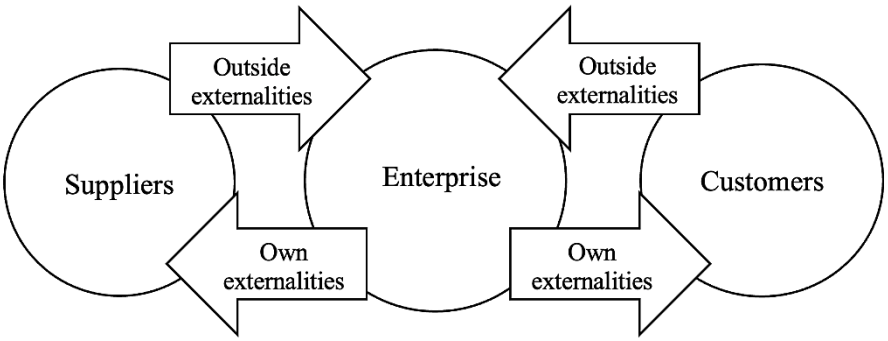


Figure 1. Mutual interactions of an enterprise with suppliers and customers in supply chains.
Source: own study.

In this study, for the purpose of further analysis, the following terms will be introduced. The outside gross externality of the enterprise will be understood as the effect of the impact of suppliers and customers on the results of the enterprise's activity. In turn, own gross externality of the enterprise will determine the effect of its impact on the activities of suppliers and customers. If these effects are not completely compensated, the remaining part will be called outside/own net externalities of the enterprise (see Figure 2).

3. Efficiency and structure of an enterprise's effects in supply chains

Economists interpret the efficiency category in different ways. In the narrowest sense, efficiency is understood in a similar way to the concept of "economy" in praxeology, i.e. as the ratio of achieved results to inputs. In a slightly broader sense, efficiency is identified with benefit (the difference between achieved effects and incurred costs) and “economy”. In an even broader sense, efficiency is presented as effectiveness (the degree of implementation of set goals), benefit and “economy” (Grzesiak, 1996). In the broadest sense, efficiency also includes the qualification of the effect obtained from the perspective of market utility, i.e. added value for the customer (Blaik, 2010). Nowadays, the concept of efficiency, especially in the dynamic sense, includes such aspects of business activity as creativity, innovation, adaptability, reactivity and flexibility, knowledge acquisition, as well as ethics (Tarasewicz, 2014).

To conduct an analysis and assessment of multidimensional business activity, various categories are certainly needed. However, it seems that efficiency should not replace other concepts that more precisely characterize various aspects of the company's activities and supply chains than the term "efficiency". The common understanding of the efficiency category comes down to the relationship between the effects (outcomes of activity) and the costs incurred to obtain them. Efficiency refers to the ability of an organization to produce goods for direct consumers at relatively low costs and with full use of resources. The definition of organizational efficiency can be extrapolated to the supply chain level because supply chain stakeholders are involved in organized and coordinated activities aimed at increasing the ability to reduce costs and enable good use of resources in business processes because these processes are extended to the entire supply chain (Negi, 2021).

Pasieczny and Więckowski (1987) underscore that the effects of economic activity are specific products and services with a given assortment and quality structure. The category of effect can, therefore, be understood as a product of labour, its utility value, i.e. a thing or service that meets a specific social need. The problem of measuring the utility value of goods has not yet been solved by science, which is why natural units of production are often used to measure it. From the point of view of value, the form of expressing the economic result of an enterprise can be the achieved revenue, added value or profit.

Matwiejczuk (2006), in turn, extends the interpretation of this concept. He believes that efficiency also depends on the operating conditions created by the environment. It seems that the effects should express the complete results of economic activity, both planned and unintended. The effects of an enterprise are the total impacts of its activity, both those that are reflected in the company's records and those that affect the activities of other entities and have an economic, social or ecological dimension.

From the above-mentioned definitions of externalities, it follows that they are the result of the activity of one entity, which affects the level of costs, employed resources, revenues and utilities of other entities and remains uncompensated by the party generating them. Externalities can cause positive and negative effects on other entities. Positive externalities (external benefits) are reflected in cost savings, increased revenues and income, or other forms of benefits, not necessarily economic. Negative externalities (external costs) bring additional costs, losses, or other inconveniences to the entity's environment. Figure 2 presents a diagram of the effects of the enterprise from the point of view of its interactions with other entities in supply chains[1].

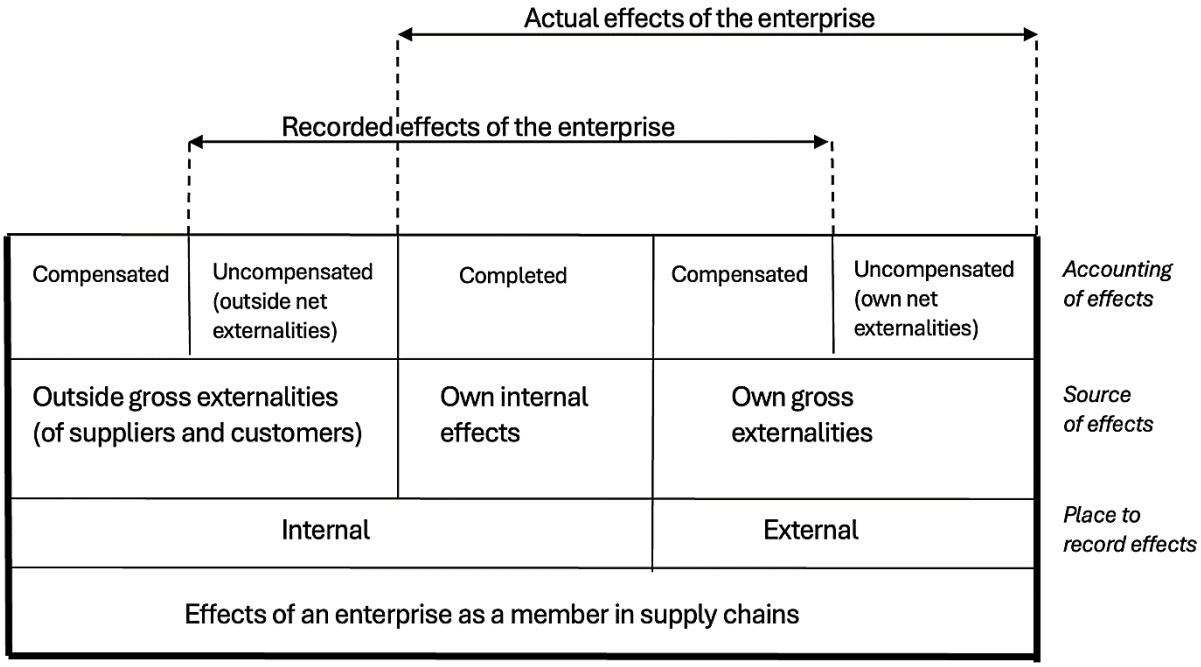


Figure 2. Structure of enterprise effects in supply chains.

Source: own study.

The internal effects of a company are the result of its own activity (own internal effect) as well as the effect of the interaction of suppliers and customers (gross outside externality). The consequences of the company's activity reach beyond its borders, creating the so-called own gross externalities on suppliers and customers. Not all effects of the company's interaction with the environment are quantified and compensated. After considering the redistribution of effects, we can talk about the outside net externality of the enterprise and the own net externality of the enterprise.

Recorded effects of an enterprise are the effects included in the records of the enterprise in accordance with applicable regulations and legally belonging to the enterprise. They should be the result of the enterprise's own activity only. The results of the interaction of other entities on the enterprise (outside net externalities) should be eliminated from the measurement, and own net externalities (uncompensated own externalities) should be included. Their significance is important when measuring and assessing the company's actual effects (Figure 2).

4. The concept of objectivizing the measurement of enterprise efficiency in supply chains

Enterprises most often measure and evaluate various aspects of their activities using groups of KPIs (Key Performance Indicators). KPIs mainly characterize the effectiveness and efficiency of an enterprise. To calculate efficiency, measures expressing the relationship between effects and inputs in various ways can be used. Comparing effects and costs in a differential form only expresses efficiency to a certain extent. The enterprise's profits depend on two factors: the amount of resources used and the efficiency of their use. That is why profit only expresses the quantitative aspect of efficiency. In relative terms, effects and inputs can be calculated based on average or incremental values. This arrangement best reflects the essence of efficiency and indicates the qualitative aspect of efficiency. Other methods of comparing effects to inputs, such as relative savings on resources (costs) or measures indicating what part of the effect is the result of increased efficiency, only partially characterize efficiency because they take the form of an effect and the quality of the increase in effect and do not express the essence of efficiency.

There are also other measures of efficiency in the literature, such as the cost-to-resource ratio or the index of increase in effects (production, profit). It seems that the first relation, from the point of view of the definition of efficiency adopted at work, cannot be considered a measure of efficiency[2]. The second relation has some justification in the fact that the improvement of efficiency should be associated (according to some authors) with an increase in positive effects. However, the increase in effects may be the result not only of the improvement in efficiency but also the scale of the resources involved.

Determining the proper way of comparing effects and inputs does not exhaust the issue of correct efficiency measurement. There should be a cause-and-effect relationship between inputs and effects, and these components should be complete, i.e. include all component elements.

Considering that the object of the efficiency measurement is an enterprise in supply chains, only those effects and inputs that are the result of the activity of this organization should be the subject of interest. The concept of objectifying the measurement of the efficiency of an enterprise in supply chains presented below is based on an appropriate correction of efficiency measures used in practice. At the base of this concept lies the structure of the company's effects presented in Figure 2. Correction of efficiency measures should be carried out in accordance with the following principles[3]:

- in order to determine the actual effects of the enterprise's activity in supply chains, own net externalities should be added to its recorded effects, and outside net externalities should be subtracted;

- externalities should be calculated as current effects (changes in revenues, costs, individual types of costs) and as capital effects (changes in fixed assets, current assets, labour resources). Depending on the type of measure, externalities should be presented in total (for a synthetic efficiency measure) or only their appropriate part (for partial efficiency measures);
- the correction of efficiency measures by the amount of outside net externalities is based on identifying them and subtracting them from the recorded effects of the enterprise and performing operations in the remaining efficiency components (costs and resources) that are the opposite of those that actually occurred (the principle of neutralizing the impact of external factors);
- the correction of efficiency measures by the size of the enterprise's own net externalities is based on identifying them and adding them to the recorded effects of the enterprise with a simultaneous correction of the remaining efficiency components (costs and resources) related to the implementation of externalities.

According to the adopted concept, the actual efficiency of the enterprise in supply chains should be expressed by measures (resource and cost) of the following general construction, formulas (1) and (2):

$$E_{en}^{r} = \frac{E_{re} - E_{ne}^{ou} + E_{ne}^{ow}}{R_{en} + R_{ex}^{ou} - R_{ex}^{ow}} \tag{1}$$

$$E_{en}^{c} = \frac{E_{re} - E_{ne}^{ou} + E_{ne}^{ow}}{C_{en} + C_{ex}^{ou} - C_{ex}^{ow}} \tag{2}$$

where:
E_{en}^{r}– resource efficiency measure,
E_{en}^{c} – cost efficiency measure,
E_{re}– current recorded effect of the enterprise,
E_{ne}^{ou}– current outside net externality,
E_{ne}^{ow}– current own net externality,
R_{en}– enterprise resources,
R_{ex}^{ou}– outside capital externality,
R_{ex}^{ow}– own capital externality,
C_{en}– enterprise costs,
C_{ex}^{ou}– outside current (cost) externality,
C_{ex}^{ow}– own current (cost) externality.

In practice, various measures are used to determine the efficiency of companies: synthetic and partial; value, natural and value-natural; static and dynamic; average and incremental; gross and net. The efficiency of an enterprise can be more fully expressed by a system of measures. This system should meet several requirements. The selection of measures,

their number and level of detail should depend on the purpose of assessing efficiency. Partial measures should characterize the efficiency of using individual types of resources and costs, types of activity and complement each other. The priority of measures in the system should correspond to the economic goals of the company and the supply chain strategy. All measures used to determine the efficiency of the company in supply chains should be corrected for the effects of the company's interaction with suppliers and recipients.

5. Summary

Measuring the efficiency is an extremely difficult task, both theoretically and practically. This results from the multi-aspect nature of economic processes, the impossibility of full quantification of effects and inputs and maintaining their comparability, and even the lack of an unambiguous interpretation of the concept of "efficiency". In addition, enterprises do not consider the indirect effects of their activities, both negative and positive. The basis for their decisions are the so-called private, not social, marginal costs and benefits. This results in the need to apply not only various regulatory mechanisms in the economy but also to correct the measurements and assessments of the activities of economic entities. This situation occurs especially in the case of supply chains, where the cooperation of entities is more intensive and diverse, and the principle of common risk, sharing inputs and benefits is not always fully implemented.

The concept presented in this article is theoretically simple, but its implementation requires quantification of externalities generated by both the suppliers and customers of the enterprise, as well as the effects of the enterprise itself recorded by its partners from the supply chain. Not all effects of impacts are easily measurable. The greater the scope of externalities considered in the corrections of the measures, the more objective the actual efficiency of the enterprise in the supply chains will be.

In the current era, the assessment of the economic efficiency of business activity alone is insufficient. The pursuit of sustainable development by societies forces enterprises to change their approach to efficiency. The concept of economic effects is expanding from the manufactured market product to all effects of the enterprise's activity. The presented concept of objectivization of the measurement of the efficiency of an enterprise in the supply chains should also consider (in its own externalities) the ecological and social effects of its activity. The study of the interaction of the enterprise with the environment requires further detailed development, in particular, the identification and measurement of externalities and the integration of economic and social aspects of business activity.

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Footnotes

1. In Figure 2, the structure of economic effects is presented, assuming that the effects are positive and expressed in net terms (e.g. profit). The above assumptions were made to simplify the diagram.
2. This relation is called the cost intensity of assets. Including it among the efficiency measures results from the interpretation of costs as an "unfinished" effect, as a condition for achieving final effects (Pogorzelski, 2007).
3. For the sake of simplicity, the assumption was made that the effects of the company's activity are measurable, positive and expressed in net terms. Negative effects should be treated in the opposite way to positive effects (where positive effects are added, negative effects should be subtracted). In the case where both positive and negative effects are generated, the total effects constitute their algebraic sum. If the effect is expressed in gross terms, then it is not possible to fully consider all the impacts of the company and its partners (i.e. those affecting the company's costs and resources).

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SOCIAL RESPONSIBILITY OF UNIVERSITIES – FROM DECLARATION TO IMPLEMENTATION

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Purpose: The aim of this article is to present the results of research concerning the implementation process of the concept of social responsibility at Polish universities that, between 2017 and 2022, formally joined the group of signatories of the "Declaration of Social Responsibility of Universities" (USR Declaration, 2022).
Design/methodology/approach: The empirical findings are presented against the background of a literature review. This article is part of a broader research project entitled "Social Responsibility in the University Value Chain" (2024-2026), funded by the Angelus Silesius University of Applied Sciences. The empirical study was conducted in 2024 and involved the analysis and assessment of information on USR practices published on the websites of 39 Polish higher education institutions (HEIs) that had signed the "Declaration of University Social Responsibility".
Findings: Based on literature and empirical studies, the authors demonstrates that the USR aligns with the principles of modern university management, and that its incorporation into the organisational structure may effectively contribute to enhancing institutional resilience to risks, as well as to the development of future-oriented competencies.
Originality/value: The essence of the presented approach lies in the continuous development of cooperation among various groups of external and internal stakeholders (students, university staff, representatives of the socio-economic environment, etc.). This cooperation may result in the creation of interdisciplinary teams, developing strategies and action plans aimed at better aligning academic education with the needs not only of the labour market but also of future generations. The research conducted in 2024 among the universities that are signatories of the "USR Declaration" led to the creation of a list of good practices, which may serve as inspiration for those institutions wishing to develop the idea of USR.
Keywords: social responsibility, university, social responsibility of universities, university management, external stakeholders.
Category of the paper: research paper.

1. Introduction

Higher education today faces numerous challenges – social, technological, and economic.

One of these challenges is generational diversity, with the most commonly distinguished groups being: BB (Baby Boomers) – often company executives or retirees over the age of 61; Generation X – aged 45-60; Generation Y (Millennials) – aged 29-44; and Generation Z – currently aged 13-27. Additionally, the mid-2020s are indicated as the final birth years of those belonging to Generation Alpha (Stolarczyk, 2024, pp. 303-304; EY Poland, 2025).

This diversity requires universities to consider the evolving needs of all stakeholder groups in both their development strategies and ongoing activities: students (full-time and part-time), academic teachers, administrative staff, and representatives of the socio-economic environment collaborating with the university. Another major challenge to the teaching and research activities conducted at universities is the rapid development of technologies, including artificial intelligence. Unpredictable needs and risks increasingly underscore the importance of enhancing institutional resilience to dynamic change (Hnatyszak, 2018, p. 336).

Addressing these challenges calls for modern university management, where decisions are not only evidence-based but also justified from the perspective of all stakeholder groups: students, staff, local communities, business representatives, local government units, and others.

In response to these dynamically evolving needs and challenges, the concept of sustainable development and university social responsibility has emerged. These concepts direct the actions of higher education institutions toward socially relevant aspects such as ethics, organisational governance, transparency, integrity, accountability, concern for current and future generations, and environmental stewardship (Detyna, 2023, pp. 208-234; Detyna, 2024a, pp. 65-66). In this context, it is worth noting that the "USR Declaration", signed thus far by 160 Polish universities, comprises 12 principles to which the research results refer in the description of good practices[1].

2. Literature Review

The idea of social responsibility was popularised by H.R. Bowen, who defined Corporate Social Responsibility (CSR) as an organisation's obligation to pursue policies, make decisions, and follow lines of action that are desirable in terms of the objectives and values of society (Bowen, 1953, p. 6). Since the 1950s, the concept has evolved – from a focus on the decisions

[1] Since 2017, Polish universities have been increasingly joining the group of signatories of the "Declaration of University Social Responsibility". In 2022, this group grew by an additional 77 institutions, bringing the total number of public and private higher education institutions involved to 160.

of individual entrepreneurs or managers to the activities of the entire organisation (Bolibok, 2022; Khoo, Monroe, 2022). Contemporary literature points to the need for comprehensive and multidimensional implementation of CSR across all areas of organisational functioning, emphasising the importance of the environment, customers, employees, and investors (Latif, Bunce, Ahmad, 2021, pp. 815-829). A key manifestation of organisational social responsibility should be its civic stance (Porter, Kramer, 2007, p. 85).

The integrative and comprehensive nature of CSR is emphasised by the European Commission, which states that socially responsible organisations should consider social and environmental issues in their operations in collaboration with stakeholders and on a voluntary basis (Circular Economy Portal in Practice, 2025). In this context, the lasting success of an organisation (university) stems from continuous dialogue with the environment, taking into account aspects such as environmental protection and the building of social capital.

It is also worth noting that, according to ISO 26000, a socially responsible organisation bases its actions on transparent and ethical conduct that contributes to sustainable development, including societal well-being and health, considers stakeholder expectations, complies with applicable law and international standards of behaviour, and is integrated into and practised within the organisation's operations (Luty-Michalak, Kotowska-Wójcik, 2016, pp. 5-12; Buglewicz, 2018, pp. 7-11; Meftah, Kuzey, Uyar, Karaman, 2023, p. 113762; Awad, 2025, pp. 181-192). The key areas of CSR include: organisational governance, human rights, labour practices, the environment, fair operating practices, consumer issues, community involvement, and the development of local communities (ISO 26000; Gerged, 2023; PKN, 2025). The common denominator across various definitions of social responsibility is the principle that organisations, regardless of their field of activity, should act in a socially and environmentally responsible manner (Detyna, 2023, pp. 208-234). Socially responsible practices today include not only adherence to ethical standards in relations with employees, competitors, and clients (e.g., students, staff, research institutions in the case of universities), but also increased investment in human resources, support for local community development, and environmental protection.

University management should therefore constantly consider the social consequences of decisions that affect broad social groups – stakeholders and the natural environment. A socially responsible approach requires analysing not only the strategic, tactical, and operational objectives adopted by the university, but also the methods of their implementation.

In responding to the needs of all stakeholder groups, universities should consider the expectations of their partners, which usually concern three general categories of higher education institution functioning and impact (Duque, 2019, pp. 451-464; Comoli, Gelmini, Minutiello, Tettamanzi, 2021, pp. 1-22; El-Kassar, Makki, Gonzalez-Perez, 2023, pp. 142-165). These categories typically include social and ethical aspects, issues related to environmental protection, and organisational governance, including systemic solutions for organisation and management within the university (Merta-Staszczak, Serafin, Staszczak, 2020, pp. 91-107;

Nguyen, Khanh, 2022, pp. 712-728; Godonoga, Sporn, 2023, pp. 445-459). According to the authors, the potential benefits and opportunities of implementing and practically applying the USR concept can be considered across various dimensions and contexts of university activity, including: ethics, responsiveness to labour market needs, quality of education, social relations, management, sustainable development, scientific research, innovation, entrepreneurship, competitive value, and marketing, including image communication (Detyna, 2024b, pp. 65-72).

It should be emphasised that through sustainable, continuous development, a university can systematically enhance its competitive value (Godonoga, Sporn, 2023, pp. 445-459). This value may be considered in the context of the benefits the university delivers to society: students, academic teachers, administrative staff, local communities, business representatives, the environment, etc. The development of the USR concept should be driven by the genuine need for continuous building and strengthening of the academic community's integrity – including its identity, organisational culture, and inclusivity. However, according to literature studies, ethics codes, social responsibility strategies, and reports on sustainable development and social responsibility are not commonly applied among the universities that signed the "USR Declaration" (Kaźmierczak, Jastrzębska, Khovrak, 2025, pp. 66-79). The literature review clearly indicated a research gap regarding empirical research conducted in the academic environment regarding the social responsibility of universities. Relatively few published research results in Poland and worldwide concern this issue in the context of communicating social responsibility (including through the university website).

3. Research Methodology

The aim of this article is to present the results of a study on the implementation of the concept of social responsibility in Polish universities that joined the group of signatories of the "Declaration of University Social Responsibility" between 2017 and 2022. The empirical findings are presented against the background of a literature review. This article is part of a broader research project entitled "Social Responsibility in the University Value Chain" (2024-2026), funded by the Angelus Silesius University of Applied Sciences. The empirical study was conducted in 2024 and involved the analysis and assessment of information on USR practices published on the websites of 39 Polish higher education institutions (HEIs) that had signed the "Declaration of University Social Responsibility". These institutions accounted for 24.37% of all HEIs that had signed the Declaration as of 10 February 2025. Of these, 84.55% were public universities and 15.45% were non-public. In terms of institutional profile, the largest group comprised universities (12 universities), followed by vocational HEIs (9) and technical universities (7). The study also included economic universities (4), universities of life sciences (4), and medical universities (3). The sample comprised HEIs from 14 voivodeships,

with the largest groups coming from three: Mazowieckie (7), Dolnośląskie (5), and Lubelskie (4), accounting for a total of 41.03%. USR practices were also analysed in institutions from the following voivodeships: Podlaskie (3), Śląskie (3), Pomorskie (3), Wielkopolskie (3), Małopolskie (3), Zachodniopomorskie (2), Kujawsko-Pomorskie (2), Warmińsko-Mazurskie (1), Łódzkie (1), Opolskie (1), and Podkarpackie (1). In order to identify examples of good USR practices, the study examined university websites and strategic documents such as development strategies, USR strategies, action plans, codes of ethics, and USR reports. Identified good practices were categorised into recommendations corresponding to the 12 principles that form the core of the "USR Declaration" signed by the participating institutions.

4. Research Findings

The vast majority of the universities studied (92.31%) refer to the concept of social responsibility in their development strategies. Most also publish the text of the Declaration on their websites (82.05%). A dedicated subpage focusing on activities related to USR is maintained by 41.03% of the institutions. This suggests that for most universities, the topic of social responsibility is not a prominent part of their image communication strategy. One in three institutions (35.90%) provide information about appointed USR coordinators or relevant teams or committees. Only 23.08% of the analysed HEIs publish reports, typically self-assessments of their implementation of the USR concept. One in ten institutions (10.26%) has developed and published a formal USR strategy online. A slightly larger proportion (17.95%) publish their USR-related objectives. Only one out of the 39 institutions refers to a separate USR budget for a given year. It is relatively uncommon to find extensive and detailed content on institutional websites concerning topics such as USR, CSR (Corporate Social Responsibility), or ESG (Environmental, Social, Governance) – only three institutions provide such materials. These include, for example, documents and links to legislation, monographs, reports, case studies, or collections of good practices (e.g. the 2022 USR Good Practices Catalogue).

Achieving the research objective required identifying examples of good USR practices among the analysed institutions. Table 1 presents examples of such practices in relation to the 12 principles of the "USR Declaration".

Table 1.
Good practices of universities in relation to the 12 principles of the "USR Declaration"

No.	Principles as Commitments	Good Practices
1.	Foster academic values written, among others, in the 'Code of Ethics for Academic Staff,' particularly: diligence, objectivity, independence, openness, and transparency.	- Establishment of an Ethics Committee and an Ethics Officer; - Development of the university's Code of Ethics or separate codes such as the Doctoral Student/Student/Staff Code of Ethics; - Publishing the 'Code of Ethics for Academic Staff' on the university website.
2.	Shape the social and civic attitudes of future elites, conducive to community building, creativity, openness and communication, as well as social sensitivity and work culture.	- Development and promotion of educational and health-related campaigns; - University membership in the international PRME[2] forum; - 'University Social Responsibility Library' on the website of USR with links to studies, documents, strategies, reports, monographs, guides, etc.
3.	Promote equality, diversity, tolerance, and respect for and protection of human rights for the entire academic community and its environment.	- Appointment of a Rector's Plenipotentiary for Equal Treatment or Equal Treatment and Anti-Discrimination; - Webpages or tabs such as: 'Equality at the University', 'Counteracting Discrimination', 'Anti-Mobbing', 'Support for Persons with Disabilities', 'Accessibility'; - Accessibility Declaration on the university homepage; - Provision of sign language interpreting services; - Adherence to and promotion of the Ten Principles of the UN Global Compact; - Organization of 'Problem-Solving Meetings' e.g., for older employees nearing retirement or non-academic staff; - Co-financing of nursery and kindergarten care for staff's children.
4.	Expand curricula to include topics on ethics and social responsibility of business, sustainable development, and social innovation.	- Introduction of CSR, SDG, ESG-themed subjects into curricula across all fields of study.
5.	Implement projects that support social responsibility principles, particularly in diversity management, employee volunteering, ethics promotion, cross-sector cooperation, and socially responsible marketing.	- Establishment of a USR Office with a dedicated website – organizing and promoting social skills training, charity events, volunteering, etc.; - Project 'University Community Volunteering Map (Empathy Map)' – research on community engagement in volunteering; - Promotion of educational and health-related campaigns through student and staff volunteering.
6.	Conduct scientific research and implementation work that, through partnerships with other academic institutions worldwide, the business sector, public administration, and non-governmental organizations, can contribute to solving significant social issues.	- Establishment of the Rector's Committee for USR implementing R&D and educational projects; - Internal grant competitions for CSR, ESG, USR-related research; - Funding and dissemination of academic publications on USR; - Development and online publication of USR promotional materials by the USR Team.
7.	Develop inter-university cooperation, both nationally and internationally, enabling the adaptation and strengthening of best practices in the field of university social responsibility.	- Implementation of HR Excellence in Research standards (working conditions, anti-discrimination, transparent recruitment – HR Excellence in Research, 2025); - Participation in the PRME international forum, including reporting on its implementation; - Membership in Magna Charta Observatory (signing the MCU document); - English version of the university website; - English version of the USR Declaration available on the website and social media.

[2] Principles for Responsible Management Education (PRME) - The program announced at the Global Compact Leaders Summit (2007), aimed at incorporating CSR (Corporate Social Responsibility) concepts into the curriculum of higher education institutions (UN Global Compact, 2025).

Cont. table 1.

8.	Maintain organizational integrity within the university, basing its management on the principles of corporate social responsibility, both in strategic documents and the actions derived from them, aimed at the comprehensive development of the academic community and the effective implementation of the university's mission	- Easy access to development strategy from the homepage; - Explicit references to USR in the strategy, including USR goals; - A separate USR Strategy including vision, values, principles, diagnosis, stakeholders, strategic goals; - Implementation report of USR with self-assessment of all 12 principles included in the USR Declaration; - Employee Budget within participatory budgeting – staff decide on annual fund allocation.
9.	Ensure transparency in university operations by measuring outcomes, promoting and disseminating achievements, and identifying a responsible team or person.	- Identification of the USR Team and its tasks on the university website; - Annual USR report developed by interdisciplinary teams; - 'Socially Responsible University' webpage – tabs like Education, Ecology, Sport, Culture, Equal Opportunities, Volunteering, For Foreigners, Student Actions; - Sharing of USR Strategy texts, regulations, reports, and university best practices, including for Faculties, staff, students, U3A, Student Culture Center.
10.	Operate in a manner that minimizes the negative environmental impact of the university community and its stakeholders in all dimensions.	- Establishment of a Team for Environmental Impact; - Promotion and organization of environmental education campaigns; - Creation of an ecological responsibility and engagement program; - Establishment of a Sustainable Development and Climate Center – with a dedicated webpage, updates, and working groups.
11.	Engage in stakeholder dialogue regarding USR policy priorities and communicate outcomes.	- Appointment of an Academic Ombudsperson; - Systemic collaboration with external stakeholders to align curricula with labor market needs – regular meetings, program evaluation research, quality assurance teams, input in new program proposals; - Active student and staff participation in university improvement via submission systems, 'kaizens', etc.; - USR Strategy implementation diagnosis involving stakeholders; - Polish and English USR reports published online.
12.	Follow principles of ethics and responsibility in teaching and research to provide stakeholders with optimal access to knowledge, intellectual capital, and university achievements (USR Declaration, 2022).	- Promotion of ethical codes among staff, including the 'Code of Ethics for Academic Staff'; - Signing of the 'Magna Charta Universitatum' (MCU) affirming academic freedom, institutional autonomy, research independence, education free from political or economic influence, and rejection of intolerance.

Source: Authors's own elaboration based on Declaration of University Social Responsibility (USR), 2022.

The informational deficits identified during the study may be surprising considering that the vast majority of institutions include USR and sustainable development in their strategic documents. It is worth noting that these strategies often highlight the importance of communication and collaboration with all stakeholder groups of higher education institutions — including students, staff, and representatives of the broader socio-economic environment, particularly at the local level.

5. Summary

The research conducted by the authors indicates that universities that are signatories of the Declaration of University Social Responsibility (USR) do not fully exploit the potential and impact of the concept of social responsibility on their stakeholder groups. Despite notable informational gaps observed on many university websites, the study has made it possible to compile a relatively extensive list of good practices relating to the 12 USR principles. Among the 39 universities analysed, many demonstrate effective image communication via their websites. The websites of the most communicatively active universities contain a logically structured range of information, indicating that the USR concept has become a significant reference point for their educational, scientific, and organizational activities. This is an important observation, as the authors argues that the idea of university social responsibility aligns well with the trend of modern university management, including the holistic concept of Total Quality Management (TQM). In light of current societal, technological, and economic challenges, embedding functions, task forces (teams), or organizational units dedicated to social responsibility into the university structure may significantly enhance institutional resilience to emerging risks. In this context, a key and recommended action is the continuous development of cooperation among various internal and external stakeholder groups (students, university staff, business representatives, local governments, NGOs, etc.). A socially responsible approach thus entails building and strengthening a network of connections among the university's partners, including the establishment of interdisciplinary teams. These teams could, for example, carry out relevant analyses, prepare diagnoses, and develop strategies and action plans aimed at improving the alignment of the university's offer with contemporary challenges—not only of the labour market but also of current and future generations.

To conclude, the authors emphasizes that the findings presented in the article relate solely to the content published on university websites. Therefore, one cannot assume that activities not mentioned on the websites are not actually being implemented. Nevertheless, the noticeable lack of communication regarding USR suggests that for many of the surveyed institutions, social responsibility is not yet associated with a perceived need to promote this concept among the academic community. It is to be hoped that the example set by USR leaders will help improve this situation in the coming years. According to the authors, the issues presented in the article are relatively little explored scientifically and should be the subject of research in the coming years. Important research problems in the social and economic context may include, among others, issues concerning the relationship between the social responsibility of the university and its effectiveness (including the quality of education). The research potential of USR stems primarily from its multidimensionality – which provides virtually unlimited conceptual possibilities for researchers.

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FAMILY FOUNDATIONS IN POLAND – AN ANALYSIS OF FUNCTIONING AND LEGAL STATUS

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Purpose: This article analyzes the role of a family foundation as a tool for managing the assets of family businesses, comparing them to similar solutions operating in other countries. In particular, the study covered: foundation management mechanisms, the roles of beneficiaries, and the impact on succession and tax optimization. The article also presents key challenges and limitations related to the implementation of this instrument.
Methodology: The article uses a mixed approach combining comparative legal analysis and a case study.
Findings: Family foundations are effective for securing assets and planning succession, especially in family businesses. The Polish model of family foundations draws inspiration from foreign solutions, but has specific regulations regarding taxation and beneficiaries.
Research limitations: Due to the recent introduction of family foundations into the Polish legal system, there is no comprehensive research on their long-term practical functioning.
Originality/value: The article contributes significantly to the existing literature on family foundations by analyzing their functioning in the context of the Polish legal system, which has only recently introduced this institution. Due to the small number of studies on this issue in Poland, this article fills a significant gap in analyzing this issue.
Keywords: family foundations, wealth management, succession, business law, beneficiary, founder.
Category of the paper: research paper.

1. Introduction

In the literature, family businesses are often called "economic stabilizers". Family business owners most often operate in a long-term perspective and are more inclined to accumulate and multiply wealth for future generations. A family business is capable of long-term investment and effectively resists the pressure to achieve short-term benefits.

Due to economic changes, many family businesses in Central Europe are entering a critical moment in their activities—after 30 years of activity, they are entering the succession phase. The task of mature legal systems is to create mechanisms that will make it easier for owners of

family businesses to carry out a generational change. One tool for multi-generational family business activities is family foundations.

The family's influence on the enterprise's functioning depends on ownership. Some researchers argue that a firm must be considered a family firm if it is majority-owned. The majority ownership is so that the family can influence decisions in the firm. Other researchers suggest that control is possible even without majority ownership. In the case of publicly traded companies and in many other instances in which family ownership is fragmented, a significant minority share is sufficient to control critical strategic decisions, such as the appointment of board members and management staff, acquisitions, divestitures, restructuring, etc. (Zellweger, 2017). As a result, in the case of large, publicly traded family firms, there is a growing consensus that an ownership stake of 20-25% may be sufficient to exert decisive influence on strategic decisions (Anderson, Reeb, 2003; Villalonga, Amit, 2006).

The concept of property is related to the term of wealth management. Families can decide on a form of wealth management with a powerful delegation of control. This forms trusts in countries such as the United States, Great Britain, Japan, Scotland, Israel, and some Latin American countries (Zellweger, 2017). There is no universally accepted definition of a trust. We interpret it as a relationship that arises whenever a person called a trustee is obliged to hold property based on a title of ownership or other title, for the benefit and in the interests of other people or to achieve the goals specified by the founder (Tomczykowski, 2023).

The grantor (settlor) transfers property in a trust to benefit the recipient (beneficiary). For this purpose, the grantor appoints a trustee who promises to manage the property for the recipient's benefit and following the grantor's ex ante instructions (Sitkoff, 2004). The beneficiary waives all property rights to the property placed in the trust and has limited ability to monitor the trustee. The trustee, not the beneficiary, exercises property rights in the trust (Zellweger, 2017).

Polish law does not provide for the possibility of establishing trusts (Górniak, 2022). However, this does not mean that it does not have solutions that fulfill similar functions. Private-purpose foundations, often referred to simply as private foundations, unlike trusts, constitute a separate entity of rights and obligations and have legal capacity. This means that the foundation acts in legal transactions in its name and on its account.

The first registrations of family foundations in Poland took place in July 2023 - 8 entities were registered then, in August 2023 - 72, in September 2023 - 77, in October 2023 - 111, in November 2023 - 76, in December 2023 - 14, in January 2024 - 59, and by 27 February 2024 - 92 (Domanowska, 2024).

In March 2024, another 174 foundations were registered, 83 in April 2024, 173 in May 2024, 88 in June 2024, and 170 in July 2024, and the number of foundations waiting for consideration of the registration application increased significantly.

In August 2024 - 102, September 2024 - 94, October 2024 - 198, November 2024 - 142, and 130 December 2024. The data was obtained directly from the District Court in Piotrków Trybunalski.

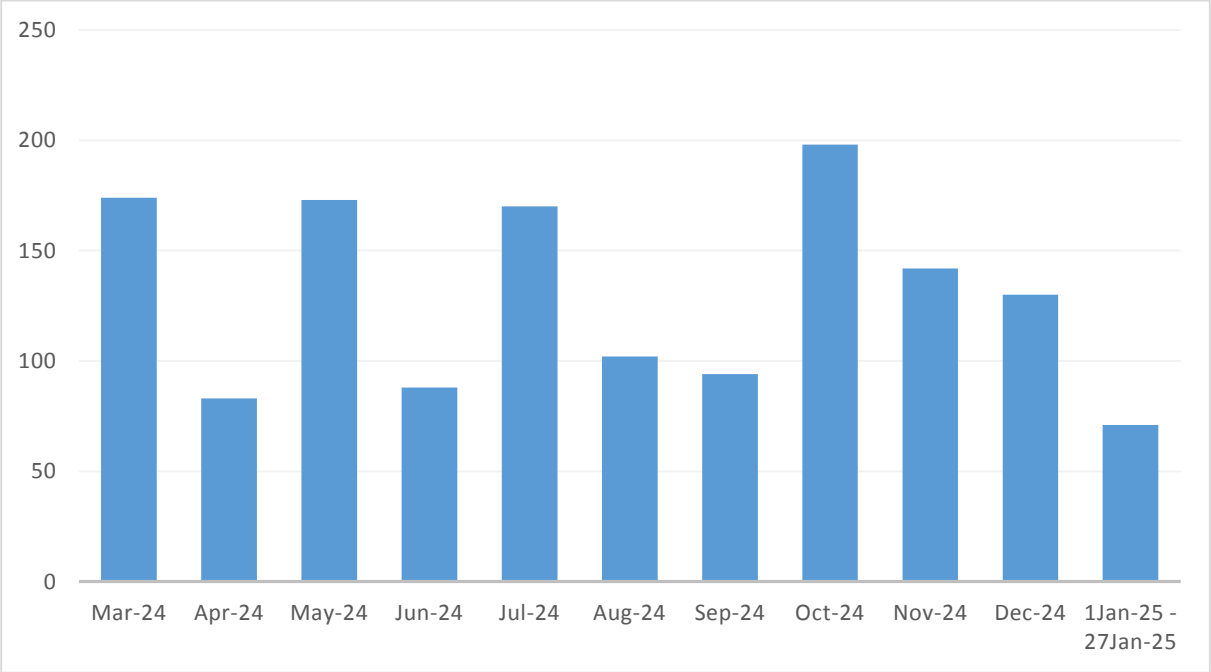


Figure 1. Registrations of family foundations in Poland by month.

Source: own study based on data from the President of the District Court in Piotrków Trybunalski.

2. Legal framework for family foundations

The word "foundation" is derived from the Latin verb " fundare", which means to cause something to arise, to create something, to build a foundation, or to establish and strengthen something (Dominowska, 2017).

A family foundation as a new legal entity /business entity/ has been in force in the Polish legal system for a short time. The Act of 26 January 2023 on the family foundation entered into force on 22 May 2023. It is intended to be an entity responsible for managing the assets of a family business and constituting property security for a group of people indicated by the founder. In practice, it most often protects families and enables the effective implementation of the family succession process in business activities (Dz.U. z 2023, poz.326).

The law requires that a family foundation have its registered office in the territory of the Republic of Poland. It is a legal person, established to collect property and manage it in the interests of beneficiaries or provide benefits to beneficiaries. The founder specifies the specific purpose of the family foundation in the statute. A foundation may be established either by a founding act or a will and takes the form of a notarial deed.

A family foundation can only be established by individuals with full legal capacity, acting individually or jointly. A family foundation established in a will can only have one founder. Family foundations are entered in the court register.

The foundation may not conduct business activity, which is justified by the assumption of limiting the risk associated with conducting business activity and the need to protect the assets contributed to it. The exceptions are: disposal of property of which the foundation is the possessor or owner, lease or tenancy, acquisition or disposal of securities. A family foundation as a legal person is a taxpayer of corporate income tax (CIT); however, as a rule, it is exempt from this tax. Art. 6 sec. 1 item 25 of the Corporate Income Tax Act "A family foundation is exempt from tax" (Dz.U. z 2025, poz. 278). This exemption does not apply absolutely. The applicable regulations provide for many exceptions to this rule. Following Art. 6, sec. 6, 7, and 8, the exemption of a family foundation from CIT does not apply:

- to the tax referred to in Article 24b, i.e., the tax on income from buildings,
- to the tax referred to in Article 24q, i.e., the tax on benefits or property transferred or made available by a family foundation.

The exemption from CIT taxation does not apply to business activities of a family foundation other than business activities permitted by the provisions of the Family Foundation Act, i.e., activities other than those within the scope of:

- disposal of property, unless the property was acquired solely for further disposal,
- renting, leasing, or making property available for use on any other basis,
- joining commercial companies, investment funds, cooperatives, and entities of a similar nature, having their registered office in the country or abroad, as well as participating in these companies, funds, cooperatives, and entities,
- acquiring and selling securities, derivative instruments, and similar rights,
- granting loans to: capital companies in which the family foundation has shares or stocks, partnerships in which the family foundation participates as a partner, beneficiaries,
- trading in foreign means of payment belonging to a family foundation to make payments related to the foundation’s activities,
- production of plant and animal products processed in a manner other than industrial, except processed plant and animal products obtained within the framework of special branches of agricultural production and products subject to excise duty, provided that the number of plant or animal products originating from own cultivation, breeding or rearing, used to produce a given product constitutes at least 50% of that product,
- forest management.

Article 5 of the Family Foundation Act describes the principles of taxation for a family foundation performing activities other than those permitted. Article 24r of the Corporate Income Tax Act regulates the tax rate, which is a penalty rate of 25% of the tax base.

Establishing a family foundation and transferring assets is not subject to corporate income tax. These activities are also exempt from tax on civil law transactions (PCC). Establishing a family foundation and transferring assets to it does not result in calculating PCC or CIT. A subjective exemption from corporate income tax covers family foundations. Therefore, the tax exemption covers the free acquisition of assets, e.g., from the founder (endowing the family foundation with assets will be tax-neutral) and income earned by the family foundation from the activities it conducts to the extent permitted by the Family Foundation Act.

The income of the founder and beneficiary received from the family foundation is subject to the provisions on personal income tax, and is not subject to inheritance and gift tax. The tax rate is then 15% of the tax base, i.e., the payment of benefits from the family foundation to the beneficiaries is each time taxed with 15% CIT, regardless of the beneficiary's tax group concerning the founder.

As a rule, family ties between the founder and the beneficiary are considered when taxing family foundations. The acquisition by individuals of benefits and property from a family foundation in connection with the dissolution of the family foundation is subject to personal income tax. Its amount depends on the degree of relationship of the beneficiary with the founder (exemption in the case of the founder and close persons belonging to the so-called "zero group" concerning the founder, specified in the Act on Inheritance and Gift Tax, i.e. spouse, descendant, ancestor, stepchild, sibling, stepfather and stepmother or in the case of other persons 15%).

The Family Foundation Act changed the provisions of inheritance law concerning the compulsory share (i.e., the rights of close relatives of the testator to demand payment of a specified amount from persons who have acquired rights to the inheritance). Among other things, it provides for the possibility of waiving the compulsory share, dividing it into installments, postponing the payment deadline, or reducing its amount. In addition, benefits received from the family foundation by the entitled person reduce the value of the compulsory share.

3. Family foundations as a wealth management tool

In the context of a family business, trusts are a common tool for structuring family affairs (Zellweger, Kammerlander, 2015). Trusts are often seen as a way to avoid family conflicts that are detrimental to both the assets and the family.

Family foundations are legal institutions that allow for the protection and succession of assets. Their goal is to enable multi-generational management of assets and eliminate the risk of their division.

The mechanism for managing family assets in family foundations includes the following entities:

- The founder defines the statute and the specific purpose of the foundation. He defines the principles of the foundation's operation and indicates the beneficiaries. The founder can withdraw from active business without losing income, and decides what shares will be in the foundation.
- Governing body (foundation board or supervisory board).
- Beneficiaries, or people entitled to use the foundation's assets, may belong to two categories of entities: individuals or non-governmental organizations conducting public benefit activities. In the case of a family business, these are usually members of the founder's family, but it can also be the founder himself. The founder determines the circle of beneficiaries of a family foundation and the scope of their rights.

The foundation is a tool for separating business matters from family matters. It is to improve business succession and minimize the risk of conflicts. According to art. 2, sec. 1 of the Act, a family foundation is a legal person established to collect property, manage it in the interests of beneficiaries, and provide benefits to them (Dz.U. z 2023, poz. 326). Family foundations may have various beneficiaries, including members of the founder's family and other persons indicated in the statute. The basic task of a family foundation is to manage assets and distribute them following the will of the founder.

The following theoretical models of family foundations exist in the literature (Adamus, Stec, 2023):

- Pure family foundation, the so-called proper family foundation. Its sole purpose is to provide the financial benefits specified in the statute to benefit the founder's family members.
- A family maintenance foundation whose goal is to support family members in a long-term manner.
- A family foundation with an ideal goal, i.e., supporting the cultural, spiritual, and intellectual needs of the founder's family members.
- A mixed family foundation, i.e., supporting the founder's family members and carrying out activities of a general social nature.

Article 43 of the Family Foundation Act lists three bodies of a family foundation: the management board, the supervisory board, and the meeting of beneficiaries (Dz.U. z 2023, poz. 326). The management board and the meeting of beneficiaries are obligatory bodies. In contrast, the supervisory board is generally an optional body, and unless the number of beneficiaries exceeds 25, it becomes a mandatory body of the family foundation. Bodies of a family foundation:

- Management Board - is responsible for the current functioning of the foundation and its representation.
- Supervisory board – the scope of supervision exercised by the supervisory board includes compliance by the management board with the law and the provisions of the foundation's statute art. 65, sec. 1 of the Act (Dz.U. z 2023, poz. 326). The right to appoint and dismiss supervisory board members is vested in the founder, and after his death, the meeting of beneficiaries art. 68 sec. 3 of the Act (Dz.U. z 2023, poz. 326).
- Beneficiary Assembly - a beneficiary of a foundation is a person who, according to the statute, may benefit from a family foundation or property in connection with the dissolution of a family foundation. Not every beneficiary is a member of the beneficiary assembly; only those who have been granted such rights in the statute in art. 70, sec. 2 of the Act. The beneficiary assembly is the decision-making body of a family foundation.

The income and assets of a family foundation may be used to finance, in particular:

- In the case of a beneficiary who is a natural person, the costs of his or her maintenance, education, or treatment.
- If a beneficiary is a non-governmental organisation conducting public benefit activities, expenses for that organisation's statutory purposes are covered.

A family foundation is liable for the founder's obligations, including maintenance obligations, arising before the establishment of the family foundation (joint and several liability) and for maintenance obligations arising after the establishment of the family foundation if enforcement against its assets is ineffective. Financial security for persons for whom the founder has maintenance obligations should be prioritized.

Figure 1 shows the percentage distribution of foundations established in Poland, as of May 2024. As can be seen, the most significant number of foundations were established in the Masovian Voivodeship (42%), Silesian Voivodeship (13%) and Lesser Poland Voivodeship (12%), and the smallest in the Świętokrzyskie Voivodeship (0.58%), Lubuskie Voivodeship (1.16%) and West Pomeranian Voivodeship and Podlaskie Voivodeship (both 1.73%). There are also voivodeships in which no family foundations have been registered, these are: Warmian-Masurian Voivodeship, Lublin Voivodeship, Podkarpacie Voivodeship, and Opole Voivodeship.

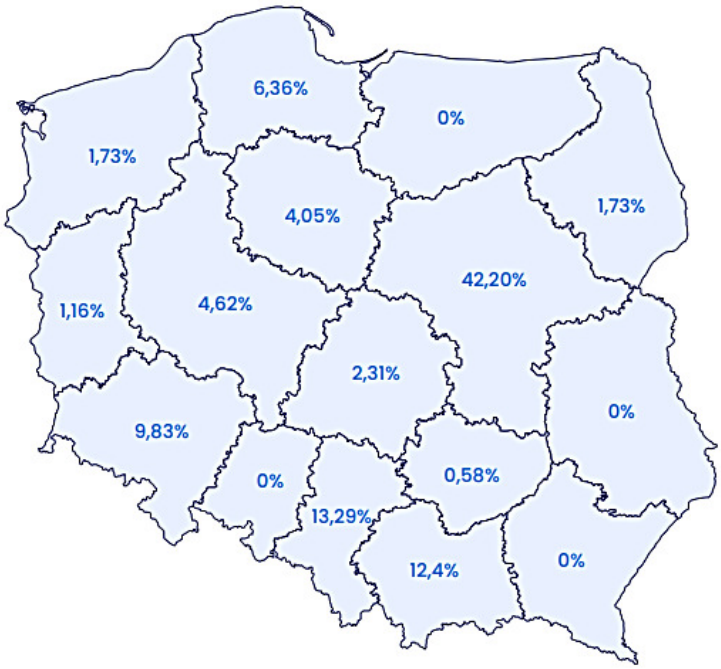


Figure 2. Register of family foundations in Poland, divided into voivodships.

Source: Business Insider, Tomczykowski - Tomczykowska, PNB Paribas – wealth management "Family foundations report", May 2024.

4. Comparison of Family Foundation Solutions in Other Countries

Family foundations are popular in many countries (Chrebelski, Podedworna-Tarnowska, 2024).

In Germany, transferring property to a family foundation is subject to taxation, unlike foundations established in Poland, where transferring property to a foundation is not subject to additional taxation. The amount of tax paid when establishing a family foundation in Germany depends on the degree of relationship between the founder and the beneficiaries. In Poland, individuals acquiring benefits and property from a family foundation in connection with the dissolution of a family foundation are subject to personal income tax. Its amount depends on the degree of relationship between the beneficiary and the founder (exemption in the case of the founder and close persons belonging to the so-called "zero group" concerning the founder, specified in the Act on Inheritance and Gift Tax, i.e. spouse, descendant, ancestor, stepchild, sibling, stepfather and stepmother or in the case of other persons 15%).

When establishing a family foundation in Germany, the founder must contribute assets worth at least 100,000 euros, in Poland it is 100,000 PLN, to cover the founding fund. As in Poland, assets can be cash, a company's shares and securities, stocks, or even real estate. A family foundation in Germany is a taxpayer of corporate income tax, regardless of whether

the income remains in the foundation or is paid out to beneficiaries. In the case of paying benefits to beneficiaries, tax is levied on the beneficiary. In Poland, a family foundation is a taxpayer of corporate income tax, but is exempt from income tax. The need to pay income tax arises when paying benefits to beneficiaries. Benefits for beneficiaries can take monetary and non-monetary forms and will be subject to personal income tax (Chrebelski, Podedworna-Tarnowska, 2024).

Currently, around 100,000 family foundations operate in Germany. In Poland, this number fluctuates around 1500 entities (District Court in Piotrków Trybunalski—as of the end of 2024).

Family foundations in Austria have a minimum capital of EUR 70,000 or its equivalent in tangible assets. The statute contains information on the foundation's objectives, the assets contributed to it, the name, registered office, and date of establishment. The foundation's beneficiaries can only be disclosed in an annex to the statute, which is not transferred to the register or court. This is a significant difference from the law in Poland, where beneficiaries are publicly identified following the Act of 1 March 2018 on Counteracting Money Laundering and Terrorist Financing (Dz.U. z 2023, poz. 1124). The foundation is established as a notarial deed by registration in the Austrian Commercial Register of Companies. In Poland, family foundations are entered in a separate register of the judiciary.

5. Summary

Family foundations can be practical tools for protecting assets, and in the long term, they can become instruments of capital accumulation in the Republic of Poland (Adamus, Stec, 2023).

The history of Polish foundations dates back to the 12th and 13th centuries. During this period, networks of poorhouses were established in parishes in the Polish lands. Initially, they were associated with religious orders: the Maltese hospital in Poznań (1170-1180), in Kraków (1200-1220), in Wrocław (1214), and other cities. During this period, shelters were also established at episcopal cathedrals, e.g., the St. Lazarus Hospital in Wrocław (Blicharz, 2016). Foundations play a different role and are the subject of numerous analyses and scientific considerations.

A family foundation is an entity responsible for managing the assets of a family business, providing financial security for families, facilitating the process of succession in a family business, and minimizing the risk of potential conflicts over assets in families. The main advantages of family foundations include securing assets against division, tax optimization, and flexibility in asset management.

A family foundation protects the assets deposited in it by limiting the risks associated with running a business. Establishing a family foundation is intended to maintain the company's assets, protect them, and consequently develop the company and implement new investments. Most often, parents establish foundations for the benefit of their children. They do this to limit children's access to wealth for fear that they will ruin the assets, such as the family business, or conversely, wealth will ruin the children (Zellweger, 2017).

According to data from the District Court in Piotrków Trybunalski, which deals with the registration of family foundations in Poland, they are of great interest to entrepreneurs. The most significant number of foundations was established in the Masovian, Silesian, and Lesser Poland voivodeships, and the smallest in the Subcarpathian, Lublin, Warmia-Masurian, and Opole voivodeships.

A family foundation allows an entrepreneur to withdraw from active business without depriving him of income. The advantage of this solution is the financial security of loved ones who can benefit from the assets accumulated in the foundation. The lack of property fragmentation and property conflicts related to inheritance allows for more effective management. This applies to the consistency of decisions; one person or a small group makes strategic decisions without consulting and negotiating with others. Larger capital provides better investment opportunities, for example, in real estate, shares, or other companies, which increases financial efficiency. Deferring tax payment is an important element for many heirs; tax is charged only when making a benefit to the beneficiary.

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THE IMPORTANCE OF THE CITIZEN'S BUDGET IN THE DEVELOPMENT OF SUSTAINABLE URBAN MOBILITY. CASE STUDY OF THE CITY OF SZCZECIN

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Purpose: This paper aims to fill a research gap in the area of identifying and determining the impact of civic participation through the citizen's budget on measures to foster sustainable urban mobility.
Design/methodology/approach: Firstly, based on a literature review, the essence of sustainable mobility is presented and its main areas are identified. Then, on the basis of a case study of the city of Szczecin, through the analysis of available data on the functioning of the civic budget (SBO) from 2014 to 2025, the impact of the civic budget on shaping sustainable mobility in this city is shown.
Findings: The research shows the importance of the participatory budget as a tool for the implementation of a sustainable urban mobility plan. The research shows that the number of adopted projects for investments supporting sustainable mobility represented an average of 32% of all adopted projects under the SBO in the different years 2014-2025 studied.
Social implications: The article points out that, by participating in the civic budget process, citizens have the opportunity to propose and decide on the implementation of sustainable mobility projects. Such activities can affect the quality of life and safety of pedestrians, cyclists and other road users. The participation of citizens in shaping sustainable mobility strategies is important and allows for a better adaptation to their needs.
Originality/value: These considerations point to the need to draw attention to the civic budget as a hitherto lesser-noticed tool for supporting the implementation of sustainable mobility, which is very important for local authorities as well as inhabitants themselves.
Keywords: sustainable mobility, citizen's budget, civic budget, participation, smart city.
Category of the paper: Research paper.

1. Introduction

Sustainable urban development is not just the sum of environmental, social and economic development goals, but focuses on the interplay of various factors stemming from these three areas (Berger, Luckmann, 2006). Local communities should play an important role in developing urban transport strategies, plans and policies.

Stakeholders in the participatory process in local governments include their residents, institutions, organisations, economic actors, as well as the local administration itself. In order to undertake participatory activities, it is necessary to have access to information resources, as well as other resources necessary for specific forms of participation, such as financial resources in participatory budgets (Council of Europe, 2019). It is also important that adequate regulations are in place for the possibility of community participation in local policy-making (Michelini et al., 2023; Correia et al., 2023). Participation can be referred to its different areas, both in terms of thematic scope and the nature (or level) of participatory activities (Schwartz, Schejter, 2024). One of the thematic areas of civic participation is urban development planning. An important role is played by participatory budgeting, which allows residents to actually co-determine how part of the local budget is spent (Rachwal, 2013) and to plan the development directions of the locality they live in. Residents have the opportunity to look at the mechanisms of constructing and spending local budgets and to consciously participate in this process. The civic budget should fulfil certain conditions, such as (Sintomer et al., 2008; Sintomer et al., 2012):

- the transfer of a certain amount of local government funds for the purposes of a participatory budget,
- the possibility for residents to participate universally,
- organising public consultations,
- implementation of projects selected by the vote,
- to report on the implementation of the budget, as well as access to information on each stage of the civic budget process,
- long-term and cyclical.

2. Research methodology

This article aims to show to what extent the citizens' budget supports the development of sustainable mobility in a selected city.

The author's aim was to answer the following research questions:

1. What are the key research areas and trends in the field of sustainable urban mobility?
2. What proportion of the projects selected for implementation under the SBO are projects in the area of sustainable mobility?
3. What percentage of the civic budget is accounted for by planned expenditure on tasks in the area of sustainable mobility?
4. What is the structure of planned spending in the SBO on sustainable mobility by type of task carried out?

Figure 1 shows the subsequent research stages.

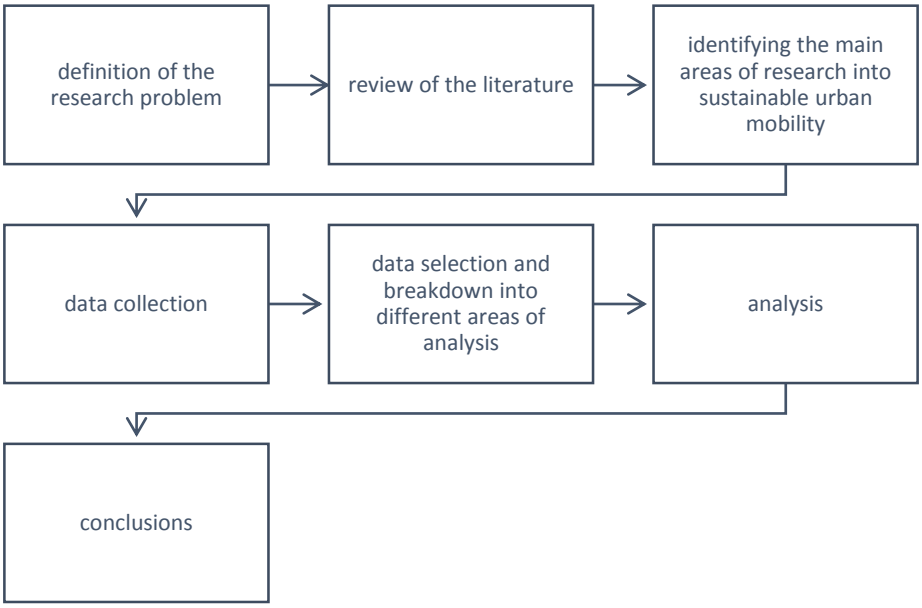


Figure 1. Stages of research conducted.

Source: own elaboration.

In the first part, a review of recent foreign literature was carried out in search of development trends and research areas of sustainable urban mobility in the context of their inhabitants. The library database sciencedirect.com was selected for the study. Based on the literature search, the most important areas of sustainable urban mobility relevant to residents were identified.

The City of Szczecin was chosen as the research area, as it is one of several cities in Poland that are pioneers in the introduction of civic budgeting. This form of public participation has been in place here since 2014.

The collection of empirical data then proceeded. For the purposes of the research, data from 2014-2025 were obtained from the Szczecin City Hall and public information on the SBO portal. A review of the scope of civic budget projects in each year studied and the planned expenditures associated with them was carried out. On this basis, a quantitative and qualitative analysis was carried out to answer the research questions posed.

3. Sustainable urban mobility - current problems and development trends

The literature on the subject points to the relevance of the issue of sustainable mobility in urban areas and reveals various important aspects of the problem. The most important and, at the same time, fundamental feature of sustainable urban mobility should be to foster improvements in the health of the population and to stimulate an increase in the standard of living by providing quality transport services and mobility opportunities (Kasraian et al., 2024, p. 2).

Sustainable transport favours public transport and also the reduction of car traffic and road congestion, which benefits the environment (Mozos-Blanco et al., 2018, p. 47). Best practices applied by cities promote modal shift while improving public transport service, encouraging active mobility and discouraging the use of private vehicles (Papadakis et al., 2024, p. 1; Zientara et al., 2024).

The implemented measures within the framework of sustainable urban mobility should take into account first of all the needs of pedestrians and cyclists. This concerns the accessibility of this form of mobility, safety in moving around, the environment in which they move and also the costs of this movement. These forms of mobility in smart cities are particularly important (Marquart, Schicketanz, 2022; Trpković et al., 2023).

Cycling is a widely promoted form of sustainable mobility worldwide. It is an active form of transport that benefits the health of its users, is non-polluting and can contribute to public health, environmental, climate, transport and other socio-economic policy goals (Garrard, Rissel, Bauman, 2012; Goodman et al., 2013; Sallis et al., 2016; Nieuwenhuijsen, 2020). Cycling transport is increasingly accessible and its flexible form makes it more and more popular, especially among young people. A solution to make cycling more accessible and develop it is shared mobility. It can also be observed that renting a bicycle is more popular than owning one (Mouratidis, 2022; Efthymiou et al., 2013). The low cost of use also makes it widely available and one of the most equitable forms of transport (Pucher, Buehler, 2008; Kristensen et al., 2023, p. 3). The development of this type of mobility has been significantly influenced by the development of urban bicycle systems (Médard de Chardon et al., 2017). Other factors influencing the adoption and use of shared mobility opportunities include shared mobility systems, ICT systems, transport infrastructure, type of city, sociodemographic profile of residents and weather conditions (Chibwe et al., 2021; Maas, Attard, Caruana, 2020; Christidis, 2023).

The way in which buildings and land use are developed also influences pedestrian activity. The organisation of space, the layout of streets (e.g. the number of intersections), access to shops or restaurants, and features related to safety (e.g. the presence of good lighting, pedestrian crossings or straight and wide pavements) and comfort (e.g. plantings of trees, shrubs or flowers, well-maintained parks) contribute to a good walking environment (Santos et al., 2022).

This form of mobility is also important from a sustainability point of view, as it contributes to the health attitudes of residents who are more willing, active walkers in an environment that benefits them (Shields et al., 2021, p. 20; Allam et al., 2024, p. 2).

Sustainable urban management also recognises various problems including, but not limited to, shortages of parking spaces including for the disabled or illegal, unsafe parking. Illegal parking is a problem for most cities, as it leads to increased traffic congestion and air pollutant emissions, and reduces the safety of pedestrians, cyclists and drivers, making cities less clean, safe and attractive for residents and tourists (Jardim, 2022). Another equally important problem is the occupation of cycle paths by cars (He et al., 2018). The planning of space for mobility, taking into account the needs of different stakeholder groups as well as the cost-effectiveness of the considered solutions and environmental sustainability, is at the core of considerations for both local communities and international organisations (Hartl et al., 2024). The European Commission also encourages cities to develop Sustainable Urban Mobility Plans (SUMPs) in order to improve the quality of life of their citizens (EU, 2023). In working towards sustainable mobility, it is becoming commonplace to involve local communities, who become the beneficiaries of the solutions implemented (Ortiz-Fernández et al., 2023, p. 2). They can indicate the desired directions for change in different circumstances as was the case, for example, during the pandemic (Kyriakidis et al., 2023). One tool that allows for this is public participation through the citizen budget.

4. Impact of the civic budget on the development of sustainable mobility in the City of Szczecin

Szczecin is located in the north-west of Poland, bordering Germany and is one of the largest cities in the country, the fifth largest in terms of area (over 300 km^2). The city is the central hub of the Szczecin agglomeration. The large, extensive area requires the provision of suitable mobility options for its inhabitants, who number more than 380,000. The primary modes of public transport are tram and bus. In Szczecin in 2023 there were about 1400 bus and tram stops altogether and their number increased by more than 200 within three years (BDL GUS, 2025). Thanks to the systematic expansion of cycling infrastructure and the implementation of the urban bicycle system, residents are more willing to use this form of transport. The total length of bicycle paths in Szczecin in 2023 amounted to 162 km (BDL CSO, 2025).

Action for sustainable mobility requires a strategy that sets out the directions for the development of urban transport, the tasks to be carried out in this area and the resources required for this.

As recommended by the European Commission in 2023. The Szczecin City Council adopted a resolution on the adoption of the Sustainable Urban Mobility Plan for the Szczecin Metropolitan Area (SOM) until 2030 (with an outlook until 2040) (RM Szczecin, 2023). The following objectives were formulated for sustainable transport of SOM:

- implementing systemic solutions and making investments to improve traffic safety,
- education and awareness-raising for residents and drivers to improve traffic safety,
- improving safety in terms of mobile activity (construction of appropriate infrastructure, improvement of pavements, introduction of signage and safety barriers),
- provision of environmentally friendly bus stop infrastructure,
- supporting active mobility through the planning and construction of infrastructure: cycle paths and footpaths to serve tourist and recreational traffic.

The city's residents are also involved in setting the directions for urban mobility development. One of the ways in which the conditions of the local community can be actively shaped is the participatory budget, which has been operating in Szczecin since 2014. Figure 2 shows the number of projects that have been selected for implementation in each year of the SBO. Initially, only two projects were selected, one of which was about sustainable mobility (the creation of the Szczecin City Bike), but over time the number of projects increased. In the latest budget, of the 32 projects selected for implementation, 6 concerned sustainable mobility.

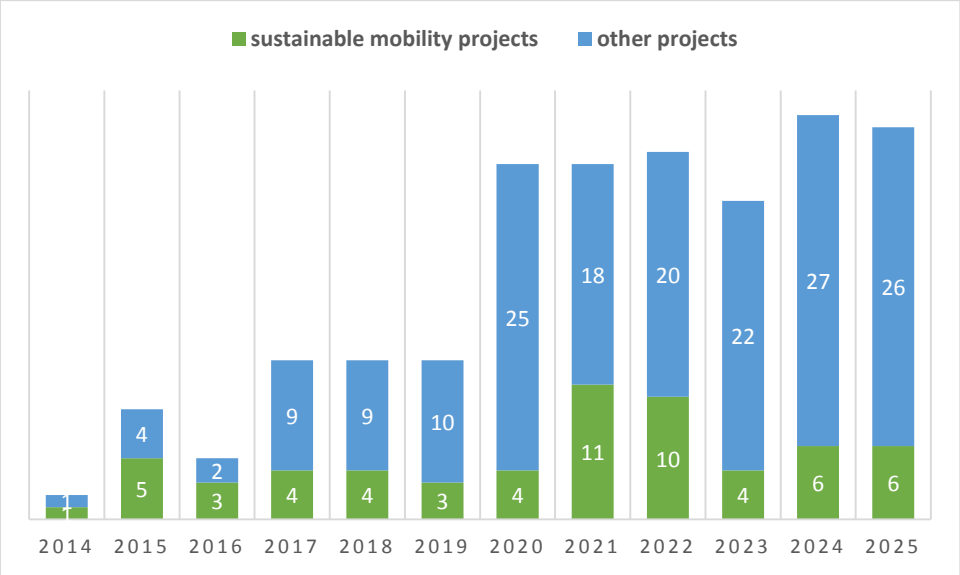


Figure 2. Number of SBO projects selected for implementation between 2014 and 2025.
Source: own compilation based on data and documents from Szczecin City Hall and the SBO portal.

In the first three years of the civic budget, the share of projects related to sustainable mobility was at least 50% in the following years this share decreased and in the last two years it was only about 18% (Table 1).

Table 1.
Share of SBO projects on sustainable mobility selected for implementation 2014-2025

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Participation of projects in the area of sustainable mobility	50%	56%	60%	31%	31%	23%	14%	38%	33%	15%	18%	19%

Source: own compilation based on data and documents from Szczecin City Hall and the SBO portal.

The funds that have been allocated to the selected SBO projects are shown in Table 2 and Figure 3.

Table 2.
SBO funding 2014-2025

Year	SBO funding pool	Funding pool for sustainable mobility projects	Funding pool for other SBO projects	Share of SBO envelope
2014	5000000	575000	4425000	12%
2015	5000000	3430102	1569898	69%
2016	6000000	3700000	2300000	62%
2017	7000000	1342500	5657500	19%
2018	8000000	1540000	6460000	19%
2019	9000000	3444000	5556000	38%
2020	12720000	1544025	11175975	12%
2021	14606083	4013826	10592257	27%
2022	16700000	6656849	10043151	40%
2023	17520000	2247000	15273000	13%
2024	17200000	2108300	15091700	12%
2025	17200000	2280325	14919675	13%

Source: own compilation based on data and documents from Szczecin City Hall and the SBO portal.

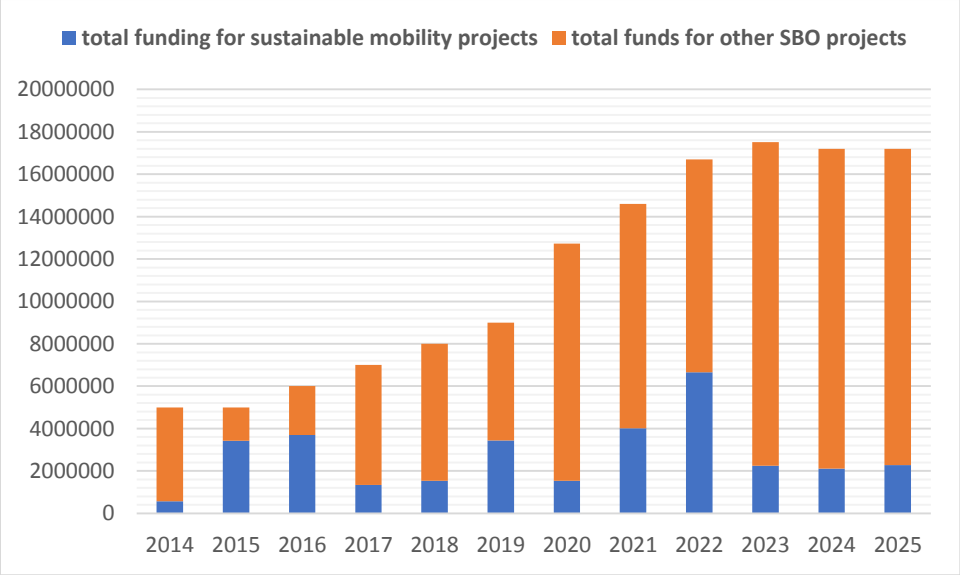


Figure 3. SBO funding 2014-2025.

Source: own compilation based on data and documents from Szczecin City Hall and the SBO portal.

On the basis of the data presented, it can be seen that in the years studied, the planned spending on sustainable mobility investments ranged from 12 to 69% of the total civic budget funds in those years. On the other hand, the total amount of the civic budget that was decided

to be spent on sustainable mobility from 2014 until 2025 is 32881927, which represents 24% of the total SBO in these years.

In line with the characteristics of sustainable urban mobility identified on the basis of literature research, an analysis was made of the types of investments that were selected for implementation as part of the civic budget. Four main groups of these were identified:

- projects concerning the development of an urban cycling system and the associated development of cycle paths,
- road infrastructure projects aimed at increasing the safety of road users, such as the reconstruction of intersections, street lighting or the construction of parking areas at schools,
- projects that improve pedestrian comfort and safety, such as repairing and building pavements, improving safety at pedestrian crossings or creating "green" public transport stops,
- projects aimed at creating infrastructure for leisure mobility.

Figure 4 shows the structure of the total expenditure planned for SBO projects since the inception of the initiative.

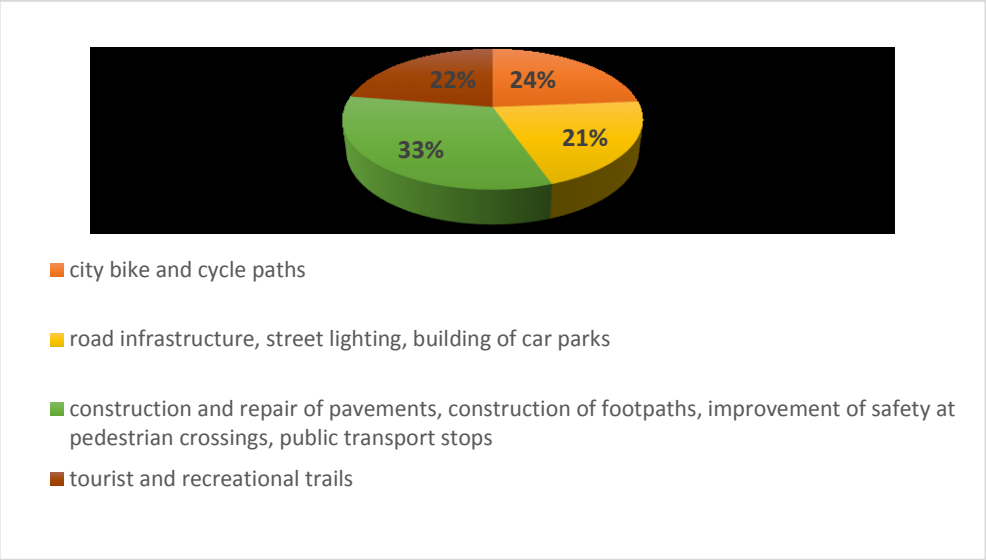


Figure 4. Structure of the total civic budget from 2014 to 2025 for sustainable mobility objectives. Source: own compilation based on data and documents from Szczecin City Hall and the SBO portal.

5. Summary

Sustainable urban mobility is being researched in various aspects. The most important of these are the impact on the environment and on the health of inhabitants as well as the shaping of new mobility habits. Best practices point to the need to favour public transport as well as the important role of cycling and the development of appropriate conditions for pedestrians.

In all of these areas most attention is paid to safety, accessibility of these forms of transport and possibilities for their further development. The importance of sustainable mobility is also recognised by the local community itself. The research carried out indicates that public participation through the civic budget has a significant impact on shaping sustainable mobility in Szczecin by participating in the process of developing and selecting suitable SBO projects. Key areas identified for supporting sustainable mobility include road infrastructure, the urban bicycle system, increasing safety for cyclists and pedestrians, and infrastructure for active recreation. The number of SBO projects selected for implementation and addressing sustainable mobility in 2025 represented 19% of all projects selected for implementation. This is a similar share to the previous year and at the same time shows an increasing trend. The pool of SBO funding for sustainable mobility projects has been at a similar level for the past three years, at around 13% of total expenditure. Throughout the life of the SBO, i.e. since 2014, most funding has been allocated to projects improving pedestrian comfort and safety and more friendly public transport stops. However, a perceived problem may be the implementation of the selected projects themselves, which is often delayed which may discourage residents from further involvement in sustainable development. The effectiveness of the implementation of SBO projects and the factors that influence the implementation of adopted projects may therefore be the subject of further research.

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PREDICTING WORK ENGAGEMENT THROUGH ORGANIZATIONAL CLIMATE: INSIGHTS FROM A POLISH STUDY

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Purpose: The aim of the study was to investigate whether Organizational Climate and its dimensions: Co-workers, Leadership, Work Organization, Information and Communication, Representation of Employees' Interests, Promotion and Rewards (Rosenstiel, Boegel, 1992) can predict Work Engagement and its components: Vigour, Dedication, and Absorption (Schaufeli et al., 2002, 2003).
Design/methodology/approach: A cross-sectional survey was conducted in 2022 on a heterogeneous sample of Polish employees (N = 229). The study used a Polish adaptation of Rosenstiel and Boegel's Organizational Climate Questionnaire (1992; cf. Durniat, 2012, 2018), which includes 55 items across 7 subscales (Cronbach's α = 0.81-0.90), as well as a Polish adaptation of the Utrecht Work Engagement Scale (Szabowska-Walaszczyk et al., 2011) in its 17-item version (3 subscales; Cronbach's α = 0.81-0.88). Correlation and linear regression analyses were conducted to examine the relationships between the studied variables, with the expectation of significant and positive associations.
Findings: Two factors of organizational climate, i.e. the 'Leadership' and 'Co-workers' interactions' emerged as key predictors of work engagement, while other climate factors demonstrated weaker or non-significant impacts on employee engagement. Surprisingly, the 'Representation of employees' interests' negatively predicted work engagement (especially 'Vigour'). Moreover, the 'General perception of organizational climate' may be more impactful for work engagement than specific climate dimensions.
Research limitations: The cross-sectional design prevents causal inferences, and the relatively small sample size constrains the generalizability of the results.
Practical implications: Managers and organizations should foster a positive organizational climate, especially investing in leadership development and team-building initiatives - key factors enhancing employee engagement.
Originality/value: The findings offer a valuable contribution by identifying organizational climate factors that enhance work engagement, and appear to represent the first study of this kind conducted in Poland.
Keywords: organizational climate, work engagement, UWES, relationships, predictions.
Category of the paper: Research paper.

1. Introduction

The most recent Gallup report on the state of the global workplace indicates that in 2023, global employee engagement stagnated, and overall employee wellbeing declined. According to Gallup's findings only 23% of employees globally (13% in Europe; 10% in Poland) fall in the group of engaged, while 62% of employees globally (72% in Europe; 75% in Poland) are not engaged, while 15% of workforce globally (16% in Europe; 15% in Poland) show active disengagement (Gallup, 2024). These figures highlight a concerning state of employee engagement, with Europe having the lowest proportion of engaged employees among all regions, and Polish employees exhibiting even lower engagement than the European average. Furthermore, Gallup report underscores that business units with high employee engagement tend to experience substantially greater employee well-being, along with increased productivity, profitability, and sales, compared to teams with lower engagement levels. It also provides compelling evidence that reducing workforce disengagement contributes to positive organizational outcomes. In its 2024 meta-analysis (the largest study of its kind, encompassing data from over 183,000 business units across 53 industries and 90 countries) Gallup found that business units with high employee engagement tend to experience significantly greater employee well-being, along with increased productivity, profitability, and sales, compared to those with lower engagement levels. Notably, according to Gallup's study results, engagement is driven more by socio-organizational factors at the business-unit level - especially the presence of engaged and supportive managers - followed by strong communication, clarity of purpose and role expectations, opportunities for development, and a strengths-based approach, than by macroeconomic factors such as national labor policies and the vibrancy of job markets (Clifton, Harter, 2019; Gallup, 2024).

This paper investigates the relationship between organizational climate and work engagement, examining both overall and specific dimensions of these constructs. By analysing data from a Polish sample, the study explores the extent to which different aspects of organizational climate predict work engagement and its components: vigour, dedication, and absorption. The results are discussed in the context of international scientific literature.

2. Theoretical background

2.1. Organizational climate

The concept of organizational climate has captivated researchers and practitioners over the last six decades (for overview see: Ehrhart et al., 2025; Ostroff et al., 2003; Schneider et al., 2017; Schein, 2000). A growing body of scientific work aims to differentiate it from

organizational culture (e.g., Ostroff et al., 2003; Payne, 2000; Schein, 2000) while examining its relationships with employee behaviour and organizational outcomes (e.g., Goodman, Dingli, 2013; Payne et al., 1976; Patterson et al., 2004, 2005). Organizational climate is a multidisciplinary phenomenon, drawing from Gestalt psychology, social anthropology, and organizational theory - particularly influenced by the Human Relations movement (cf. Schneider et al., 2011; Schneider, Barbera, 2013).

Although there are many ways in which organizational climate has been defined, in the most widely accepted modern paradigms, it is understood as the collective perceptions and the significance employees attribute to the policies, practices, and procedures they encounter in the organisation, as well as the behaviours they see being rewarded, supported, and expected in the workplace (Ostroff et al., 2003; Schneider et al., 2011, 2017; Schein, 2000). These perceptions refer to the key, relatively stable characteristics of an organisation (such as leadership, cooperation, communication, work organisation, recognition, and support) which differentiate one organisation from another and significantly influence the behaviour of its members. Researchers emphasise that organizational climate emerges from employees' interactions with leadership, HR practices, coworkers, and organizational norms and reflects how individuals and groups perceive their work environments (Ehrhart et al., 2025; Schneider et al., 2011, 2017).

Within the outlined organizational climate paradigm, we can place the concept developed by German scientists Rosenstiel and Boegel (1992; cf. Durniat, 2012, 2018). This concept emerges from Kurt Lewin's (1951) psychological field theory, in which he emphasised the importance of an individual's subjective perception of their environment in determining human behaviour. In line with this, Rosenstiel and Boegel (1922) assumed that human behaviour in an organisation results from two fundamental factors: personality and environment. Accordingly, researchers claimed that organizational climate emerges from a dynamic interaction between the organisation (with its formal characteristics and cultural features, such as mission, goals, power distance, and leadership) and the employees (with their needs, expectations, competencies, and values). According "organizational climate is a notion referring to the features of the entire internal environment of a given organisation, as perceived and evaluated by groups of its members" (Rosenstiel, Boegel, 1992, p. 22). Although organizational climate is a collective concept, it can be measured at both individual and organizational levels (Schneider et al., 2013, 2017). Rosenstiel and Boegel (1992) identified six core dimensions of organizational climate, which form the basis of the main scales of their tool: (1) Co-workers (concerns the quality of relationships, mutual trust and cooperation with co-workers), (2) Leadership (refers to the approach taken by leaders and managers, including decision-making processes and leadership style), (3) Organization of work (describes the adequacy and efficiency of task allocation, workflow, and overall organization of work processes), (4) Information and communication (concerns the clarity, reliability, efficiency, and transparency of communication within the organization), (5) Representation of employees' interests (assesses how effectively employees' interests are represented and advocated for

within the organisation, particularly through trade unions, workers' councils, and similar bodies), (6) Promotion and rewards (concerns the adequacy and effectiveness of the organizational system of rewards and promotion opportunities) (cf. Durniat, 2012, 2018).

Research indicates that positively assessed organizational climate dimensions, such as supportive leadership, autonomy, communication, trust, and recognition, enhance work motivation, engagement and satisfaction (Bakker, Demerouti, 2007; Schaufeli et al., 2002; Rožman, Štrukelj, 2021). Supportive leadership helps employees feel valued and motivated, while mutual trust, open communication and strong relationships foster a sense of security and connection, further enhancing employee engagement (cf. Holloway, 2012; Kahn, 1990; Meyer et al., 2004; Mazzetti et al., 2023).

2.2. Work engagement

Work engagement refers to the positive, fulfilling, and motivational state in which employees become deeply involved with their work. This concept was first introduced to scientific discourse by Kahn (1990), later on evolved primarily through the work of organizational psychologists Schaufeli, Bakker, and their colleagues, who developed the most recognizable definition and theoretical model of work engagement (cf. Schaufeli et al., 2002, 2003, 2004; Bakker et al., 2008, 2010). They defined this phenomenon as "A positive, fulfilling, work-related state of mind that is characterized by vigour, dedication, and absorption (Schaufeli et al., 2002, p. 72). Vigour reflects high energy, resilience, and persistence at work, even in challenging situations. Dedication involves deep involvement, enthusiasm, and a strong sense of meaning and accomplishment. Absorption is characterized by full immersion in work, where time passes quickly due to intense concentration and engrossment (cf. Schaufeli et al., 2002; Bakker et al., 2010). It is worth underlying that absorption differs substantially from vigour and dedication, which have been theoretically and empirically identified as the core dimensions of work engagement (Schaufeli, Bakker, 2004). It resembles flow, a state of deep concentration that may not always be linked to motivation or commitment (Schaufeli, Bakker, 2004). Research shows that absorption, rather, functions as a long-lasting mood or a temporary state in which a person is fully focused on and deeply immersed in their job (cf. Schaufeli, Bakker, 2004; Mazzetti et al., 2018, 2023).

The antecedents and consequences of work engagement have been widely researched and thoroughly described in the scientific literature (e.g., Bailey et al., 2017; Bakker et al., 2010; Mazzetti et al., 2023; Meyer et al., 2004; Wefald et al., 2011). Studies indicate that high work engagement is influenced by various individual and socio-organizational factors, foremost among them supportive and inspiring leadership, as well as a favorable organizational climate (Abun et al., 2021; Arya, Sainy, 2017; Rahmadani et al., 2022; Rožman, Štrukelj, 2021; Szczepańska-Woszczyna, Bogaczyk, 2023). In turn, high work engagement increases employee satisfaction and job performance, innovation and creativity, mental health and well-being,

as well as organizational outcomes and overall success (Bakker et al., 2008; Patterson et al., 2004, 2005; Rahmadani et al., 2020, 2022).

3. Research hypothesis

Based on the literature review and research findings, the following research hypotheses have been proposed:

H1: Organizational climate and its factors (co-workers, leadership, organization of work, information and communication, representation of employees' interests, career opportunities and rewards and general impression) are positively correlated with work engagement and its factors (vigour, dedication, and absorption).

H2: Organizational climate and its factors (as cited above) significantly and positively predict work engagement (as unidimensional phenomenon) and its factors: vigour, dedication, and absorption.

H3: Among all the factors of organizational climate, leadership will be the most significant positive predictor of work engagement.

4. Data collection and sample description

The study was a cross-sectional survey conducted in Wrocław in 2022, involving 229 participants (average age: 35.7, SD = 11.4), selected from a population of working adults. Respondents were tested individually or in small groups by a trained pollster. Participation was voluntary and anonymous. The surveyed individuals were informed of the scientific aims of the study and completed a paper-and-pencil version of the questionnaires. They were assured the right to withdraw from the study at any time without providing a reason. Detailed sociodemographic data for the sample is provided in Table 1.

Table1.
Socio-demographic data of the sample (N = 229; 2022)

Demographic category		Count	%	Demographic category		Count	%
Sex	woman	143	62.4	**Sector**	public	111	48.9
	man	85	37.1		private	114	50.2
	missing data	1	0.4		missing data	2	0.9
Age	up to 25 years	48	21	**Position**	director	10	4.5
	26-35 years	74	31.4		supervisor	28	12.6
	36-45 years	55	24		specialist	85	38.3
	above 45 years	54	23.6		subordinate	98	44.1
	missing data	0	0		missing data	1	0.5

Cont. table 1.

Branch	industry	28	12.3	**Seniority**	up to 1 year	22	9.6
	commerce	20	8.8		above 1 to 3 years	59	25.8
	services	55	24.2		above 3 to 6 years	27	11.8
	administration	22	9.7		above 6 to 10 years	36	15.7
	education	38	16.7		above 10 years	85	37.1
	health service	11	4.8		missing data	0	0
	others	53	23.3				
	missing data	0	0				

Source: Own research.

5. Instruments and methods

5.1. Organizational climate questionnaire

The organizational climate was assessed using the questionnaire developed by Rosenstiel and Boegel (1992) in the Polish adaptation by Durniat (2012, 2018). The tool was designed to capture the multidimensional nature of organizational climate. The Polish version of the test comprises 55 items divided into 6 main subscales: (1) Co-workers (Cronbach's $\alpha = 0.86$; 9 items; e.g., "If anyone has problems at work, they can always count on their workmates" and "Everyone can freely express their own opinions and feelings"), (2) Leadership (Cronbach's $\alpha = 0.92$; 12 items; e.g., "Good work is well appreciated by our superiors" and "The superiors understand our problems and worries"), (3) Work organization (Cronbach's $\alpha = 0.81$; 7 items; e.g., "The aims and tasks we are faced with make an interesting challenge" and "Interesting and uncommon tasks are distributed fairly"), (4) Information and communication (Cronbach's $\alpha = 0.90$; 10 items; e.g., "We are often informed about facts and decisions that have already been made" and "The management of our company is ready to consider employees' ideas and suggestions"), (5) Representation of employees' interests (Cronbach's $\alpha = 0.81$; 5 items; e.g., "The interests of employees are fully respected in our company" and "Even when the staff's interests conflict with management's, there is always a solution that satisfies everyone"), (6) Promotion and rewards (Cronbach's $\alpha = 0.85$; 7 items; e.g., "There are many opportunities to get promoted" and "Professional achievements are well evaluated in our company"). The test also includes a scale measuring 'General perception of organizational climate' (Cronbach's $\alpha = 0.85$; 5 items; e.g., "Working in our company is nice" and "Our company cares about the well-being of employees"), highly correlated with particular climate dimensions.

The questionnaire uses a five-point Likert scale, ranging from 1 (I strongly disagree) to 5 (I strongly agree), with higher scores indicating a better organizational climate. Factorial and reliability analyses confirm that the organizational climate questionnaire can be interpreted as either a unidimensional measure (providing an overall score) or a multidimensional tool for

assessing specific aspects of organizational climate. The Polish adaptation demonstrates excellent reliability and validity across multiple studies and meets all psychometric requirements. It is suitable for scientific research and can be applied to both group- and individual-level analyses (cf. Rosenstiel, Boegel,1992; Durniat, 2016, 2018).

5.2. Work engagement scale (UWES)

Work engagement was measured using the 17-item Utrecht Work Engagement Scale (UWES) (Schaufeli et al., 2002, 2003) adapted for the Polish context by Szabowska-Walaszczyk et al. (2011). The UWES-17 evaluates three key dimensions of engagement through its subscales: Vigour (Cronbach's $\alpha = 0.81$; 6 items; e.g., "When I get up in the morning, I feel like going to work" and "At work, I feel bursting with energy"), Dedication (Cronbach's $\alpha = 0.88$; 5 items; e.g., "I am enthusiastic about my job" and "I am proud of the work I do"), and Absorption (Cronbach's $\alpha = 0.84$; 6 items; e.g., "When I am working, I forget everything else around me" and "I am immersed in my job"). Each item is rated on a seven-point Likert scale ranging from 0 (never) to 6 (always/daily), with higher scores indicating greater levels of work engagement. The scale can be used to assess engagement as either a single construct, represented by an overall score (Cronbach's $\alpha = 0.94$), or as a multidimensional construct comprising the three subscales (Schaufeli et al., 2002, 2003).

6. Statistical solution and results

All statistical analyses were performed using JAMOVI (version 2.3.18) software. In the initial step, descriptive statistics and Pearson's r correlations between all the variables included in the study were computed. This analysis allowed for the exploration of the overall pattern of relationships between organizational climate and work engagement factors. The obtained correlation matrix demonstrates a general pattern of significant, positive, and moderate correlations (ranging from 0.32 to 0.52) between all dimensions of organizational climate and work engagement (cf. Table 2). This means that, as expected, higher assessments of organizational climate are associated with higher levels of work engagement, and vice versa.

Table 2.
Means, standard deviations, and correlation matrix (Pearson's r) between Organizational Climate (overall score) and UWES-17 scales (N=229; 2022)

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11
1.Organizational Climate (overall)	108.6	36.40											
2. Co-workers	31.3	6.05	0.71										
3. Leadership	38.8	9.94	0.93	0.58									
4. Work organization	24.3	4.90	0.80	0.54	0.69								

Cont. table 2.

5.Communication	31.8	7.88	0.90	0.55	0.79	0.68							
6. Employees' interests	16.2	4.29	0.81	0.53	0.71	0.55	0.74						
7. Promotion and rewards	21.3	5.87	0.81	0.42	0.73	0.55	0.71	0.67					
8. UWES (overall)	63.4	18.20	0.52	0.38	0.48	0.39	0.46	0.34	0.43				
9. Vigour	22.4	6.40	0.49	0.34	0.46	0.36	0.41	0.30	0.40	0.91			
10. Dedication	19.9	6.37	0.48	0.34	0.45	0.36	0.43	0.31	0.38	0.92	0.77		
11.Absorption	22.1	7.23	0.45	0.31	0.44	0.35	0.40	0.32	0.38	0.91	0.72	0.75	
12. General impression of Org. Climate	16.9	4.43	0.83	0.57	0.75	0.67	0.70	0.58	0.58	0.53	0.52	0.50	0.45

Note. $p < 0.001$; M = mean; SD = standard deviation.

Source: Own research.

Next, regression analyses were conducted to examine whether organizational climate and its dimensions can predict work engagement, measured as both a uni- and multi-dimensional phenomenon. The results of the regression analyses are presented in the Appendix (cf. Appendix, Table 1).

In the first step, a simple linear regression was performed (model 0) to examine the relationship between 'Organizational climate' and 'Work engagement' (both measured as unidimensional constructs). The results indicated that 'Organizational climate' significantly predicted 'Work engagement' ($\beta = .519$, $p < .001$). The overall model was statistically significant ($F(1, 227) = 83.7$, $p < .001$), explaining 27% of the variance ($R^2 = .27$). This finding suggests that a more favourable work climate is associated with higher work engagement.

In the second step, a multiple linear regression model (model 1) was applied to assess the predictive power of specific organizational climate factors on overall work engagement.

The model 1. (predicting 'Work engagement' as unidimensional variable) was well-fitted to the data ($F(6, 222) = 14.0$, $p < .001$) and explained 23% of the variance ($R^2 = .23$). The results indicated that 'Work engagement' was significantly and positively predicted by 'Interactions with co-workers' ($\beta = .16$, $p = .031$) and 'Leadership' ($\beta = .23$, $p = .043$). Furthermore, a marginally significant positive relationship was found between 'Career opportunities and rewards' and 'Work engagement' ($\beta = .16$, $p = .070$), while a marginally significant negative relationship was observed between 'Work engagement' and 'Representation of employees' interests' ($\beta = –.16$, $p = .087$). This suggests that when employees feel well-represented, their personal engagement in work may decline. However, this result did not reach the conventional threshold of statistical significance ($p < .05$). The remaining organizational climate factors (i.e. 'Organization of work' and 'Communication') did not significantly contribute to the model (cf. Appendix, Table 1).

Subsequently, it was tested whether the six distinct factors of organizational climate significantly predict specific aspects of work engagement: Vigour, Dedication and Absorption. In the case of 'Vigour' as the dependent variable (model 2), the model was well-fitted to the data ($F(6, 222) = 13.2$, $p < .001$) and explained 24% of the variance ($R^2 = .24$). The results indicated that 'Vigour' was significantly and positively predicted by 'Leadership' ($\beta = .26$,

p = .021) and ‘Interactions with co-workers’ (β = .22, p = .003). Moreover, a marginally significant positive relationship was found between ‘Vigour’ and ‘Career opportunities and rewards’ (β = .16, p = .075). Interestingly, ‘Vigour’ showed a significant negative relationship with the ‘Representation of employees’ interests’ (β = –.29, p = .035), suggesting that as employees perceive their interests to be more effectively represented, they may feel less urgency or motivation to invest high energy and engagement, leading to lower levels of vigour. The remaining organizational climate factors (i.e. ‘Organization of work’ and ‘Communication’) did not significantly predict ‘Vigour’.

The next regression model (model 3) was well-fitted to the data ($F(6, 222) = 11.3$, $p < .001$) and explained 21% of the variance ($R^2 = .21$). The results showed that ‘Dedication’ was significantly predicted by ‘Leadership’ (β = .23, p = .051) and marginally positively predicted by ‘Communication’ (β = .20, p = .072). However, the four remaining organizational climate factors did not significantly predict ‘Dedication’ (cf. Supplement, Table 1).

Finally, a multiple regression analysis was conducted to predict ‘Absorption’ (model 4) from organizational climate factors. The overall model was statistically significant ($F(6, 222) = 9.33$, $p < .001$) and explained 18% of the variance ($R^2 = .18$). However, none of the individual predictors reached statistical significance. These results suggest that other (unmeasured) factors may be more influential in determining absorption in work.

It is worth highlighting that when the seventh predictor, namely ‘General impression of organizational climate,’ was introduced into the multiple regression models (model 5; cf. Appendix, Table 1), the models remained well-fitted to the data and explained slightly larger portions of variance in the dependent variables (i.e. for ‘Work engagement’: 32%, ‘Vigour’: 29%, ‘Dedication’: 25%, ‘Absorption’: 20%). Moreover, the ‘General impression of organizational climate’ significantly predicted ‘Work engagement’ as a unidimensional phenomenon (β = .36, p < .001), as well as its dimensions; respectively: ‘Vigour’ (β = .37, p < .001), ‘Dedication’ (β = .35, p < .001), and ‘Absorption’ (β = .27, p = .006) (models: 6, 7, 8 – which details are available from the author upon request). Thus, this predictor proved to be a stronger and more significant factor of ‘Work engagement’ (and its dimensions) than the distinct factors of organizational climate included in the models 1, 2, 3, and 4. At the same time (comparison between model 1 and 5 predicting overall ‘Work engagement’) some predictors that were initially significant in the original model 1 (i.e. ‘Interactions with co-workers’ and ‘Leadership’) lost their statistical significance after the inclusion of this new variable in model 5 (cf. Appendix, Table 1). This effect may be attributed to the fact that ‘General impression of organizational climate’ is highly correlated with the six distinctive dimensions of organizational climate, which were included in the model. As a result, it may absorb some of their explanatory power, causing their significance levels to drop.

7. Discussion

This study examined the relationship between organizational climate and work engagement, focusing on both overall engagement and its dimensions: vigour, dedication, and absorption. The findings provide partial support for the hypotheses, confirming that while organizational climate is associated with work engagement (supporting H1) and 'Leadership' is the most significant positive predictor of engagement (supporting H3), not all climate factors significantly and positively predict engagement and its components (partially supporting H2).

The obtained results indicate that 'Leadership' and 'Interactions with Co-workers' significantly predict overall work engagement, suggesting that supportive, employee-oriented leadership and positive interpersonal relationships at work foster higher levels of employee engagement. This aligns with previous research emphasizing the role of transformational leadership and social support in promoting engagement (e.g., Bakker et al., 2010; Holloway, 2012; Schaufeli, Bakker, 2008; Wefald et al., 2011), as well as with findings from more recent studies (e.g., Kohnen et al., 2024; Mazzetti et al., 2023).

Interestingly, Gallup found that as much as 70% of the variance in team engagement can be attributed to the manager and leadership style (Clifton, Harter, 2019; Gallup, 2024). The Gallup report states: "While economic prosperity and labor protections are strongly correlated with less misery at work, engagement is more closely tied to interpersonal relationships with one's manager. An effective manager motivates team members, moving them from indifferent to inspired" (Gallup, 2024, p. 19). These results can be explained through the framework of Self-Determination Theory (Deci, Ryan, 2000), emphasizing that inspiring and engaged leaders who foster cooperation and mutual trust fulfill employees' basic needs for autonomy, competence, and relatedness, which, in turn, boost their level of work engagement (cf. Mazzetti et al., 2023; Rahmadani et al., 2020, 2022).

Furthermore, 'Career opportunities' and rewards' showed a marginally significant positive relationship with work engagement, suggesting that access to career development and recognition may play a role in fostering engagement, albeit at a weaker level than initially expected. This aligns with job resources theory, which posits that employees are more engaged when they perceive opportunities for professional growth and fair compensation (Bakker, Demerouti, 2007; Demerouti et al., 2001; Mazzetti et al., 2023; Schaufeli, Bakker, 2004). However, given its marginal significance, future studies should explore whether this relationship is influenced by moderating variables, such as job tenure or organizational hierarchy.

Interestingly, the 'Representation of employees' interests negatively predicted 'Vigour', contradicting the assumption that all organizational climate factors enhance engagement (cf. Abun et al., 2021; Szczepańska-Woszczyna, Bogaczyk, 2023). This unexpected finding suggests that employees who perceive their interests as well-represented may, paradoxically,

exhibit lower energy and enthusiasm at work. One possible explanation is that strong employee representation reduces a sense of urgency or proactive engagement, leading to decreased vigour. This result can be interpreted through 'Conservation of Resources Theory' (1981; cf. Hobfoll, Shirom, 2001), which posits that individuals strive to acquire and protect valuable resources such as energy and psychological well-being. When employees feel secure in the representation of their interests, they may experience reduced pressure to actively invest energy in advocating for their needs, leading to lower vigour. In this context, strong employee representation may contribute to a more stable but less intensely engaged workforce. Alternatively, organizations that highly emphasize employee interests may still present other stressors (e.g., job demands, role ambiguity, or bureaucratic constraints) that could diminish energy levels. However, this counterintuitive finding warrants further investigation to better understand these dynamics.

Notably, when 'General impression of organizational climate' was introduced as an additional predictor, the new models explained a larger proportion of variance in work engagement and its dimensions. Moreover, some previously significant predictors lost their statistical significance. This suggests that employees may evaluate organizational climate holistically, with an overall positive perception of the workplace playing a more influential role in work engagement than individual dimensions of organizational climate (cf. Abun et al., 2021; Arya, 2017; Rožman, Štrukelj, 2021). Given the high correlations between the 'General Impression of Organizational Climate' and other specific climate factors, this may explain why previously significant predictors lost their explanatory power. Moreover, this result underscores the complexity of relationships in organizational settings, where variables are often interdependent rather than acting in isolation. Future analyses could explore mediating or moderating effects to better understand the interplay between these factors.

Finally, the analysis of 'Absorption' showed that none of the organizational climate dimensions significantly predicted this aspect of engagement. This suggests that absorption may be driven by individual factors (e.g., personality traits, intrinsic motivation) or task-related characteristics (e.g., job complexity, autonomy) rather than by broader organizational conditions (cf. Bakker et al., 2008; Schaufeli et al., 2002; Wefald et al., 2011). Future research could explore these alternative influences on absorption to better understand its determinants. Moreover, the results from the current study align with findings from a recent large-scale meta-analytic study on the antecedents and outcomes of work engagement, which showed that the absorption dimension of engagement (in comparison to vigour and dedication) consistently exhibited weaker associations with all investigated variables (Mazzetti et al., 2023). Such findings can be explained by earlier evidence suggesting that absorption is somewhat distinct, less stable, and the least central indicator of work engagement. Empirical research proves that absorption is a more transient state of deep involvement, which can sometimes overlap with workaholism or flow experiences rather than motivation or commitment (Mazzetti et al., 2018). These findings warrant further exploration.

8. Study limitations and Future Research Directions

While these findings provide valuable insights, some limitations must be acknowledged. First, the reliance on self-reported measures raises concerns about common method bias. Second, the cross-sectional design prevents causal inferences, making it unclear whether 'Organizational climate' influences 'Work engagement' or whether engaged employees perceive their work environment more positively. Future longitudinal or experimental studies could help clarify the direction of these relationships. Moreover, the marginal significance of some predictors (e.g., 'Career opportunities and rewards') suggests that their impact on engagement might be context-dependent, varying across different employee groups or organizational settings. Furthermore, the unexpected negative relationship between 'Representation of employees' interests' and 'Vigour' warrants further investigation, as qualitative studies could provide deeper insights into why this effect occurs. Finally, although the study used a heterogeneous sample that helped increase statistical power, the relatively small sample size constrains the generalizability of the results. Future research should consider employing lager and more representative sampling methods to enhance external validity.

9. Conclusion

This study underscores the role of organizational climate and its factors, especially the critical role of leadership and co-worker relationships in fostering work engagement, highlighting the need for organizations to invest in leadership development and team-building initiatives. In line with these findings, Gallup's report states that "A great manager builds an ongoing relationship with an employee grounded in respect, positivity and an understanding of the employee's unique gifts. Great managers help employees find meaning and reward in their work. As a result, employees take an interest in what they do, leading to higher productivity and enjoyment" (Gallup, 2024, p. 19).

The current study results also suggest that a holistic perception of organizational climate may be more impactful than individual climate dimensions. However, the negative relationship between representation of employees' interests and vigour presents an intriguing finding that requires further exploration. Addressing these questions through future research could provide deeper insights into how organizations can cultivate an engaging and supportive work environment.

The results of this study should be of interest to both scientists and practitioners, internationally and particularly in Poland, where levels of work engagement appear to be alarmingly low and even lower than in other European countries, which themselves lag behind regions such as North America or Southeast Asia, as shown in Gallup's 2024 report.

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Appendix

Table 1.
Linear regression analyses' results. Prediction of work engagement on the basis of organizational climate (measured as uni- and multi-dimensional constructs)

Dependent variable: UWES (overall) (F(1.227) = 83.7; p < .001); R2 adj. = 0.266					
	B	**Beta**	**SE**	**t**	**p**
(Intercept)	17.458		5.2272	3.34	< .001
Organizational climate (overall)	0.260	**0.519**	0.0284	9.15	**< .001**
1. Dependent variable: UWES (overall) (F(6.222) = 14.0; p < .001); R2 adj. = 0.225					
(Intercept)	18.258		6.184	2.953	0.003
Co-workers	0.483	**0.1606**	0.223	2.169	**0.031**
Leadership	0.416	**0.2269**	0.204	2.033	**0.043**
Organization of work	0.107	0.0287	0.315	0.339	0.735
Communication	0.398	0.1720	0.254	1.565	0.119
Employees' representation	-0.679	-0.1598	0.395	-1.718	0.087
Carrier opportunities and rewards	0.500	0.1611	0.283	1.763	0.079
2. Dependent variable: Vigour (UWES) (F(6.222) = 13.2. p < .001); R2 adj. = 0.242					
(Intercept)	6.45352		2.1929	2.9429	0.004
Co-workers	0.23561	**0.22260**	0.0790	2.9818	**0.003**
Leadership	0.16798	**0.26061**	0.0725	2.3168	**0.021**
Organization of work	0.00865	0.00662	0.1118	0.0774	0.938
Communication	0.08974	0.11038	0.0901	0.9962	0.320
Employees' representation	-0.29792	**-0.19941**	0.1401	-2.1272	**0.035**
Carrier opportunities and rewards	0.17952	0.16465	0.1005	1.7862	0.075
3. Dependent variable: Dedication (UWES) (F(6.222) = 11.3; p < .001); R2 adj.= 0.213					
(Intercept)	5.4825		2.2246	2.464	0.014
Co-workers	0.1295	0.1230	0.0802	1.616	0.108
Leadership	0.1444	**0.2251**	0.0736	1.963	**0.051**
Organization of work	0.0282	0.0217	0.1134	0.249	0.804
Communication	0.1652	0.2043	0.0914	1.808	0.072
Employees' representation	-0.2444	-0.1644	0.1421	-1.720	0.087
Carrier opportunities and rewords	0.1311	0.1208	0.1020	1.286	0.200
4. Dependent variable: Absorption (UWES) (F(6.222) = 9.33; p < .001); R2 adj.= 0.180					
(Intercept)	6.3218		2.5743	2.456	0.015
Co-workers	0.1181	0.0989	0.0928	1.274	0.204
Leadership	0.1034	0.1422	0.0851	1.215	0.226
Organization of work	0.0700	0.0474	0.1312	0.533	0.594
Communication	0.1426	0.1555	0.1058	1.348	0.179
Employees' representation	-0.1363	-0.0809	0.1644	-0.829	0.408
Carrier opportunities and rewards	0.1889	0.1536	0.1180	1.601	0.111
5. Dependent variable: UWES (overall) (F(7.221) = 15.0; p < .001); R2 adj.= 0.300					
(Intercept)	19.118		5.997	3.188	0.002
Co-workers	0.326	0.1082	0.220	1.482	0.140
Leadership	0.154	0.0842	0.209	0.738	0.462
Organization of work	-0.153	-0.0411	0.313	-0.489	0.625
Communication	0.250	0.1081	0.249	1.003	0.317
Employees' representation	-0.649	-0.1528	0.383	-1.695	0.091
Carrier opportunities and rewards	0.494	0.1594	0.275	1.800	0.073
General impression of organ. climate	1.467	**0.3572**	0.374	3.920	**< .001**

Note. B = unstandardized regression coefficient; Beta = standardized regression coefficient; SE = regression coefficient error; significant regression coefficients are highlighted in bold.

Source: Own research.

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FINANCING OF RESEARCH AND DEVELOPMENT ACTIVITIES IN POLAND – SELECTED ASPECTS

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Purpose: The aim of the article is to examine and assess changes in the size of expenditures incurred by enterprises in the area of research and development activities in Poland in the years 2018-2023 and to determine Poland's place in the ranking of EU countries in the area of R&D.
Design/methodology/approach: The analysis and assessment of changes in R&D expenditures were made on the basis of calculated indicators of dynamics, pace, and structure. The grouping of EU countries according to the level of R&D intensity was carried out using the Hellwig method. The source of statistical data for the calculations is the Central Statistical Office and Eurostat.
Findings: The results of the research indicate positive changes in the R&D activity of enterprises in Poland. An increase in R&D expenditures is marked, the number of enterprises taking the initiative in R&D is increasing, the number of enterprises using foreign funds in terms of R&D expenditures is increasing.
Research limitations/implications: The research was carried out for the period 2018-2023. In the future, it will be possible to survey the R&D activity of enterprises for another six-year period in order to make a comparative analysis of the changes that have occurred.
Practical implications: The presented results of the research can be a source of motivation for enterprises to undertake R&D activities as well as a stimulus to continue the implementation of initiatives to extend tax relief offers for enterprises undertaking R&D activities.
Social implications: The involvement of enterprises in R&D and the implementation of the latest achievements of science and technology contribute to an increase in the innovativeness of the economy and, at the same time, a rise in the living standards of society. The analysis and evaluation of changes in the R&D area makes it possible to adapt the instruments of state policy to provide greater support for enterprises in undertaking R&D activities.
Originality/value: This paper analyses and assesses changes in the level of outlays incurred by the executive and financing sectors of R&D activity in Poland. It also compares Poland with other EU countries in the area of R&D intensity. The article provides information for both researchers and practitioners dealing with the analysed issues. The article enriches the literature on R&D activity of enterprises.
Keywords: research and development, R&D, innovation.
Category of the paper: research paper.

1. Introduction

Research and development activity is a creative activity involving scientific research or development work undertaken systematically to increase knowledge and its use in the processes of creating new or improved products, services, technologies, and processes (Dz.U. 1992, nr 21, poz. 86; Dz.U. 1991, nr 80, poz. 350).

Undertaking research and development activities and using the solutions obtained in creating process or product innovations is of fundamental importance for the development and progress of society.

Access to financial resources is crucial for the implementation of R&D projects and the commercialization of innovations. It is also important to provide a favourable environment for innovation and strengthening economic growth. Governments can support R&D through appropriate policies and regulations in the field of introducing tax relief for R&D, providing financing for R&D, simplifying implementation procedures. In creating a modern, sustainable and knowledge-based economy, the European Union policy plays an important role, setting priorities and directions for economic development. In the developed development strategies, goals are also set in the area of R&D, and their implementation is financed from EU funds.

The article presents issues related to R&D expenditures incurred in Poland in the years 2018-2023. The aim of the article is to analyse and assess changes in the level of expenditures incurred by enterprises in the area of research and development activities and to place Poland in the designated ranking of EU countries in the area of intensity of R&D activities.

2. Research and development as a source of innovation for companies

Contemporary businesses operate in a dynamically changing environment, which influences the search for new sources of competitiveness. A company's ability to create and implement innovation is crucial to its development. One source of innovation is R&D.

The literature on the subject emphasises the key importance of the R&D work undertaken for the strategic management of the enterprise (Schumpeter, 1960; Penc, 1999; Janasz et al., 2002; Stanisławski, 2017; Dolińska, 2010). There are three types of research within the research and development area: basic, applied and developmental (Szopik-Depczyńska, 2009).

Conducting research and development activities and implementing the latest scientific and technological achievements contribute to an increase in the innovativeness of the economy, which is consequently reflected both in an increased ability to compete on international markets and in a higher standard of living for society (Stankiewicz, 2006; Pangsy-Kania, 2007; Tidd, Bessant, 2011).

The innovations introduced help companies gain new international markets and at the same time create opportunities to compete on a global level. In the process of creating an innovative economy, research and development work is of key importance, which discovers new phenomena and mechanisms, creating a basis for future technological innovations, transforms scientific discoveries into specific technologies and implemented solutions in practice, and uses the results of research and development to improve products and services.

3. Research methods

In order to assess changes in R&D expenditures by individual executive sectors, a comparative analysis of the formation of calculated indicators was used: structure, dynamics, and pace of change. The analysis covered entities from four executive sectors: business, government, higher education, and private non-commercial institutions. The analysis of R&D expenditure financing was conducted for the following five sectors: enterprises, government, higher education, private non-commercial institutions, and abroad. Moreover, the intensity of R&D expenditures in Poland was compared with other EU countries. In this respect, a comparative analysis was conducted of the values of the calculated indicators for Poland and other European Union countries.

In order to group EU countries by their level of R&D intensity and to place Poland in comparison with these countries, the Hellwig method was applied (Hellwig, 1968)

On the basis of the calculated synthetic index, a ranking of EU countries in the area of R&D activity was created. Four groups of countries with the highest, high, low and lowest levels of R&D intensity were distinguished. The following indicators were used to measure the level of intensity: R&D outlays, R&D outlays *per capita*, the ratio of outlays to GDP, the share of funds from abroad, R&D personnel, the rate of change of the outlays incurred.

The data source for the calculations is the CSO database and Eurostat. The research was conducted for the period 2018-2023.

4. Research findings and their analysis

4.1. Changes in the level of R&D expenditure of executive sectors

There were 7549 businesses operating in the R&D sector in 2023. Compared to 2018, this number increased by 1770 entities (*i.e.*, by approximately 30%). Between 2018 and 2023, the number of enterprises implementing R&D increased annually. Compared to the previous year, the largest increase in the number of entities with R&D activities (by about 16%) occurred

in 2021 (Table 1). The largest share - more than 92% in terms of conducting R&D activities was attributed to entities in the business executive sector, followed by entities in higher education, government sector (2.8%) with a share of 3.4% (Figure 1). The smallest number of entities engaging in R&D is in the private non-commercial institutions sector (1.6%).

Table 1.
Entities with R&D activities

Specification	Year					
	2018	**2019**	**2020**	**2021**	**2022**	**2023**
Number of entities	5779	5863	6381	7370	7431	7549
Change rate [previous year =100%]		1.5	8.8	15.5	0.8	1.6

Source: own study.

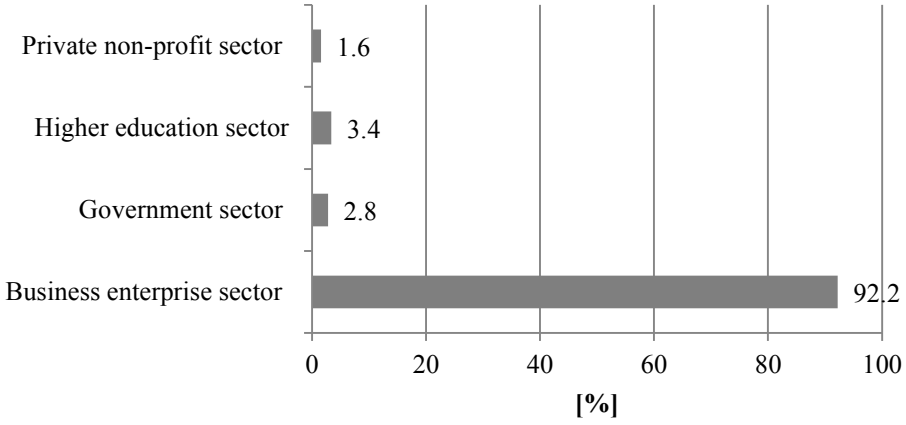


Figure 1. Structure of entities with R&D activities by executive sectors (2023).
Source: own study.

Compared to 2018, expenditures on research and development activities in 2023 increased by over 107% and amounted to PLN 53.1 billion. In the period under review, expenditures increased annually, with a smaller increase (7%) compared to the previous year noted in 2020. The average annual growth rate of expenditures on R&D in the period 2018-2023 was 19.9% (Table 2). The R&D intensity index increased year by year. In 2023, its value was 1.56% and increased by 0.35 percentage points compared to 2018.

The largest R&D expenditures are incurred by the business sector. In 2023, they amounted to more than PLN 34 billion and, compared to 2018, they increased by more than 102% (Figure 2). This was followed by significant R&D expenditure by the higher education sector, which spent nearly PLN 18 billion in 2023 and this was an increase of around 119% compared to 2018. The higher education sector ranks third and the non-profit sector fourth in terms of R&D expenditure incurred.

Table 2.
The amount of expenditure [PLN billion] on R&D and the dynamics of their changes

Specification	Year					
	2018	**2019**	**2020**	**2021**	**2022**	**2023**
Gross domestic expenditure on R&D (GERD) [PLN billion]	25.6	30.3	32.4	37.7	44.7	53.1
Change rate GERD [previous year =100%]		18.1	7.0	16.3	18.7	18.8
Relation of GERD to GDP [%]	1.21	1.32	1.39	1.43	1.44	1.56

Source: own study.

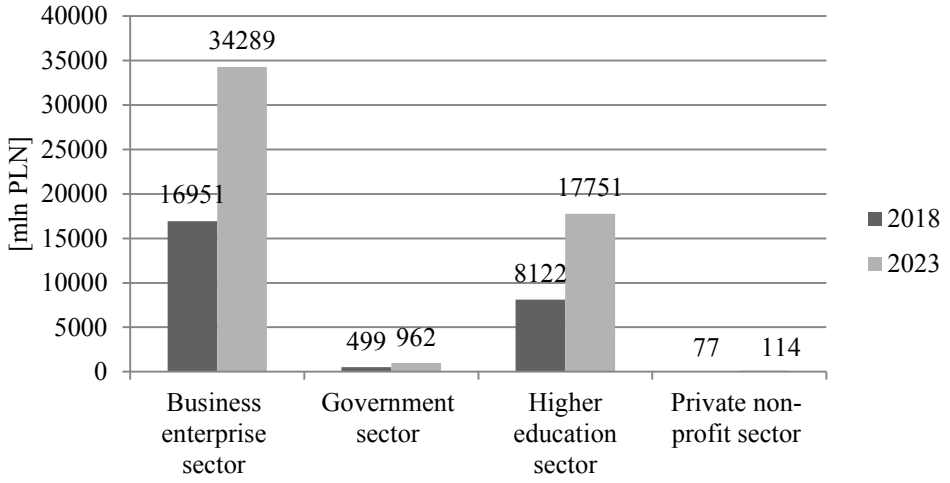


Figure 2. Expenditures on R&D of executive sectors in 2018 and 2023.

Source: own study.

In the structure of expenditures incurred by each executive sector on R&D, the share of two sectors is particularly significant (Figure 3).

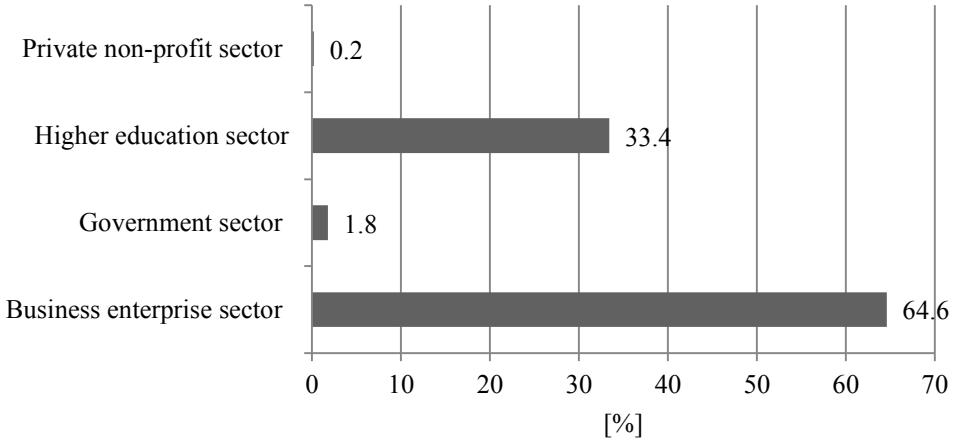


Figure 3. Structure of expenditures on R&D of executive sectors in 2023.

Source: own study.

The share of the business sector is the largest, accounting for nearly 65%, and is almost double the share of the higher education sector (around 33%). The government sector accounted for PLN 962 million (1.8%). The lowest expenditures are in the private non-commercial institutions sector, whose share was 0.2% (PLN 114 million).

4.2. Changes in the funding of R&D expenditures

In 2023, the business sector allocated more than PLN 29 billion to finance R&D expenditures. This sector financed R&D expenditure to the greatest extent (over 50%). Between 2020 and 2023, its share increased annually from 50.6% to 54.8% in covering R&D costs (Table 3).

Table 3.
Structure of expenditures on R&D by funding sectors

Specification		Year					
		2018	2019	2020	2021	2022	2023
Business sector	[%]	53.3	50.7	50.6	51	54.8	54.8
Government sector		35.4	38.8	39	37.4	33.5	31.9
Higher education sector		4.1	3	2.7	3	3.3	3.5
Private non-profit sector		0.2	0.5	0.5	0.4	0.3	0.3
Rest of the world		7	7	7.2	8.2	8.1	9.5

Source: own study.

More than one-third of R&D expenditures were covered by the government sector - becoming the second most used source of funding for the expenditures analysed. From 2020, a decrease from 39% to 31.9% of this sector's share in the R&D funding structure was marked.

In covering R&D expenditure, the third place was occupied by funds from abroad, whose share increased from 7% (in 2018) to 9.5% (in 2023).

The higher education and private not-for-profit sectors financed R&D expenditures to a lesser extent. In the financing structure, their shares were in the ranges [2.7%; 4.1%] and [0.2%; 0.5%], respectively.

Table 4.
Dynamics of change in R&D expenditure of the three main funding sectors [previous year = 100%]

Specification		Year					Pace of change
		2019	2020	2021	2022	2023	
Business sector	[%]	12.5	6.9	17	27.5	18.6	20.8
Government sector		29.4	7.4	11.6	6.2	13.3	16.9
Rest of the world		18.3	8.9	32.4	17.7	39.8	29.4

Source: own study.

The considered main sectors financing R&D expenditure marked an annual increase in the volume of financed expenditures compared to the previous year (Table 4). Over the period 2018-2023, the highest average annual growth rate in the financing of expenditure incurred was marked by foreign countries (29.4%), followed by the business sector (20.8%).

The business sector accounts for the largest share of R&D expenditure. It is also the sector that finances the largest share of expenditure in this area. Table 5 shows the changes in the structure of sources of funding for the business sector.

Table 5.
Structure of sources of funding expenditures on R&D for the business sector

Year	Business sector	Government sector	Higher education sector	Private non-profit sector	Rest of the world
	[%]				
2018	78.58	13.5	0.01	0.01	7.9
2019	78.69	13.4	0.01	0.1	7.8
2020	78.89	13.6	0.2	0.01	7.3
2021	79.1	12.7	0.1	0.1	8
2022	81.6	10	0.1	0.1	8.2
2023	83.3	9.4	0.1	0.1	7.1

Source: own study.

In the business sector, the three main sources of funding for its R&D expenditure are business, government, and foreign countries. The share of businesses in financing the R&D expenditure incurred has increased every year. In 2023, more than 83% of the expenses incurred were covered by companies. Compared to 2018, the share of this source of funding increased by 4.7 pp. In contrast, the government's share of funding from the business sector decreased by 4.1 pp, with a share of 9.4% in 2023. Foreign funds in the financing of the business sector in 2023 accounted for 7.1 pp of the expenditures incurred.

In 2023, 1,438 entities used foreign funds for R&D activities (Figure 4). They accounted for 19% of entities conducting R&D activities. Compared to 2018, the number of these entities increased by 406 (about 39%) and their share among entities engaging in R&D increased by about 1.1 pp.

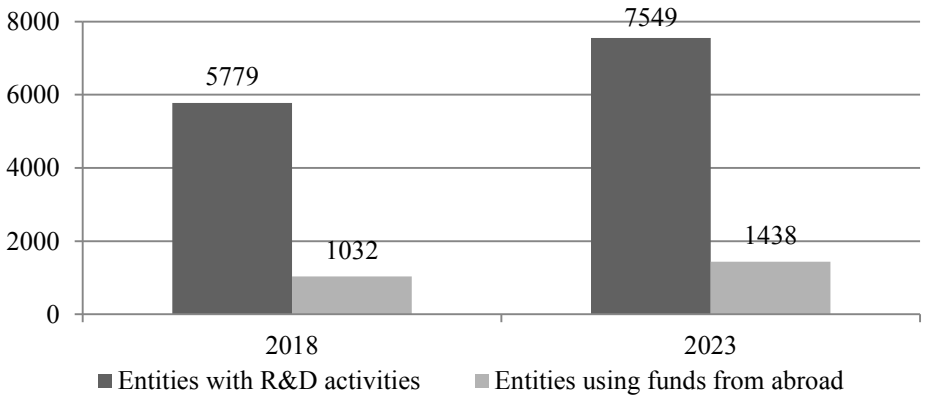


Figure 4. Entities in R&D activities using funds from abroad.

Source: own study.

Table 6.
Share of main sources of foreign funds in financing R&D expenditures

Specification		Year					
		2018	2019	2020	2021	2022	2023
Funds from EU	[%]	57.4	66.7	73.6	77.7	82	86
Funds from enterprises		35.8	27.0	19.9	16.4	12.5	9.9
Budgetary funds in project co-financed from EU funds		14	12.5	25.1	17.1	9.5	12.7

Source: own study.

In the structure of foreign financing of R&D works, the largest share and its annual increase is attributed to funds from EU funds (Table 6). Compared to 2018, their share increased by 28.6 percentage points and in 2023 reached the level of 86%. The second foreign source used in financing R&D activities were funds from enterprises, the share of which decreased year by year from the level of 35.8% (in 2018) to 9.9% (in 2023).

Budget funds of projects co-financed by the EU constitute the third main source of foreign financing of R&D activities. Their share fluctuated between 9% and 25.1%.

Table 7.
Share of foreign sources of funds in financing R&D expenditures by the business sector

Specification		Year					
		2018	2019	2020	2021	2022	2023
Funds from EU	[%]	49.7	58.7	65.0	71.0	80.9	66.3
Funds from enterprises		46.1	37.1	29	25	17.1	19.0
Budgetary funds in project co-financed from EU funds		9.4	8.5	-	10.8	5.2	5.0

Source: own study.

In the business sector, the largest share of foreign R&D funding was marked by EU funds (Table 7). It increased from 49.7% (in 2018) to 80.9% (in 2022). In 2023, there was a 14.6 pp decrease in the share of this source of funding compared to 2022.

Corporate funds represent the second significant source of foreign R&D funding for the business sector. However, between 2018 and 2022, their share decreased annually from 46.1% to 17.1 %. Compared to 2018, the share of these funds decreased by 27.1 pp in 2023. The business sector also benefited from budgetary measures with EU co-financed projects. The share of these measures fluctuated between [5%; 10.8%].

4.3. Research and development activity of Poland in comparison with EU countries

In 2023, the R&D intensity rate in the European Union was 2.2%. Poland, with an indicator value of 1.56, ranked 13th in the EU (Figure 5). Table 8 shows the selected characteristics of R&D expenditures of EU countries.

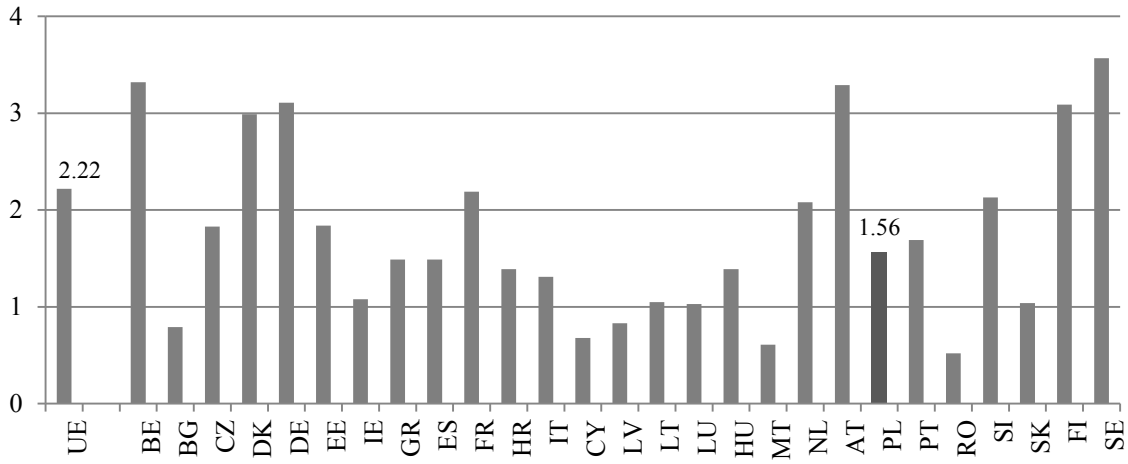


Figure 5. Relation of GERD to GDP in EU countries (2023).

Source: own study.

Table 8.

Characteristics of R&D expenditures of EU countries: average expenditures, average annual rate of change of R&D expenditures, average expenditures per capita (2018-2023) and share of national R&D expenditures in EU R&D expenditures

Specification	Average expenditures [EUR billion]	Average annual rate of change of R&D expenditures [%]	Average expenditures per capita [EUR]	Share of national R&D expenditures in EU in 2023 [%]
UE	331	6.5	454	100
Belgium	16.6	10.7	930	5.2
Bulgaria	0.6	15.3	48	0.2
Czechia	4.8	9.7	244	1.5
Denmark	9.8	5.8	980	2.9
Germany	114	5.5	877	34.1
Estonia	0.5	17.7	168	0.2
Ireland	4.2	7.3	655	1.4
Greece	2.6	11.4	103	0.9
Spain	17.3	10.6	185	5.9
France	55.7	4.4	516	16.2
Croatia	0.7	21.2	68	0.3
Italy	26.3	2.5	262	7.3
Cyprus	0.2	12.5	75	0.1
Latvia	0.2	14.8	32	0.1
Lithuania	0.6	16	78	0.2
Luxembourg	0.8	3.8	624	0.2
Hungary	2.3	7.3	163	0.7
Malta	0.1	14	105	0.1
Netherlands	19.4	7.6	681	5.8
Austria	13.3	6.9	961	4
Poland	8.3	18	112	3.1
Portugal	3.5	13	161	1.2
Romania	1.2	13	31	0.4
Slovenia	1.1	11.1	340	0.4
Slovakia	0.9	14.2	81	0.3
Finland	7.3	7	814	2.2
Sweden	17.6	5.4	1168	5.1

Source: own study.

Between 2018 and 2023, the EU's average R&D expenditure was €331 billion. The leaders in this area were Germany (€114bn), France (€55.7bn) and Italy (€26.3bn). Poland's outlays amounted to EUR 8.3 billion and accounted for 3.1% of EU outlays. Sweden had the highest R&D outlays *per capita* (EUR 1168), followed by Denmark (EUR 980) and Austria (EUR 961). In Poland, these outlays accounted for nearly 25% of the EU average outlays and amounted to €112. In turn, in terms of the average annual growth rate of R&D outlays, Poland ranked third (18%) after Croatia (21.1%) and Estonia (17.7%).

Table 9 shows the evolution of the value of the synthetic index of the level of R&D intensity in EU countries, the place obtained by a given country and the division of EU countries into four groups depending on the intensity of R&D activities in 2018-2023.

Table 9.
The values of the synthetic index of the level of R&D intensity for individual EU countries and their place in the ranking and group

Country	Synthetic index	Place	Group
Germany	0.6152	1	I
France	0.4732	2	
Austria	0.3253	3	II
Belgium	0.3208	4	
Sweden	0.3204	5	
Netherlands	0.3070	6	
Italy	0.2949	7	
Finland	0.2727	8	
Czechia	0.2545	9	
Spain	0.2504	10	
Denmark	0.2492	11	
Ireland	0.2241	12	III
Slovenia	0.2179	13	
Poland	0.1949	14	
Lithuania	0.1822	15	
Hungary	0.1793	16	
Greece	0.1773	17	
Bulgaria	0.1667	18	
Portugal	0.1656	19	
Estonia	0.1593	20	
Latvia	0.1524	21	
Croatia	0.1517	22	
Cyprus	0,1439	23	
Luxembourg	0.1379	24	
Slovakia	0.1283	25	
Romania	0.0920	26	IV
Malta	0.0839	27	

A higher index value indicates a better position of the country in the intensity level studied.

Source: own study.

In the analysed period 2018-2023, Poland ranked 14th among EU countries in the analysed ranking. Group I (*i.e.*, the most developed countries in R&D) included Germany and France. The highest value of the index characterises Germany (0.6152). Group II (highly developed countries in R&D) includes nine countries: Austria, Belgium, Sweden, the Netherlands, Italy, Finland, the Czech Republic, Spain and Denmark. Group III includes 14 countries, among

which is Poland. This is a group with a low level of R&D intensity. In addition to Poland, this group includes Ireland, Slovenia, Lithuania, Hungary, Greece, Bulgaria, Portugal, Estonia, Latvia, Croatia, Luxembourg, and Slovakia. Group IV (*i.e.*, the least R&D-intensive countries) is composed of Romania and Malta.

Poland is ranked 3rd in Group III (after Ireland and Slovenia). Undertaking work to create appropriate conditions for the rapid development of the R&D sector remains one of the greatest challenges and may increase the value of the analysed index and improve Poland's place in the ranking of the level of R&D intensity of EU countries and its qualification to Group II - highly developed countries in the area of R&D activity.

It is necessary to increase the activity of enterprises in investing in R&D activity and to increase the involvement of enterprises in the development and commercialisation of pioneering products and services. Tax breaks, subsidies and EU funds - as support mechanisms for these enterprises - can be helpful in this respect.

The offer of tax incentives is a key tool to encourage entrepreneurs to undertake and implement R&D intentions and thus move towards an economy based on knowledge and innovation. Currently, companies investing in R&D can benefit from special tax breaks: for prototyping, for robotisation, for supporting innovative employees, R&D, IP-Box (Janiszewska, Janiszewski, 2020; Gomułowicz, Małecki, 2011).

Another very important mechanism for supporting entrepreneurs in undertaking R&D activities is the possibility to obtain funding for R&D works from European Funds. The European Funds for a Modern Economy 2021-2027 programme is currently being implemented, with a budget of approximately EUR 10 billion. The FENG programme is a continuation of the Intelligent Development 2014-2020 programme, under which more than €8 billion was used for scientific research, development work and the implementation of their results (Ministry of Funds and Regional Policy, 2022).

Financial support for the implementation of ground-breaking R&D projects that will advance technology, find solutions to global challenges and at the same time strengthen Europe's competitiveness is the European Union's Horizon Europe framework programme for 2021-2027 (Regulation of the European Parliament and of the Council of the EU, 2021). The budget for this programme is more than €95 billion. It is the European Union's continuation of the 2014-2020 Horizon framework programme for research and innovation, which had a budget of €80 billion.

5. Summary

A key element of any country's economic strategy is the implementation of innovation policies to promote research, development and implementation of new technologies. The implementation of innovative solutions and setting future directions of development in this area is the basis for increasing the competitiveness of the economy, creating jobs, improving the quality of life and solving global climate change challenges. The results of research and development have a direct impact on the innovations implemented in various sectors of the economy. However, there are significant risks associated with conducting R&D activities. Therefore, it is fundamental for the development of the R&D sector to support it by offering various types of tax relief, as well as creating opportunities to obtain funding for ongoing research and the implementation of innovative solutions.

In the analysed period 2018-2023, the number of enterprises engaging in R&D projects in Poland increased. Outlays incurred on R&D were also increasing. More than 50% of these outlays were incurred by the executive sector of enterprises, followed by the government sector with a share of more than 30%. During the period under review, an increase in the share of foreign funds in financing R&D outlays was marked. In 2023, the share of these funds accounted for approximately 10%.

The business sector primarily uses its own funds to finance R&D (over 83% in 2023), followed by government funds (over 9% in 2023) and foreign funds. The number of companies using foreign funds increased during the period under review. The largest proportion of these entities benefited from EC funds.

In the period under review, significant differences were observed between EU countries in terms of their R&D activity. Against the background of the EU countries, Poland was ranked 13th in terms of the amount of expenditure on R&D to GDP, and in the ranking of the level of R&D intensity carried out in the article, Poland was ranked 14th. Despite a significant improvement in R&D activity, in this ranking Poland was placed in Group III which is composed of countries with a low level of R&D intensity. In this group, Poland was ranked 3rd (after Ireland and Slovenia), which, in the case of an increase in R&D activities, gives a good chance to qualify for Group II - highly developed countries in the area of R&D activity.

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EUROPEAN UNION ENERGY INDEPENDENCE IN 2013-2022 IN LIGHT OF ITS ENERGY POLICY

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Purpose: The study analyses the energy independence of European Union member states from 2013 to 2022. Its specific objective was to analyse the development of renewable energy sources in the European Union between 2013 and 2022.
Design/methodology/approach: The authors investigated a hypothesis that the energy independence of European Union member states gradually increased between 2013 and 2022. The research employs such quantitative methods as dynamics analysis and EU member state clustering with zero unitarisation (a multivariate analysis method).
Findings: More than half of EU countries increased their energy dependency rate in 2022 compared to 2013. The metric for the Netherlands and Denmark has increased thrice since 2013, reaching the highest level among all countries. In contrast, Estonia, Sweden, and Romania had the lowest energy dependency rates of 6.2%, 26.8%, and 32.4%, respectively, in 2022.
Research limitations/implications: The study is founded on a single index as a prologue for a more in-depth investigation of the issue, which should consider a broader range of indicators, such as the price competitiveness of other energy sources. Therefore, the article is a starting point for further discussion on energy security as an important factor in economic security.
Originality/value: The study is founded on a single index as a prologue for a more in-depth investigation of the issue, which should consider a broader range of indicators, such as the price competitiveness of other energy sources. Therefore, the article is a starting point for further discussion on energy security as an important factor in economic security.
Keywords: energy independence, renewable energy sources, sustainable energy industry, sustainable development, European Union.
Category of the paper: research paper.

1. Introduction

Efforts are made today to eliminate the adverse environmental impact of economic development. It is evident in the struggle to balance environmental well-being, social development, and economic growth (Firlej et al., 2024). Global energy consumption grows by the year. Energy from coal and other fossil fuels is harmful to the environment. The European Union (EU) is proceeding with a plan to decarbonise member states and reach energy autarky by 2050. The means to this goal is energy from renewable sources, renewable energy, or RE (European Council meeting, 2019). The recent energy policy of Poland was founded on hard and brown coal. This has led to a low contribution from renewable energy sources (RES) to Poland's energy mix. The EU energy policy provides for individual member states to gradually increase the share of renewable energy (Wysocka, 2023).

The development of renewable energy sources has a significant impact on changes in energy prices. Firstly, the development of renewable energy sources causes a decrease in the costs of energy production. Thanks to technological progress in the field of renewable energy infrastructure, the cost of generating energy from these sources is decreasing. In EU countries such as Sweden, Finland and Latvia, wholesale energy prices are lower, especially during mass production such as sunny days. The development of renewable energy sources also has an impact in terms of dependence on conventional energy sources, mainly fossil fuels. RES can reduce imports of natural gas or coal (Seroka, 2022).

The development of renewable energy sources also has a significant impact on the economy. The RES sector generates new jobs, especially in the production and maintenance of energy farms (Generowicz, 2019). Countries with a high share of RES in the total energy mix are less sensitive to economic crises, mainly due to energy self-sufficiency (Katarzyński, Przekota, 2024). A greater number of investments in renewable energy sources affects the development of technology, which directly translates into innovation and competitiveness of the economy (Wojtaszek, 2022).

The energy and climate transition involves innovation and the latest technologies. Research and development efforts aim at tapping the national potential in technology, intellectual capital, and competitive advantage. Poland intends to spend 2.5% of its GDP on climate and energy research in 2030 (National Energy and Climate Plan).

The energy dependency rate is the degree to which a national economy relies on energy imports to satisfy its consumption needs (Braun, 2018). An analysis of energy security should consider such factors as the size and diversification of the country's fuel stock, supply system condition and supply infrastructure ownership, the degree of diversification and use of national and international energy source suppliers, and fuel storage capabilities (Mazurkiewicz, 2008).

The 2030 Agenda for Sustainable Development was adopted in 2015. It sets seventeen Sustainable Development Goals (SDGs) (Transforming our world). The main objective of the EU climate policy is to secure the production and use of sustainable energy. Access to sources of stable, sustainable, and innovative energy at an affordable price is encapsulated in SDG7 (Ensure access to affordable, reliable, sustainable and modern energy for all) (Report of the Inter-Agency…; Ensure access to affordable, reliable, sustainable and modern Energy).

Energy is the central factor ensuring energy security and the proliferation of renewable energy. The EU has made substantial progress in the use of RES in industry and transport (SDG7 Affordable and clean energy). EU member states consider the expansion of the renewable energy sector as the key to energy security. This approach is driven by the fear of a shortage of conventional energy sources in the early twenty-first century (Tomala, 2024). The EU climate and energy policy is shaped mainly by the SDGs. The European Commission undertook to implement the 2030 Agenda in the European Green Deal and Delivering on the UN's Sustainable Development Goals — A comprehensive approach (EU approach to SDGs implementation).

In addition to adopting the 2030 Agenda, the EU has its independent and targeted climate policy. The EU energy legislation is adapted to the 2030 goals by means of Directive 2012/27/EU. Directive 2018/2002 from November 2018 amended the 2012 directive, expanding the goals in the 2030 horizon (Directive (EU) 2018/2002).

In July 2021, the EU presented a new legislative package for the climate policy, Fit for 55. The 2030 objective is to reduce greenhouse gas emissions by 55% compared to 1990. Simultaneously, it was decided that the entire Europe should be climate-neutral by 2050. Apart from climate, the package addresses building energy-related issues, such as zero-emission buildings (Fit for 55; European Commission, 2019).

Conventional energy sources for electricity production can be replaced only by more sustainable energy technologies (Rizzi et al., 2014). Global warming and climate change are caused by excessive consumption of fossil fuels for energy purposes (Ang, Salem, Kamarol, Das, Nazari, Prabaharan, 2022). This entails a growing pressure towards renewable energy: solar energy, hydropower, wind power, geothermal energy, bioenergy, and hydrogen power (Michalcewicz-Kaniowska, Zajdel et al., 2022). The goal is to overcome the environmental crisis regarding electricity generation (Santika et al., 2019).

The study analyses the energy independence of European Union member states in 2013 and 2022. Its specific objective is to investigate the development of renewable energy sources in the European Union between 2013 and 2022. The input data come from secondary sources, official statistics time series from Eurostat, the International Renewable Energy Agency (IRENA), and Statistics Poland. The authors investigated a hypothesis (H1) that the energy independence of European Union member states steadily increased from 2013 to 2022.

2. Methods

The analysis for 2013–2022 is founded on official statistics from Eurostat, for example. The spatial scope of the analysis are European Union member states. The time series under scrutiny are energy intensity, energy import dependency rate, and share of renewable energy in gross final energy consumption. The study looks into the dynamics of changes with rates of increase $\left(\Delta_{t/(t-1)} = y_t - y_{t-1}\right)$ and ratios $\left(i_{t/(t-1)} = \frac{y_t}{y_{t-1}}\right)$.

The synthetic index of energy security in the EU in light of its energy policy makes use of a multivariate analysis method. First, the authors selected the variables (Table 1) and determined their profiles (BTB – bigger the better, STB – smaller the better).

Table 1.
Diagnostic variables selected for the analysis

Label	Variable	Profile
X_1	energy intensity [kgoe/1000PPS]	STB
X_2	energy dependency rate [%]	STB
X_3	share of renewable energy in gross final energy consumption [%]	BTB

Source: original work based on Eurostat.

The variables were chosen considering data availability and factual analysis. Values of the primary numerical measures are summarised in Table 2.

Table 2.
Statistics for the diagnostic variables for 2013 and 2022

Variable	2013				2022			
	max.	min.	mean	CV	max.	min.	mean	CV
X_1	241.00	84.30	144.44	0.26	155.60	34.70	96.01	0.29
X_2	97.60	12.30	55.26	0.46	99.00	6.20	61.06	0.36
X_3	50.20	3.50	19.02	0.60	66.00	13.10	25.73	0.49

CV: coefficient of variation.

Source: original work based on Eurostat.

All the variables exhibit variation over 10%. The coefficient of variation of X1 grew slightly between 2013 and 2022. Conversely, the CV of variables X2 and X3 declined. The second step was to standardise the variables using the following formula (Kądziołka, 2021, p. 72):

$$z_{ij} = \begin{cases} \dfrac{\max\limits_i x_{ij} - x_{ij}}{\max\limits_i x_{ij} - \min\limits_i x_{ij}}, & X_j - STB \\ \dfrac{x_{ij} - \min\limits_i x_{ij}}{\max\limits_i x_{ij} - \min\limits_i x_{ij}}, & X_j - BTB \end{cases}$$

where: x_{ij}, z_{ij} are actual and normalised values of X_j for country i, respectively, $z_{ij} \in [0,1]$.

In the third step, the authors calculated the value of the synthetic variable Qi with the following formula:

$$Q_i = \frac{1}{4}\sum_{j=1}^{3} z_{ij}$$

where: Q_i is the value of the synthetic variable for country i, $Q_i \in [0,1]$.

The highest value of Q_i means the object performed the best in the EU member state energy policy evaluation regarding energy security.

Using the method reported above, the authors ordered EU member states by Q_i. The investigated regions were grouped according to the following equations (Luty, Zioło, 2022):

- Group I: $Q_i \in (\max_i Q_i - A; \max_i Q_i]$.
- Group II: $\mathrm{Q_i} \in (\max_i Q_i - 2A; \max_i Q_i - A]$.
- Group III: $Q_i \in (\max_i Q_i - 3A; \max_i Q_i - 2A]$.
- Group IV: $Q_i \in (\min_i Q_i; \max_i Q_i - 3A]$.

where: Q_i is the value of the synthetic variable for country i; $A = \frac{1}{4}(\max_i Q_i - \min_i Q_i)$.

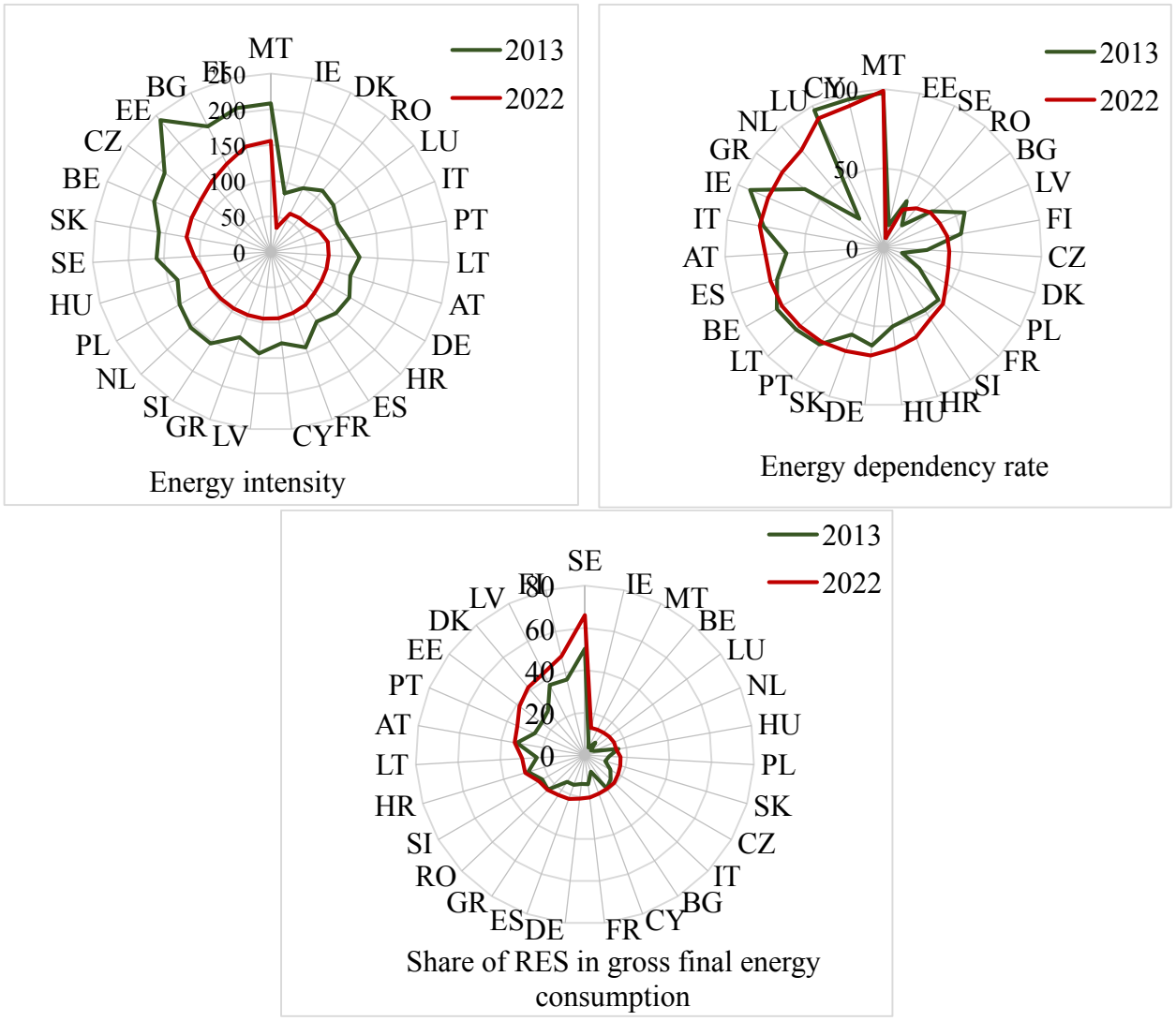
3. Results

Energy intensity reflects the amount of energy necessary to generate a unit of gross national product. It is expressed as kilograms of oil equivalent (kgoe) per thousand euros in purchasing power standards (1000 PPS). The EU mean value of energy intensity for 2022 was 86,5 kgoe per 1000 PPS. Only ten EU member states had energy intensity below the EU average in 2022. The least energy-intensive economies in that year were Romania (62.4), Denmark (60.2), and Ireland (34.7). Poland was the tenth most energy-intensive economy in the EU (98.3 kgoe per 1000 PPS in 2022). The ranking leaders were Bulgaria (137.9), Finland (152.1), and Malta (155.6).

Conversely, Estonia, Sweden, and Romania had the lowest energy import dependency rates of 6.2%, 26.8%, and 32.4%, respectively, in 2022. Poland was the ninth most energy-independent EU member state, even though its energy dependency rate skyrocketed by 75% between 2013 and 2022. The most energy-dependent EU member states in 2022 were Luxembourg (91.3%), Cyprus (92%), and Malta (99%) (figure 1).

The share of RES grew in every investigated country over the period of interest. In 2022, countries with the best shares of RES in total energy were Latvia (43.3%), Finland (47.9%), and Sweden (60%). In Poland, only 16.9% of the total energy was sourced from RES in 2022.

The lowest portions of renewable energy were found in Belgium (13.8%), Malta (13.4%), and Ireland (13.1%). The share of RE in the total EU energy in 2022 was 23%.



Labels for EU member states: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Cyprus (CY), Czechia (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Greece (GR), Spain (ES), Netherlands (NL), Ireland (IE), Lithuania (LT), Luxembourg (LU), Latvia (LV), Malta (MT), Germany (DE), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Sweden (SE), Hungary (HU), Italy (IT).

Figure 1. Changes in the metrics of energy security in EU member states from 2013 to 2022.

Source: Original work based on Eurostat.

The most energy-secure EU member states in 2013 were Romania, Sweden, and Denmark at the top. The lowest-ranked states were Cyprus, Belgium, and Malta (figure 2). In 2013, Poland was the seventh most energy-secure EU member state.

The landscape changed slightly in 2022. Sweden became the most energy-secure country, followed by Denmark. The third most energy-secure country was Latvia. Poland went down to the 14th position in 2022. Ireland and Estonia were the leaders in energy security improvement in 2022. In contrast, the Netherlands and Hungary neglected their energy security the most in 2022.

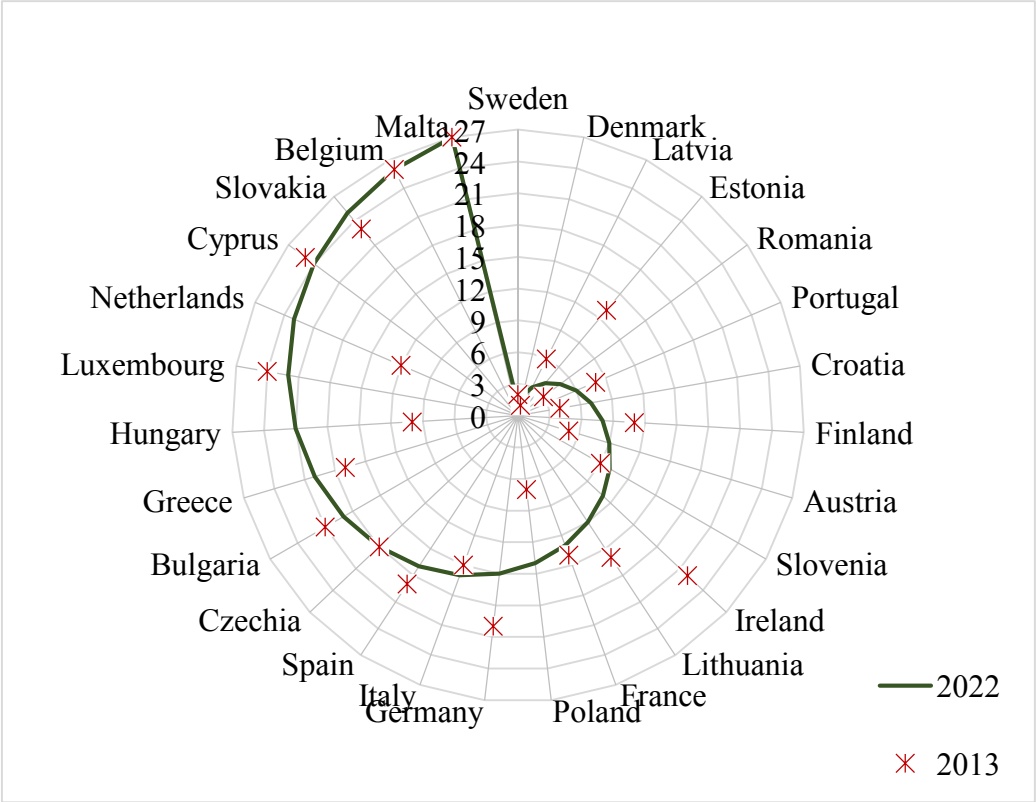


Figure 2. Ranking list of EU member states' energy security in 2022 and 2013.

Source: Original work based on Eurostat.

The authors classified EU member states into four groups regarding energy security, considering three metrics: energy intensity (X1), energy dependency rate (X2), and share of RES in gross final energy consumption (X3). The first group exhibits outstanding energy security. These five countries have a high share of RE, a minimal energy dependency rate, and small or average energy intensity.

The second group covers countries with adequate levels of energy security. They exhibit average energy intensity and share of RES and a small value of energy dependency rate. There were nine such EU countries.

The third group contains countries with average energy security levels. Their energy intensity is high, RES share average, and energy import dependency rate high. It is the largest group of all.

The fourth group of two EU member states demonstrates very low levels of energy security. These countries import over 90% of their energy. They also have very energy-intensive economies and very low shares of RE in their mixes.

Energy intensity declined in all EU member states between 2013 and 2022. Romania, Estonia, and Ireland were the most successful in this regard. The metric decreased by 45%, 47%, and 59% in Romania, Estonia and Ireland, respectively (Table 3). More than half of the EU member states grew more energy-dependent in 2022. The greatest increase of over three times compared to 2013 was in the Netherlands and Denmark.

Table 3.
EU member state groups according to energy security in 2022 and metric increases compared to 2013

Group	EU member state	Increase and ratio for X_1		Increase and ratio for X_2		Increase and ratio for X_3	
Group I	Sweden	-52.6	0.67	-6.0	0.82	15.8	1.31
	Denmark	-39.6	0.60	30.6	3.49	14.4	1.53
	Latvia	-49.0	0.66	-17.2	0.69	6.3	1.17
	Estonia	-99.4	0.53	4.3	1.06	13.1	1.52
	Romania	-50.1	0.55	14.1	1.77	0.2	1.01
Group II	Portugal	-28.3	0.74	-2.0	0.97	9.0	1.35
	Croatia	-41.4	0.67	12.9	1.27	1.4	1.05
	Finland	-55.2	0.73	-8.8	0.82	11.3	1.31
	Austria	-35.0	0.70	13.2	1.22	1.0	1.03
	Slovenia	-58.9	0.62	6.5	1.14	1.8	1.08
	Ireland	-49.6	0.41	-12.4	0.86	5.6	1.75
	Lithuania	-43.2	0.65	-3.2	0.96	6.9	1.30
	France	-51.6	0.64	3.9	1.08	6.4	1.46
	Poland	-49.5	0.67	19.7	1.75	5.4	1.47
Group III	Germany	-45.3	0.64	6.2	1.10	7.0	1.51
	Italy	-28.1	0.72	2.5	1.03	2.4	1.14
	Spain	-28.5	0.76	4.3	1.06	7.0	1.46
	Czechia	-63.4	0.66	14.2	1.51	4.3	1.31
	Bulgaria	-58.9	0.70	-1.2	0.97	0.2	1.01
	Greece	-33.0	0.74	17.8	1.29	7.4	1.48
	Hungary	-37.6	0.72	14.1	1.28	-1.0	0.94
	Luxembourg	-45.2	0.59	-5.8	0.94	10.9	4.11
	Netherlands	-58.4	0.62	56.6	3.39	10.3	3.19
	Cyprus	-35.0	0.73	-4.1	0.96	11.0	2.31
	Slovakia	-39.4	0.75	11.2	1.19	7.4	1.73
Group IV	Belgium	-57.1	0.68	-3.7	0.95	6.1	1.79
	Malta	-52.8	0.75	1.4	1.01	9.6	3.53

Source: original work based on Eurostat.

4. Discussion

The National Energy and Climate Plan for 2021–2030 (NECP) is the pivotal document for the Polish energy sector and other sectors of the country's economy (National Energy and Climate Plan). According to the NECP, Poland can reduce greenhouse gas emissions by 35% compared to 1990. To this end, all sectors should be decarbonised. According to forecasts, Poland will reach a 29.8% share of RES in the total energy mix in 2030 (National Energy and Climate Plan). Investments in RES help countries curb fossil fuel and energy import dependency, reducing exposure to oil and gas price shocks. This approach improves both energy security and control over national resources (Chen et al., 2021). The latest events in Europe (the COVID-19 pandemic and war in Ukraine) stress-tested the continent's energy security. They have led to supply chain disruptions, CO2 emissions trading speculations

(the COVID-19 pandemic) (Horky et al., 2023) and energy price increases (the Russian gas sabotage) (Sattich et al., 2022).

Oil consumed in Poland is sourced mainly from Russia. The difficult geopolitical position of the country calls for diversification of the supply chain, leading to higher prices. Poland may be less dependent on its eastern neighbour but will remain dependent on imports. The planned nuclear power plant will offer a stable supply of energy in Poland (also regarding renewable energy) (Pangsy-Kania, Wierzbicka, 2022). The advantages of nuclear energy include high performance, zero emissions, and full decarbonisation.

Poland's energy independence and security require that the options of oil and natural gas imports from politically stable countries be investigated. Also, the condition of hard coal mining will impact Poland's energy security as coal remains the country's primary source of energy.

5. Summary

Poland's energy policy is founded on increased RE supply to decarbonise the economy. A nuclear power station is planned for the future. Transport needs more RE, and the energy efficiency of the entire economy has to improve. For this, it is critical to reduce coal dependency. Poland's economic policy is set to increase energy security and reduce energy import dependency (Poland 2022 - Energy Policy Review).

The country's energy independence is central to its energy security. More focus is required on energy infrastructure, which affects energy security regarding the distribution, transmission, and storage of carriers and energy (Gomółka, Kasprzak, 2023).

Due to the increasing political instability related to the armed conflict in Ukraine, the EU energy policy should aim at improving energy independence or diversifying imports of energy carriers from politically volatile countries. It is critical for economic and energy security. Renewable energy sources are believed to be less risky for energy security and independence. Their downside is lower predictability compared to nuclear energy, for example. European Union's dependency on a single supplier of natural gas and oil, Russia, threatens the energy security of the entire Community. Despite its high energy independence, Poland still extensively relies on imports of energy carriers from Russia.

The main objective of the research, which was to analyze the energy dependence of the European Union countries in 2013-2022 was achieved. Also the side objective, which was to analyze the development of renewable energy sources in the European Union in 2013-2022. The hypothesis that the energy dependence of the European Union countries systematically decreased in the years 2013-2022 was verified negatively.

The article is a starting point for further considerations in the field of energy dependency and development of renewable energy sources, extending future research to other countries or time range. The analysis of the European Union's energy independence encounters certain limitations such as the changing energy policies of the European Union members.

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CROWDFUNDING AS AN ALTERNATIVE SOURCE OF STARTUP FINANCING

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Purpose: The aim of this article is to assess the suitability of crowdfunding – as an alternative source of business financing – for addressing the specific needs of startup ventures.
Design/methodology/approach: The study is based on expert evaluation using the Best-Worst Method (BWM), which allows for a structured assessment of crowdfunding's usefulness in raising capital for startup development. The analysis is supplemented by desk research focusing on the dynamics of the crowdfunding market in Poland.
Findings: The results indicate a high level of alignment between crowdfunding and the needs of startups. Crowdfunding performs significantly better than traditional bank loans and also shows an advantage over other funding sources such as technology loans or public funds. Although interest in this form of financing has been growing in Poland over the past decade, the overall volume of capital raised through crowdfunding remains relatively modest.
Research limitations/implications: The analysis is exploratory in nature and is based on a limited number of academic experts. Future research should incorporate the perspectives of practitioners – startup founders, investors, and crowdfunding platform representatives.
Practical implications: The findings may serve as a useful guide for startup creators in identifying and selecting funding sources during early development stages.
Social implications: The broader adoption of crowdfunding – particularly in investment and lending models – requires increased public awareness and financial education. This applies to both entrepreneurs seeking funding and citizens who could act as small-scale investors supporting innovative projects in their communities.
Originality/value: The article offers an original contribution in the form of a matching matrix concept, enabling a systematic assessment of selected financing sources – including various crowdfunding models – against key characteristics of startups. The comparative analysis also applies the relatively new and increasingly recognized Best-Worst Method (BWM).
Keywords: crowdfunding, startup, innovation financing.
Category of the paper: Research paper, conceptual paper.

1. Introduction

Innovation is a key driver of competitive advantage for enterprises, as well as economic and social development. In addition to generating above-average profits, it provides implementing entities with marketing benefits, reinforcing their image as technological leaders. Nevertheless, obtaining capital to implement innovative solutions often proves challenging. Paradoxically, it is frequently easier to secure funding for traditional projects than for pioneering initiatives. In response to these difficulties, innovative businesses increasingly turn to alternative financing methods, such as crowdfunding. This community-based funding model, enabled by online platforms, relies on small contributions from a broad group of supporters. In recent years, it has gained significant global popularity, including in Poland.

The aim of this article is to assess the suitability of crowdfunding – as an alternative source of business financing – for the specific needs of startup ventures. The analysis focuses on the main barriers to financing innovative entities and explores how crowdfunding mechanisms may help overcome them. The article also discusses the nature of crowdfunding, its main models, and the procedures involved in raising funds. The study is complemented by a concise overview of quantitative and qualitative developments that have taken place on the Polish crowdfunding market in recent years.

The literature reveals a tendency to generalize and idealize the role of crowdfunding in the development of startups, often without sufficient differentiation between its various models and their suitability for the actual conditions and limitations faced by early-stage ventures. This article seeks to provide a more nuanced and methodical assessment of the usefulness of different crowdfunding models in the context of the typical challenges encountered by startups in their early stages of development.

2. Challenges in raising capital for innovative ventures

Financing innovative activities remains a major challenge for businesses. Despite the growing importance of innovation, access to capital remains limited. This is due both to the nature of innovative projects themselves and to the mechanisms by which financial markets operate (Grossman, Stiglitz, 1980; Egger, Keuschnigg, 2015).

Among the many barriers to innovation financing, four are of particular importance. First, innovative projects involve a high level of risk – technological risk (whether the product will meet expectations), market risk (whether it will find buyers), and managerial risk (especially in the case of new business models). This uncertainty often leads traditional financial institutions, including banks, to avoid financing innovation (Nanda, Rhodes-Kropf,

2017; Łopaciński, 2018). Second, assessing the risk of innovative ventures is complex and costly. The lack of comparable projects hinders credit evaluation, and expert analysis may increase the cost of capital to levels unacceptable to entrepreneurs (Deptuła, Knosala, 2015). Third, long return-on-investment periods discourage capital involvement. The pre-commercial phase – comprising research, testing, and product refinement – significantly extends the waiting time for profits. Fourth, securing liabilities is often problematic. Capital is typically allocated to R&D services or hard-to-liquidate assets (e.g., specialized equipment), which do not create valuable collateral (Głodek, Pietras, 2011). These barriers result in a so-called capital gap – the difference between the declared demand for funding and the actual capital obtained – which is significantly greater in innovative firms than in traditional enterprises (Bernat, 2015).

Importantly, the severity of capital access constraints depends on the type of enterprise. Large, well-established firms with a market track record and financial history are better positioned in the credit market, have access to capital markets, and may also partially offset external financing barriers with internal funds allocated to innovation projects. Startups, on the other hand, are in a completely different situation. These are newly established enterprises operating under conditions of high uncertainty, often without a clearly defined business model, but with the potential for rapid scaling. By their nature, startups are innovative entities focused on the commercialization of new technologies, business models, value creation and delivery methods, and process organization (Ries, 2011). Their typical characteristics include a lack of operational and financial history, limited human resources, and difficulties in providing financial collateral. In startups, the aforementioned financing barriers tend to accumulate, making access to capital particularly challenging.

The literature distinguishes several phases of startup development – from idea and concept development, through product creation and commercialization, to scaling and maturity. In each of these phases, access to specific sources of funding may vary. In the early stages, funding typically comes from founders' own savings (bootstrapping), support from family and friends (known as the "FFF" segment – friends, family, and fools), and public grants or subsidies. At later stages, business angels – private investors who provide capital and often share their know-how – become involved in exchange for equity stakes. In the growth phase, when scaling opportunities emerge, venture capital funds – specialized institutions investing in high-risk, high-return projects – gain importance. Only in the maturity phase do startups typically gain real access to bank financing and capital markets. A potential opportunity for technology-oriented startups is the technology credit instrument – a hybrid of a traditional bank loan with partial debt forgiveness, usually supported by public funding (Zawadzka et al., 2018; Lerner, Nanda, 2020).

Given the limited availability of many of the aforementioned sources to the youngest and riskiest ventures, alternative financing mechanisms are gaining increasing importance. The following section of the article focuses on one such mechanism – crowdfunding – and offers an assessment of its suitability for addressing the specific needs of startups.

3. Crowdfunding – concept, types, and fundraising procedures

Crowdfunding is a method of raising funds for a specific purpose through small contributions from a large number of individuals via online platforms, without the involvement of traditional financial intermediaries (Mollick, 2014; Jemielniak, 2019; Majewski, 2020). Three key features define crowdfunding.

The first is a clearly stated purpose declared by the entity seeking funding. Funds are not collected for general operational needs, such as working capital or liquidity buffers, but rather for a precisely defined goal communicated to potential backers at the beginning of the crowdfunding campaign. This approach not only builds trust among supporters but also serves a marketing function – a well-defined and attractive project increases the likelihood of successfully attracting capital (Tchoualak et al., 2020).

The second defining feature is the appeal for support directed toward a broad audience of potential backers, which enables large-scale fundraising. Individual contributions are typically small, but their number allows for the accumulation of significant total amounts. The term "significant" is relative and refers to the modest scale of most crowdfunded projects – crowdfunding is a form of microfinancing and is not intended to raise multimillion-dollar funds for large entities (Attuel-Mendes, 2016). One consequence of this mechanism is that it allows for the financing of high-risk projects – because individual contributions are small, campaign participants tend to exhibit lower risk aversion (Damodaran, 2009; Piktus, Czerwonka, 2018). While funding usually comes from ordinary individuals, there are exceptions. In some cases, professional investors also participate in campaigns, allocating larger sums that are diversified across multiple projects – thus preserving the principle of low individual exposure (Majewski, 2020).

A characteristic feature of crowdfunding is the essential role of the internet in the fundraising process. It serves as both the space for announcing campaigns and the channel for communication and information exchange between parties. Transactions are initiated and completed entirely through digital technologies, ensuring speed, transparency, and automation. Moreover, the intermediaries in crowdfunding are online-based companies – specialized crowdfunding platforms that facilitate campaign organization, payment processing, and interaction between project creators and potential investors (Wiścicka-Fernando, 2021; Mora-Cruz, Palos-Sanchez, 2023). Notably, the Polish term for crowdfunding - „finansowanie społecznościowe" (community-based financing) – directly refers to the importance of online communities and social media in promoting campaigns and building engagement around projects (Majewski, 2020).

The purpose for which funds are raised remains an imprecise element in defining crowdfunding. In its broadest sense, it includes any economic or social goals, including educational or cultural initiatives and charitable campaigns (Mollick, 2014; Trzebiński, 2022).

In a narrower view, crowdfunding refers strictly to business ventures, and in its narrowest sense – to financing startups and innovative projects (Arieli et al., 2017). The narrower approach appears to be gaining ground in the literature and is reflected in market regulations, where business-related campaigns are subject to specific legal frameworks (Bagińska, 2018).

Four crowdfunding models are most commonly distinguished (Majewski, 2020; Shneor, 2020):

- Equity crowdfunding involves the issuance of shares or equity to investors.
- Lending crowdfunding is based on the granting of loans that are repaid with interest.
- Reward-based crowdfunding offers backers non-financial rewards, typically of lesser value than the contribution (e.g., a product sample).
- Donation-based crowdfunding is charitable in nature and does not involve any return or compensation.

The first two are referred to as investment crowdfunding, associated with business and innovation, while the latter two are categorized as social crowdfunding, typically used in philanthropic, cultural, and social projects. However, this division is not always clear-cut – innovative projects, especially those with a social dimension, can also be successfully financed through reward-based or donation-based models (Kraus et al., 2016).

The fundraising process varies depending on the platform, type of crowdfunding, and applicable legal regulations. Typically, the initiative is taken by the entrepreneur, who selects a platform and adjusts the campaign to its requirements. Some platforms actively seek out firms, offering promotional and advisory support (Kędzierska-Szczepaniak, Szopik-Depczyńska, 2017). Once a project is submitted, it undergoes a verification process – similar to a creditworthiness assessment in lending or equity crowdfunding, or focused on marketing potential in reward-based models (Moysidou, Hausberg, 2020).

After project approval, the organizer prepares promotional materials and sets the fundraising parameters, including the target amount, campaign duration, and potential rewards for supporters. A particular challenge for innovative projects is the need to present an attractive offer to investors while limiting the disclosure of sensitive technological information. Information asymmetry is an inherent feature of crowdfunding and requires a degree of trust from investors (Majewski, 2020; Jiang et al., 2024).

Once the campaign is launched, the organizer engages in marketing activities – such as promotion through social media – to increase the chances of success. The "all-or-nothing" rule is a common standard: if the financial goal is not reached, all contributions are returned to investors. If the campaign is successful, the platform transfers the collected funds to the organizer and deducts a commission. Finally, depending on the crowdfunding model, the organizer fulfills obligations to investors – repaying loans, issuing equity, or delivering rewards (Schnaider, 2020).

4. Research methodology

To support the analysis, a matching matrix was developed to provide a systematic assessment of the extent to which crowdfunding – compared to alternative sources of financing – addresses the key needs of startups. The starting point was the identification of ten characteristics of startups that are particularly relevant in the context of fundraising. In addition to the features previously discussed as typical barriers to financing innovative ventures, several additional characteristics were considered, including:

- limited organizational and human resources (making it difficult to prepare documentation and maintain communication with investors),
- the need to raise funds quickly (driven by pressure to launch a solution before competitors enter the market),
- a relatively small scale of projects and capital needs (resulting in high transaction costs relative to investment size),
- the need for market validation and community building (testing the product and engaging early users or customers),
- the risk of losing control over the project or company (due to takeover or disproportionate influence of investors on strategic decisions),
- the risk of disclosing know-how (resulting from the need to publicly present key elements of the project to attract funding).

In the next step, opinions were collected from five academic experts specializing in innovation and startups. The consultation was conducted remotely using electronic communication tools. Experts were asked to evaluate crowdfunding and other selected financing sources in terms of their fit with the listed characteristics, using a scale from 0 (no fit) to 5 (full fit), based on their research experience and practical observations.

Additionally, each expert assigned a weight to each characteristic, reflecting its significance in the financing process. These weights were determined using the Best-Worst Method (BWM), which involves selecting the most and least important criterion and comparing them with the others. This method allows for an efficient and consistent identification of preferences even when the number of respondents is limited (Rezaei, 2015). The average ratings and weights were then used to calculate the aggregated results, which are presented in tabular form.

The analysis is complemented by a concise diagnosis of the development of the crowdfunding market in Poland, aimed at highlighting the practical relevance of this form of financing in the national context. Due to the lack of comprehensive market statistics and the dispersed nature of available information, this part of the study was conducted using a desk research approach, based on a review of industry reports, data published by crowdfunding platforms, and academic literature.

5. Analysis of crowdfunding fit with startup characteristics

The aggregated results of the assessment of how selected sources of financing align with the characteristic features of startups are presented in Table 1. The analysis includes three categories of crowdfunding: equity, lending, and reward- and donation-based (combined), due to differences in the behavior and expectations of contributors in each model. For comparison, the table also includes other capital sources relevant at the early stages of startup development. However, capital market instruments (such as public share or bond issuance) were excluded from the analysis due to their practical inaccessibility for young companies in the initial growth phase.

Tables 1.
Crowdfunding compared to other financing sources – ranking of fit with startup needs

	Equity crowdfunding	**Lending crowdfunding**	**Reward- or donation-based crowdfunding**	**Business angels**	**Venture capital**	**Technology loan (with guarantees)**	**Public funds (EU, PARP, etc.)**	**Traditional bank loan**
Startup characteristic (average weight)	**Score on a 0–5 scale for fit (average expert ratings)**							
No operational or financial history (0.17)	4.7	4.3	4.9	4.7	4.0	3.3	3.0	1.0
Lack of assets for securing financing (0.14)	4.7	4.5	4.9	4.7	4.0	3.3	3.0	1.0
High level of risk (0.14)	3.7	3.3	4.9	4.7	4.7	3.0	3.0	1.3
Difficulty in risk assessment by financiers (0.13)	3.3	3.3	4.8	4.5	4.7	3.0	3.0	1.3
Limited organizational and human resources (0.08)	2.7	3.0	3.0	3.7	4.0	3.0	3.0	2.0
Need for rapid fundraising (0.09)	4.3	4.0	4.0	3.7	3.0	2.3	2.3	2.0
Small-scale projects and capital needs (0.07)	5.0	4.3	4.7	3.0	3.0	3.0	2.0	3.0
Need for market validation and community building (0.07)	4.3	2.0	4.4	3,0	2.7	2.0	1.3	1.0
Risk of losing control over project/company (0.06)	1.7	3.7	5.0	2.0	2.0	4.3	4.7	5.0
Risk of disclosing know-how during fundraising (0.05)	2.5	2.7	3.0	2.0	2.0	4.3	4.3	5.0
Overall score	**3.9**	**3.7**	**4.5**	**4,0**	**3.7**	**3.1**	**2.9**	**1.8**

Source: Own elaboration based on expert assessments.

The weights assigned to individual startup characteristics, determined using the Best-Worst Method (BWM), were averaged across respondents, as were the scores assigned to each financing source. The overall score for each source of capital was calculated as the weighted average of partial scores, which allows for direct comparison of the financing options in terms of their overall fit with the startup profile.

The results of the analysis indicate that, despite certain limitations, crowdfunding is relatively well aligned with the profile of startups. Among all the evaluated sources of financing, the highest overall score was obtained by reward- and donation-based crowdfunding (4.5), outperforming both equity-based (3.9) and lending-based models (3.7). Such a high score

may suggest a particularly strong fit between this form of financing and the typical challenges faced by startups, especially in their earliest stages of development. However, it should be noted that reward- and donation-based crowdfunding remain niche instruments, most often used for consumer-focused or lifestyle-oriented projects, and less frequently in strictly technological or B2B ventures. Their high score in the analysis is primarily due to the lack of formal barriers and the speed of implementation, rather than a dominant role in the market.

A closer look at individual startup characteristics reveals notable differences between equity and lending models. In general, equity crowdfunding was assessed as more risk-tolerant, scoring a perfect 5.0 for compatibility with small-scale projects, but it performed less favorably in terms of the risk of losing control – both over the company and over the ideas being developed. This risk is naturally lower in the lending model. Both variants were rated low in compatibility with limited organizational and human resources, which may reflect the perception that selecting a platform and managing a campaign is a time- and labor-intensive process.

In comparison with other sources of financing, business angels also received high scores (4.0), confirming their important role in funding startups. Venture capital was rated slightly lower (3.7), which may reflect the selective nature of these funds and their high expectations regarding project scalability. Public funds (2.9) and technology loans (3.1) received moderate scores – their relatively good availability is often offset by bureaucratic procedures and time-consuming application processes. Traditional bank loans, with a score of 1.8, were found to be the least compatible with the needs of startups, which is consistent with real-world challenges faced by SMEs in financing innovation.

In summary, although crowdfunding is not a uniform solution and has its limitations, it stands out as a flexible, relatively accessible, and fast-acting financing tool for startups, particularly in the early stages of development. Its importance is not always reflected in its current level of adoption, yet the results of the analysis confirm its potential to complement or even replace traditional forms of capital in high-risk environments characterized by limited resources and the need for rapid execution.

6. The development of crowdfunding in Poland – quantitative and qualitative aspects

Crowdfunding, understood as the financing of projects through online platforms, began to develop in the early 21st century, initially within the artistic sector. In Poland, it appeared in 2007 with the launch of MegaTotal.pl, a platform focused on funding music productions (Kędzierska-Szczepaniak, 2018). A key milestone came in 2012 with the launch of Beesfund, the first Polish equity crowdfunding platform, enabling capital acquisition through equity

issuance (Jóźwiak, 2025). This marked the beginning of a dynamic – though not always coordinated – development of this market segment.

The most important qualitative changes concerned legal regulations. Notably, the emergence of crowdfunding in Poland was driven by bottom-up initiatives from private actors, and for the first few years, there were no dedicated legal frameworks for this form of financing. As a result, general legal principles applied, such as freedom of economic activity (regarding the operation of platforms) and freedom of contract (governing relationships between investors and project creators). At the same time, specific existing regulations were used, including those concerning electronic services, personal data protection, and consumer rights. The absence of clear legal guidelines did not halt the expansion of crowdfunding but did lead to risks and challenges, particularly in relation to investor protection. Moreover, the scope of services offered by crowdfunding platforms effectively made them financial intermediaries, even though they did not formally hold such status or operate under financial supervision procedures (Bagińska, 2018). Special difficulties arose in equity crowdfunding, where the public offering of shares to a broad group of investors could resemble a public offer as defined in capital market regulations. The lack of appropriate legal provisions meant that many projects operated in a gray area of legality, prompting later legislative efforts to regulate the sector (Gemra, 2019).

In response to legal uncertainties and the risks associated with the spontaneous growth of crowdfunding, many countries (e.g., the USA, UK, and Italy) introduced dedicated regulations tailored to the specific nature of this financial market segment (Bagińska, 2018). The European Union also recognized the need to harmonize rules across member states, resulting in the adoption of Regulation (EU) 2020/1503 of the European Parliament and Council, which established uniform rules for crowdfunding service providers in the context of business projects. The regulation defines, among other things, issuance limits, investor information obligations, and licensing requirements for crowdfunding platforms. In Poland, adaptation to the EU framework was achieved through the Act of July 7, 2022 on Crowdfunding for Business Ventures, along with implementing regulations. Notably, the act introduced supervision by the Polish Financial Supervision Authority (KNF) over platform operations, licensing requirements, and a fundraising limit of EUR 5 million for equity crowdfunding. The new rules improved investor protection by enhancing transparency in crowdfunding campaigns but also increased formal requirements for platforms, which reduced the number of active players in the market (Kopeć, 2020; Trzebiński, 2024).

The development of crowdfunding has been closely linked with technological progress. Initially, social media played a key role, significantly expanding campaign outreach. Over time, platforms introduced automated fundraising management systems, personalized investor recommendations, and analytics tools to evaluate campaign performance. In subsequent years, the focus shifted to transparency and transaction security – blockchain technology and smart contracts were implemented to automate fund returns in the event of campaign failure.

The latest trend involves the use of artificial intelligence to optimize campaign management, forecast outcomes, and detect risks or fraud, thereby enhancing investor security (Krupa, 2017; Dziuba, 2018; Ye et al., 2024).

Quantitative analysis of the Polish crowdfunding market remains challenging due to the lack of standardized reporting. Available data come mainly from crowdfunding platforms and industry reports, which are not always comparable. Nevertheless, existing data indicate a dynamic growth trajectory. For example, during the period of most intense growth (2014-2021), equity crowdfunding in Poland increased at an average annual rate of 140%. Companies and potential investors had access to an increasingly diverse platform offering – the number of platforms grew from 6 in 2012 to 32 a decade later (Kozioł-Nadolna, 2024).

The dominant segment in Poland remains social crowdfunding (donation- and reward-based). It is estimated that between the launch of the first platforms and 2022, approximately PLN 3.5 billion was raised in this model, mainly through donation-based campaigns. Equity crowdfunding has developed more slowly – by 2022, equity platforms had raised approximately PLN 300 million (Trzebiński, 2022). The value of lending crowdfunding is the hardest to estimate. The leading platform in this segment, Finansowo.pl, reports that it has organized loans totaling PLN 150 million, suggesting that the market value of lending and equity crowdfunding may be comparable. Based on this assumption, the share of equity crowdfunding in the entire Polish crowdfunding market does not exceed a dozen percent.

Although social crowdfunding is largely aimed at charitable causes, a significant portion of campaigns—estimated at nearly PLN 1 billion – has supported creative projects, organized on platforms such as croowdfund.pl, odpalprojekt.pl, and polakpotrafi.pl. For startups and innovative ventures, the reward-based model is a particularly useful tool for financing early-stage ideas (Trzebiński, 2022).

For more advanced business projects, equity crowdfunding offers broader opportunities. Since 2012, this segment has developed steadily, reaching a peak in 2021, when PLN 125 million was raised across 79 campaigns. In 2020, the number of investors surpassed 30,000, marking a record year. The following years saw a decline, largely due to market instability and new regulations, which required platforms to adapt to KNF requirements. In the long term, however, the formalization of the market may support further development (Kozioł-Nadolna, 2024; Trzebiński, 2024).

Interestingly, the majority of entities using equity crowdfunding were joint-stock companies, and the average campaign amount in 2021 was approximately PLN 1.6 million. This indicates the existence of a funding gap between seed-stage financing and large-scale equity offerings. It is possible that this gap is partially filled by lending crowdfunding, but the lack of detailed data makes it difficult to verify this assumption conclusively.

7. Conclusions

The analysis conducted in this article indicates that crowdfunding has the potential to play a significant role in financing business ventures. Its importance is particularly evident in the context of capital access barriers encountered by startups implementing innovative projects. Traditional sources of financing, such as bank loans or capital market instruments, are often inaccessible to such entities or require conditions that are difficult to meet at early development stages. Other alternatives, such as business angels, while relatively well suited to the needs of startups, do not yet form a widely available or mature support system in Poland. As a result, crowdfunding may offer a valuable alternative, especially during the seed and early stages of business activity.

It should be emphasized, however, that the assessment of crowdfunding's alignment with startup characteristics presented in this article is preliminary in nature and is based on subjective yet structured expert opinions from researchers specializing in innovation and startup ecosystems. What stands out is that the results are relatively moderate and cautious, contrasting with some of the literature, where crowdfunding is often portrayed in an overly enthusiastic and idealized manner. From the perspective of the credibility and practical utility of the findings, a logical next step in future research would be to increase the number of respondents and expand the pool of experts to include startup founders and managers, capital market practitioners, investment advisors, and representatives of crowdfunding platforms. This would enable not only a more in-depth evaluation of the suitability of crowdfunding but also the identification of factors that determine its actual application in business practice – such as project readiness, team competencies, marketing resources, or industry specifics. An interesting direction for further research could also be the segmentation of startups by sector, business model, or development stage. The present analysis assumed a relatively homogeneous set of needs, while in practice, reality may be far more diverse.

The growth dynamics of the crowdfunding market in Poland are impressive, though largely attributable to the low base effect. The total value of funds raised remains relatively small. For example, the total amount raised via equity crowdfunding from its inception in Poland to 2022 was approximately PLN 300 million, while annual R&D expenditures of leading international corporations can exceed USD 20 billion. Nevertheless, the pace of market growth suggests increasing acceptance of this form of financing among both entrepreneurs and individual investors. It is also worth noting that interpretation of crowdfunding data in the context of startup financing should be approached with caution. There is a lack of detailed and systematic statistics to clearly determine what share of crowdfunded capital is directed toward startups as opposed to other types of projects (e.g., consumer, local, or community-based initiatives).

One of the key factors supporting the further development of investment crowdfunding in Poland is the expanding infrastructure (i.e., the growing number of platforms) and the introduction of legal regulations following the implementation of EU Regulation 2020/1503. Although in the short term, these new regulations may have slowed market growth – mainly due to the KNF licensing requirements and increased administrative burdens for platforms – their long-term impact is expected to be positive, improving investor protection and fostering greater professionalism within the crowdfunding sector.

A major challenge for the continued expansion of the market is the relatively low public awareness of investment crowdfunding. While charitable campaigns and reward-based crowdfunding are well known, equity and lending-based models still require greater promotion and education – among both potential investors and entrepreneurs. Another important direction for further development is increasing the liquidity of ownership rights acquired through equity crowdfunding. The introduction of secondary market mechanisms (such as bulletin boards for share trading) and the development of systems enabling equity transfer could significantly enhance the appeal of this form of financing. Similar solutions already operate in more developed international markets and could serve as a strong stimulus for the further growth of crowdfunding in Poland.

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INFLUENCE OF SUSTAINABLE TEAM MANAGEMENT IN VIRTUAL TEAMS ON TEAMWORK PERFORMANCE

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Purpose: The aim of this paper is to present the solution to the research problem concerned the impact of sustainable virtual team management on the performance of such a team.
Design/methodology/approach: The research method used in the research was long-term non-participant observation using online managerial tools as research tools. The research involved 60 participants in 12 teams, working for 41 days on a complex organizing problem.
Findings: Two key conclusions were drawn from the research. First, the lack of a defined virtual team manager has little effect on the emergence of a balanced influence of team members on the course of the team's performance. Second, the balanced influence of virtual team members has very little effect on the fulfillment of the criteria for team performance.
Research limitations/implications: The findings prompt us to plan further research in the field of social influence in virtual teams and to find other dependencies of virtual teams' performance on psychophysical factors and work environment. Such research is designed and undertaken in the future by the authors of this publication.
Practical implications: The best evaluation of performance had the team with the highest coefficient of variation in %. The "hero manager" pattern was not confirmed.
Social implications: As the results varied, but it can be assumed that future research incorporating very rigorous experimental requirements will answer several questions. First, whether dispersion is universal to all teams or whether it is divided into different types, such as the complete absence of a manager. Second, or whether the delegation of leadership roles to each other by all participants increases the efficiency of work in a virtual team.
Originality/value: The system of organizational terms which is an original methodology for studying organizational reality. It is based on monitoring real managerial activities undertaken by the manager and team members in the organization.
Keywords: sustainable team management, virtual teams, teamwork performance, managerial work, virtual teams.
Category of the paper: Research paper.

1. Introduction

As a result of research on the influence of people on others in an organization, two opposing approaches to the importance of social influence in achieving team or organization-wide performance have developed. On the one hand, the literature emphasizes the leading role of the team manager in achieving high team performance (Kets de Vries, 2008), and on the other hand, there are views on reducing the influence of the team manager in order to realize the full potential of team members (Kożusznik, 2018). From this point of view, a new approach is emerging, which can be called sustainable team management (Cizmaș et al., 2020), which is based on treating one's influence in the organization as a factor shaping effectiveness, rather than as an attribute of one's own importance and prestige (Kożusznik, 1996, 2014). The phenomenon is increasingly likely to occur due to the growing formation of virtual teams instead of traditional teams based on workplace cohesion (González-Anta et al., 2021).

Therefore, the research problem formulated in the study concerned the impact of sustainable management of a virtual team on the performance of such a team. Two research questions were formulated that stemmed from the research problem:

- RQ1: To what extent does the lack of a defined manager of a virtual team affect the emergence of a balanced influence of team members on the course of the team's performance?
- RQ2: To what extent does the balanced influence of virtual team members affect the fulfillment of the criteria for team performance?

The research method was long-term non-participant observation using online managerial tools as research tools. The study involved 60 participants in 12 distributed teams who worked on a given multimedia project for 42 days. Section 2 below describes the theoretical foundation of social influence in an organization, Section 3 presents the methodology of research. Section 4 contains the results of research, and Section 5 contains the conclusions of the research.

2. Theoretical foundation of social influence in an organization

2.1. Historical review of research on influence in organizations

The history of research on the problem of social influence begins in the 19th century with the study of suggestion (Allport, 1968). The term "suggestion" was proposed by Liebeault in 1866 and describes a group of phenomena that can be characterized in that an individual's behavior is identical to the one that another person wanted to induce.

Dominant and subordinate behavior were studied over the following decades. Binet (1900) examines the concept of suggestibility or susceptibility to suggestion and wishes to measure an individual's resistance to suggestion. As a result of his research, Moore (1921) found that there is a cognitive reconstruction of an individual's statements under the influence of social context. The research proved how much influence social processes have on perception.

In the following decade, Kurt Lewin and his students began the "era" of group dynamics in social psychology. For Lewin, the essence of the group was the interdependence of its members: each member of the group depends on all others - a field of influence is formed (Lewin, 1950).

Two other researchers - Deutsch and Gerard (1955) - distinguished normative social influence from informational social influence. By normative influence, they meant the tendency to conform to the influence of others, by informational influence - the tendency to accept information provided by others. The results of Asch's experiment can be interpreted in the category of informational influence in determining the length of a stretch, as well as normative influence when it comes to group solidarity, as confirmed by the studies of Thibaut and Strickland (1956), as well as Hovland and Janis (1959).

Cialdini (2003), showing the types, sources and importance of influence, says that influence is there to facilitate our decision-making. We succumb to influence in order not to take action, and most often we trust that someone knows something better and more than us.

Research on social influence in organizations over the decades has divided into two main streams. The first assumes the high importance of leadership qualities and power attributes in a manager's work, while the second conversely recognizes the influence of team members' participation in management and the role of sustainable organizational management.

2.2. Increasing influence of the manager on performance of team members

In the first research stream, which assumes the high importance of leadership qualities of team managers, basic group and intergroup processes, based on defining oneself as a member of a group, generate various supervisor-subordinate relationships that have implications in terms of how and what kind of influence managers exert (e.g., Bass, 2000; Chemers, 2001).

The earliest studies focused on managerial traits, and later studies focused on managerial behavior. These culminated in Fiedler's (1978) research, known as the interaction model. Subsequent research focused on leadership as a dynamic effect of transactions between leader and subordinates, and later on the transformational meaning of leadership (Bass, 2000; Hollander, 1985), which introduced a new view of the manager as change-oriented, proactive, and having a mission and vision. These studies did not yield satisfactory solutions, so the perspectives of social cognitive psychology and expectancy theory currently being adopted seem promising (Hogg, 2001; Pfeffer, 2015).

At this point, it is worth citing the three most important approaches, well-established in the social sciences, regarding the influence of the manager on the behavior of organizational members.

The first example of this approach is Fiedler's model (1979), which assumes that group effectiveness can only be predictable if the behavioral style of the manager and the manager's ability to control the situation are known in advance, and that leadership processes cannot be considered solely in psychological, personality or behavioral terms, since they reach deep into group structures and are themselves structural (Kożusznik et al., 2020).

Fiedler has shown that:

- if (a) the team manager has a good relationship with the group of subordinates, as measured by their level of acceptance of the manager using the Least Preferred Co-worker (LPC) scale; (b) the manager has a lot of power, i.e. can punish or reward subordinates; (c) the task is well-defined, has clear goals, there are few ways to achieve the goal and perform the task, then it can be said that the team manager is in favorable conditions; in such conditions, Fiedler found negative correlations between high LPC, that is, in these situations the task-oriented leader performs best,
- under moderately favorable conditions, managers with high LPC perform best,
- under unfavorable conditions, task-oriented managers with low LPC perform best.

The second approach is that of Blake and Mouton (1969), which is based on a similar approach to Fiedler's theory and assumes that the ideal approach is one that is simultaneously people-oriented and production-oriented, but it does not provide clear evidence on whether this is psychologically possible.

The choice of the participation option, and thus the determination of how to accomplish a task (whether taking more group freedom or placing more emphasis on the importance of the person in charge of the team or organization), is largely determined by the individual manager's inclination to behave in a certain way - his preference for a leadership style. In this view, awareness of one's own limitations (the tendency to focus too much on the so-called "human side" or to focus too much on tasks) should be the basis of managerial decisions.

The basis of the management grid (developed by Blake and Mouton, 1969) is two dimensions: people orientation and goal orientation. The 9.9 style (a combination of people-orientation and goal-orientation) is the most appropriate course of action to achieve excellence. The basis of the 9.9 style is the assumption of synergistic groupthink, the emphasis on group problem solving, the assumption of flexibility and logical thinking, team innovation, the importance of team evaluations and the importance of criticism (Nussbaum, 2013). Using the research method described in Section 3, the authors conducted a study of management styles in 2022, which they included in previous publications (Flak, Pyszka, 2022).

A third approach describing a manager's influence on his team members may be Hersey and Blanchard's concussion. Hersey and Blanchard (1977) began their analysis of leadership effectiveness by rejecting the notion that there is one ideal leadership style, since all the results of research on various dimensions show that satisfied groups can be led by individuals representing any style and leadership behavior.

In their study, they found that the more managers adapt their leadership style to meet the demands and needs of the situation and subordinates, the more effective they will be in achieving organizational and personal goals (Flak, Pyszka, 2022).

The concept under discussion distinguishes four basic leadership styles: persuading, participating, delegating, commanding. Effective managerial behavior is defined as behavior appropriate to the situation. The concept introduces a new variable - a key dimension of the environment - the maturity of subordinates, or their readiness to take on the tasks facing the group (Rożnowski, Fortuna, 2020).

Maturity, defined only in relation to the specific tasks facing the group, is the ability to set high but achievable goals (achievement motivation), the desire and ability to accept responsibility, and the education and experience of individual group members. The basic assumptions of the theory are as follows (Hersey, Blanchard, 1977).

In doing so, the literature identifies the following principles (Kożusznik, 2005):

- if maturity is low, the leader should exhibit behavior that is highly task-oriented and lowly relationship-oriented to help the group succeed and begin to learn (command),
- as the maturity level of subordinates increases, the leader should reduce task-oriented behavior and increase relationship-oriented behavior to help the group build competence (persuasion),
- as the maturity of subordinates increases, then the leader should reduce both task-oriented and relationship-oriented behaviors so that the group can develop self-confidence and self-reliance in its work (participation),
- if the group reaches maturity, then the leader can further reduce both task-oriented and relationship-oriented habits and possibly delegate tasks to the group and expect them to be achieved (delegation).

2.3. Decreasing influence of the manager on performance of team members

The second approach involves increasing the participation of team members in management and reducing the influence of managers on work outcomes. This way of thinking originated in the 1950s, when Lewin (1951) defined the work environment as the main determinant of the behavior of organizational members. The creation of rules related to the course of social interactions in the organization largely concerned the establishment of physical distance and physical space (Weisband, 2008).

From a psychological point of view, a person’s spatial relations are determined not only by the boundaries of his body, but by a kind of map that includes zones of closer and further spatial fields (Hall, 1976; Weisband, 2008). Assigning an employee a work space in an organization leads to the employee treating this space in a more personal way (Rożnowski, 2020).

The use of people's abilities and capabilities depends on two elements. On the one hand, these are the qualities and characteristics of people themselves, and on the other hand, the external circumstances in which they live. Both elements determine the "full realization of human potential" (Le Blanc et al., 2017).

In order to perpetuate this principle, it is good to be guided by a concept called interactionism, present in psychology, among others. Interactionism assumes the aforementioned dual conditioning: the interaction between the person (subject) and the circumstances. This simply means that even the best of a person's equipment, inner abilities and dexterity will not be fully utilized if they are not accompanied by certain conditions outside, in the environment, such as having the means or tools with which someone can make use of them (Pfeffer, 2015).

The concept of de-influence is based on treating one's own influence in the organization as a factor shaping effectiveness, rather than as an attribute of one's own importance and prestige (Kożusznik, 2005). It is based on rational de-influence, with full acceptance and awareness of the importance of the influence of all elements of the team, as well as multiple sources:

- the natural game of influence within the team, and the assumption that conformity and the search for independence are equivalent mechanisms (Hollander, 1985; Pratkanis, 2007),
- the idea of interactivity, from which it follows that exerting influence is not possible without the right space; even the best-equipped employee with his or her own qualities, skills and competencies will not be effective in an organization unless special external conditions are provided (Paliga et al., 2020),
- research results showing that the act of influence changes not only the behavior of those who are the addressees of the influence, but also the values and attitudes of the influencers (Haslam et al., 2011),
- researchers' doubts about whether managers can actually flexibly change the means of influence they use depending on the demands of the situation (Schein, 1988),
- the assumption that individuals can consciously control their behavior (Latham, 2012).

Therefore, the authors decided to conduct research in virtual, task-oriented teams, whose management rules were based on the above assumptions.

3. Methodology of research

One of the difficulties of studying organizational reality, including the actions of managers and team members in an organization, is to get to the facts of teamwork. Therefore, the authors developed an original methodology for studying organizational reality, which is based on

monitoring real managerial activities undertaken by the manager and team members in the organization (Flak, 2018; Yang et al., 2018; Flak et al., 2023).

The study used non-participatory observation as a research method, in which observation participants used online managerial tools. At this point, it is necessary to present how these tools work and their methodological basis.

The methodological basis of the study conducted is the system of organizational terms, which is an original concept for studying organizational reality (Flak, 2018). In the system of organizational terms, a manager's action is represented by a combination of "event" (derived organizational term) and "thing" (primary organizational term) (Flak, 2022). The event or thing is denoted by the symbols n.m, where n denotes the number of the event or thing, and m denotes its successive version. An example of the layout of various managerial actions is illustrated in Figure 1.

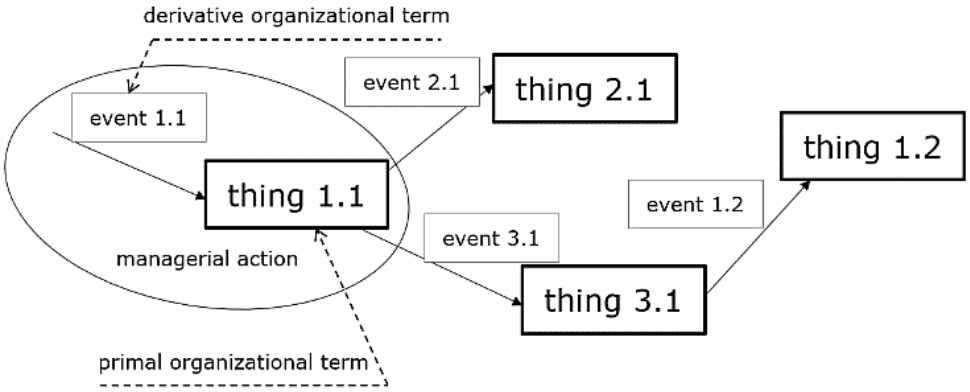


Figure 1. Example structure of managerial activities.

Source: (Flak, 2022).

Based on the system of organizational terms, 10 managerial tools were designed and implemented, the function of which is also to record the parameters of 10 managerial actions during their use. In this way, online managerial tools function as research tools (Flak, 2021). The tools are available on the research platform TransistorsHead.com at: http://transistorshead.com/

Since the research was conducted in virtual teams working in online management tools, it is necessary to define a virtual team and an online management tool. A virtual team is "a group of people with complementary competencies performing simultaneous, joint work processes through electronic media, regardless of geographic location" (Chinowsky, Rojas, 2003). An online managerial tool, on the other hand, is a simple or complex instrument for performing the work of a manager, which has a virtual form (e.g., in the form of an IT program or databases in computer memory) (Flak, 2017).

4. Results of research

The long-term observation was conducted from December 18, 2023 to January 29, 2024 among the students of management faculty of Jan Kochanowski University of Kielce, Poland. The study involved 60 participants in 12 virtual teams. Every team consisted of 4-6 members. What is important, in teams there were no defined team managers, all the team members could take managerial actions and use all online management tools. The only moment when a temporary team manager was appointed was at the very beginning of setting all the teams in the TransistorsHead.com platform (his role was to add all other members to the team and it came only from functions of the platform). After this moment all team members were equal and had the same social influence on the teamwork.

Participants in the long-term observation were given the task of preparing documentation of the program project on the YT channel in the Talent Show format. The task of the participants was as follows: formulate an organizing problem and solve this problem - propose a detailed format for the program and preparations for its implementation. The result of the study participants' work was a pdf document containing a detailed description of the solution to the organizing problem. The assessment parameters of the task completion were: (a) detail, (b) completeness and (c) originality. Participants used the online management tools implemented in the TransistorsHead.com platform, including 10 online management tools, described in the Section 3.

The first research question posed in the study was RQ1: To what extent does the absence of a defined virtual team manager affect the emergence of a balanced influence of team members on the course of the team's performance? To answer it, the number of managerial actions undertaken (counting all 10 measured managerial actions in total) by individual virtual team members was measured. Basic statistical measures were then calculated to assess the degree of balanced influence of team members on the course of the team's performance. Table 1 shows the number of managerial actions taken by members of each virtual team (some teams had 4, 5 or 6 people), and Table 2 shows statistical measures on their work.

Table 1.
Number of managerial actions taken by team members

virtual team	member 1	member 2	member 3	member 4	member 5	member 6
1	2669	661	968	448	710	-
2	1327	1117	872	929	414	559
3	1044	1166	1644	711	165	163
4	1152	857	893	718	672	-
5	959	458	308	598	426	-
6	1190	270	380	943	683	390
7	1653	1249	927	1289	1380	-
8	1317	527	209	180	582	-
9	830	401	203	258	-	-

Cont. table 1.

10	1124	1889	1115	845	-	-
11	1087	644	639	227	561	-
12	1354	789	302	291	-	-

Source: own elaboration.

Table 2.
Statistical measures on the work of virtual teams based on the number of managerial actions taken

virtual team	managerial actions in total	Arithmetic mean	standard deviation	gap (max-min)	coefficient of variation in %
1	5456	1091,20	806,07	2221	73,87
2	5218	869,67	310,38	913	35,69
3	4893	815,50	535,62	1481	65,68
4	4292	858,40	168,44	480	19,62
5	2749	549,80	224,49	651	40,83
6	3856	642,67	332,44	920	51,73
7	6498	1299,60	233,61	726	17,98
8	2815	563,00	410,41	1137	72,90
9	1692	423,00	245,84	627	58,12
10	4973	1243,25	389,32	1044	31,31
11	3158	631,60	274,33	860	43,43
12	2736	684,00	435,98	1063	63,74

Source: own elaboration.

As can be read from Table 1, the number of managerial actions taken varied among team members. In some of the teams, one person dominated, for example, in team 1 person member 1, and in team 10 person member 2. In contrast, management in team 7 was very balanced - team members undertook a similar number of managerial actions.

The statistical measures presented in Table 2, particularly the coefficient of variation in % (the higher the value, the greater the variation in influence on workflow), show how the teams participating in the study varied in terms of team members' influence on workflow. On the one hand, there were teams with a low balance of team management and thus the dominance of one person (e.g. team 1, team 3, team 8). On the other hand, it is possible to identify teams and a high balance of team management and, consequently, a similar influence of team members on the course of the team - team 4 and team 7.

Answering research question RQ1, it can be concluded that the lack of a defined virtual team manager has little effect on the appearance of balanced influence of team members on the course of the team's performance.

The second research question is RQ2: To what extent does the balanced influence of virtual team members affect the fulfillment of the criteria set for team performance? To answer it, we evaluated the effects of virtual teams according to the criteria that were set for them at the beginning of the study. These were the following criteria for solving the organizing problem, presented to us as a pdf file: (a) detail (whether the solution to the organizing problem was detailed), (b) completeness (whether the organizing problem was solved completely) was and (c) originality (whether the solution to the organizing problem was original).

Table 3 shows the results of the evaluation of the effect of the teams' work on a scale of 1 to 5 (1 - the least fulfilled criterion, 5 - the most fulfilled criterion) and a comparison of these evaluations with the coefficient of variation in %. Figure 2 shows the distribution of coefficient of variation in % of individual virtual teams and total teamwork assessment. Based on the data in Table 3, Pearson's correlation coefficient was also calculated, which in this case was 0,3773 for the trend line function, which is a fourth-degree polynomial. Increasing the degree of the polynomial does not produce any apparent improvement in the correlation coefficient. Therefore, it can be concluded that the balanced influence of virtual team members has very little effect on meeting the criteria for team performance.

Table 3.
Team effect scores and coefficient of variation in %

virtual team	criteria: detail	criteria: completeness	criteria: originality	total teamwork assessment (average of detail, completeness and originality)	coefficient of variation in %
5	5	5	4	4,67	40,83
7	4,5	4,5	5	4,67	17,98
10	4	4	4,5	4,17	31,31
12	4,5	4	4	4,17	63,74
2	4,5	4	3,5	4	35,69
9	4,5	4	3,5	4	58,12
3	4	4	3,5	3,83	65,68
1	3,5	3,5	4	3,67	73,87
4	3	4	4	3,67	19,62
6	3	3,5	3	3,17	51,73
8	3	3	3	3	72,9
11	2,5	3	3	2,83	43,43

Source: own elaboration.

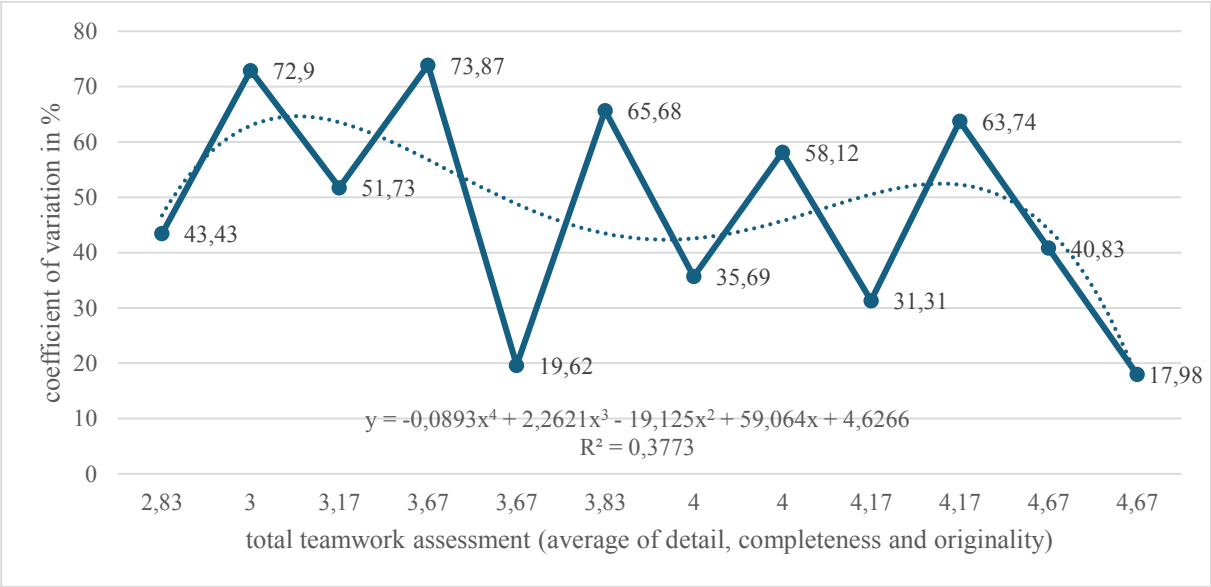


Figure 1. Distribution of coefficient of variation in % of individual virtual teams and total teamwork assessment.

Source: own elaboration.

5. Results of research

The research carried out using the method of long-term non-participant observation allowed to answer two research questions, related to the research problem, what was the impact of sustainable management of a virtual team on the performance of such a team. Answers to two research questions were obtained. First, the lack of a defined virtual team manager has little effect on the emergence of balanced influence of team members on the course of the team's performance. Second, the balanced influence of virtual team members has very little effect on the fulfillment of the criteria for the team's performance.

The results of the study do not link the activity of the manager to effectiveness, as if one would expect, especially since the best evaluation of performance had the team with the highest coefficient of variation in %. The "hero manager" pattern was not confirmed, as the results varied, but it can be assumed that future research incorporating very rigorous experimental requirements will answer several questions. First, whether dispersion is universal to all teams or whether it is divided into different types, such as the complete absence of a manager. Second, or whether the delegation of leadership roles to each other by all participants increases the efficiency of work in a virtual team.

The above questions prompt us to plan further research in the field of social influence in virtual teams and to find other dependencies of virtual teams' performance on psychophysical factors and work environment. Such research is designed and undertaken in the future by the authors of this publication.

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REVISITING DEA APPLICATION IN THE JUDICIARY: ASSESSING MACRO-EFFICIENCY OF THE POLISH DISTRICT COURT SYSTEM IN THE 21ST CENTURY

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Purpose: The objective of this article is to investigate the technical efficiency of Poland's district court system from 2002 to 2021, employing a constrained variant of Data Envelopment Analysis (DEA) on appropriately processed time series data.
Design/methodology/approach: Different DEA models were employed to estimate the technical efficiency of this system, beginning with classical CCR DEA and super-efficiency DEA. After identifying crucial shortcomings in the outcomes produced by these two methods, a novel procedure based on constrained DEA was proposed to address and overcome these limitations in the context of evaluating judicial efficiency using DEA.
Findings: Applying super-efficiency DEA to a small sample does not yield sound or fully interpretable outcomes regarding the estimated scores of individual DMUs, despite seemingly increasing the variability of these scores. It is only when adequate restrictions are imposed on both the input and output weights—price and virtual alike—that one can obtain results free from the significant imperfections commonly associated with the classical DEA method in the context of judicial efficiency.
Research limitations/implications: Ignoring the inherent shortcomings of classical or super-efficiency DEA can lead to significant distortions in the estimated ratings assigned to individual DMUs.
Practical implications: Policy recommendations derived from traditional unconstrained DEA, intended to enhance the actual efficiency of specific DMUs, might ultimately be misleading.
Originality/value: The research contributes to the existing body of knowledge on judicial efficiency in at least two significant ways. First, unlike previous studies, it focuses on a single DMU (the first-instance court system) over a long 20-year period, allowing conclusions drawn from this investigation to be interpreted within the context of systemic macro-level efficiency over time. Secondly, and more importantly, the article highlights the inherent weaknesses of classical DEA, which cast reasonable doubt on the quality and interpretability of the results obtained using this method. To address these issues, the article introduces—for the first time in the field of judicial efficiency research—a procedure specifically designed to overcome these limitations.
Keywords: efficiency, DEA, weight constraints, judiciary.
Category of the paper: Research article.

1. Introduction

The aim of this paper is to illustrate the possibility to estimate the judicial technical efficiency using time-series data – as opposed to cross-sectional data typifying all the previous research on this subject matter – with Poland's district court system serving as the reference. The macro perspective adopted enables a holistic assessment of the combined efficacy of the legal, administrative, procedural, organizational, and economic frameworks—uniformly applied to all district courts—that collectively influence the system's functioning and thus determine its systemic efficiency across individual years in the analysis, something that cannot be achieved with the use of cross-sectional data because this macro-level context remains constant then.

A parallel methodological goal of the study is to draw attention to the immanent weaknesses of classical DEA, including its super-efficiency variant which cast reasonable doubt on the quality and interpretability of the results obtained using this class of methods. At the same time, the article proposes - for the first time in the field of judicial efficiency research - a procedure to address these weaknesses within the framework of existing modifications of classical DEA.

The set of research hypotheses subjected to empirical verification in this study is as follows:

H1: Neither classical DEA nor super-efficiency DEA produces fully interpretable weight estimates during the efficiency optimization process.

H2: Previous efforts to ensure unambiguous interpretability of results in the field of judicial efficiency research have proven insufficient.

H3: Policy recommendations derived from classical DEA in the context of judicial efficiency may ultimately be unreliable or misleading.

2. Methodological note and literature outline

The starting point of the classical DEA method (e.g., Panwar et al., 2022) is the following quotient of the weighted sum of outputs to the weighted sum of inputs, defining the technical efficiency of a given decision-making unit, DMU, (for ease of reading, the equivalents of general terms used in this study are provided in parentheses):

$$E_z = \frac{\sum_{t=1}^{T} w_{tz} Y_{tz}}{\sum_{s=1}^{S} v_{sz} X_{sz}} \tag{1}$$

where:

E_z – technical efficiency of the *z-th* decision-making unit (efficiency of the district court system in each year of the 2002-2021 period),

$z = 1, 2 \ldots, Z$ – index of the *z-th* decision-making unit (total Z = 20, i.e. number of years),

X_{sz} – the *s-th* type of input in the *z-th* decision-making unit (the amount of the *s-th* input - out of the three considered in the study: the number of judges, outlays on the disctrict court system and the system load - in a given year of analysis),

s = 1, 2 …, S – index of the *s-th* input (total of S = 3 types of inputs, listed above, common to all decision-making units),

Y_{tz} – *t-th* type of output in the *z-th* decision-making unit (amount of the *t-th* type of output - out of the six included in the study: number of resolved civil, criminal, family, labour law, social security and commerce cases - in the given year of analysis),

t = 1, 2 …, T – index of the *t-th* input (total of T = 6 output types, listed above, common to all decision-making units,

w_{tz}, v_{sz} – weights assigned to the *t-th* outcome and *s-th* input in the *z-th* DMU, respectively.

A key property of the DEA method is that the weights appearing in formula (1) are determined through a linear programming procedure, rather than by arbitrarily assigning specific values to them. Thus, the most important—and at the same time, most disputable—issue of determining the values of these weights, which implicitly conveys the gradation, importance, or significance of individual inputs and outputs, is objectivized in a way that ensures the most favourable set from the perspective of individual decision-making units. This is achieved by maximizing outputs and minimizing inputs, represented by the following mathematical problem (e.g., Panwar et al., 2022):

$$max\ E_z = \frac{\sum_{t=1}^{T} w_{tz} Y_{tz}}{\sum_{s=1}^{S} v_{sz} X_{sz}} \tag{2}$$

with respect to the following constraints:

$$0 \leq \frac{\sum_{t=1}^{T} w_{tz} Y_{tz}}{\sum_{s=1}^{S} v_{sz} X_{sz}} \leq 1 \tag{3}$$

$$0 \leq w_{tz} \leq 1;\ 0 \leq v_{sz} \leq 1 \tag{4}$$

The bulk of the existent empirical applications in the public sector, including judiciary, use the above-reported constant returns to scale CRS-DEA scheme to assess the efficiency of various public units. A comprehensive review of research on judicial efficiency can be found in works by Voigt (2016) or Ippoliti and Tria (2020).

There is a great deal of variation in empirical studies as far as selection of input and output variables are concerned. In the nature of inputs, the "duty variable" - completely understandably - is almost always (exceptions is e.g. Tulkens, 1993) the number of judges, while other variables are selected most likely depending on the availability of data. In addition to the aforementioned variable, DEA studies of court efficiency take into account such variables as the number of cases outstanding/caseload (this is the variable most often present - along with the number of judges: e.g. Mattsson, Tidana 2019), the size of non-judicial staff (e.g. Angrell et al., 2019), office and IT equipment and work space (e.g., Angrell et al., 2019), or expenditures on court operations (e.g., Deynelli, 2012). It should be emphasized that in the vast majority of DEA

applications in the judiciary the number of inputs simultaneously considered does not exceed three (Peyrache, Zago 2016 is an exception).

The vast majority of empirical applications include as outputs an aggregate of cases resolved in a given year, and therefore only one factor. Given the variation in the duration of litigation and labour input by subject of law, treating all cases coming before the courts as homogeneous is certainly a very far-reaching simplification. This raises the question of whether the efficiency scores achieved by individual courts can be reliably inferred from such far-fetched aggregate results, covering all types of legal cases. Exceptions in this regard include only the work of Kittelsen & Forsund (1992; seven categories of cases by subject of law); Tulkens (1993; four categories of cases); Mattsson & Tidana (2019; three categories of cases), Angrell et al. (2019; three categories of cases), and the work of Santos & Amado (2014; a very exhaustive breakdown of cases by subject of law: 43 categories).

In all the works cited in this micro-review, the outcome-maximising version of DEA is used. This approach is justified by the specifics of the operation of the judiciary, where an increasing burden on court systems can be observed in recent years. The only exception is the work of Schneider (2005). Furthermore, in cases where a non-discretionary variable is present in the set of inputs (e.g. caseload), it can only be treated on same terms as a discretionary variable if the chosen version of DEA is outputs maximising (see Cook et al., 2014).

Classical DEA exhibits low discrimination of efficiency scores between the analysed DMUs when the number of DMUs is small. Researchers typically address this issue by employing a variant of DEA that utilizes the concept of super efficiency (known as the SE-DEA model), the methodological details of which can be found e.g. in Lee et al. (2011). An example of application of the super-efficiency concept in which the aforementioned phenomena are present is e.g. Mattsson & Tidana (2019).

However, neither classical DEA-CRS nor its SE-DEA extension prevents the results from including inputs and/or outputs with zero weights, which, while consistent with the procedures (see constraint (4)), raises concerns about the validity of such outcomes (discussed further). To ensure that all inputs and outputs contribute meaningfully to the analysis —effectively ensuring that no weights are zero — a constrained SE-DEA model can be employed (e.g. Pedraja-Chaparro et al., 1997). This version of DEA, though not yet applied in the context of judicial efficiency, forces the optimal weights to adhere to specific assumptions based on logical considerations, ensuring that none of the weights are zero and thus eliminating the previously noted objections.

3. Data

In order to carry out the task at hand, it was necessary to collect data at the macroeconomic level, which involved using various sources and processing the information accordingly. Data on regional court activity by different categories of cases (including criminal, civil, family, labour, social security, and business cases) in 2011-2021 were taken from publicly available resources of the Ministry of Justice. The key source was the .xls-format database "Records of Cases in Common Courts in Poland," available on the Ministry's website (https://isws.ms.gov.pl/pl/baza-statystyczna/opracowania-wieloletnie). To expand the period of analysis and include the years 2002-2010, the document "Statistical Analysis of the Activities of the Judiciary in 2002-2011" (https://isws.ms.gov.pl/pl/baza-statystyczna/opracowania-jednoroczne-w-tym-pliki-dostepne-cyfrowo/rok-2011/) was additionally used. In addition, the collected data required further modifications to ensure it could be properly applied to efficiency analyses using the DEA method. In particular, this included the need for some identity-related additions concerning the basic relationships derived from the statistical court records, which were crucial for the calculations to be carried out correctly:

$$Caseload_t = Pending\ cases_{t-1} + Incoming\ cases_t \tag{5}$$

$$Pending\ cases_t = Caseload_t - Resolved\ cases_t \tag{6}$$

$$Case\ processing\ time_t = \frac{Pending\ cases_t}{Resolved\ cases_t} \cdot 12 \tag{7}$$

where the subscript "*t*" stands for *t-th* year.

The number of cases completed by subject of law were chosen as the output variables describing the effects of regional courts activity. The selection of such variables ensures that the conditions of homogeneity and completeness are met for the decision-making units under study (here: individual years of district courts activity), which is a key requirement for the correctness of DEA analyses. The results defined in this way reflect the effects of the courts' activities over time. Input variables were drawn from several sources. The non-discretionary input variable (caseload), reflecting the burden on the judicial system, was calculated based on formula (5). On the other hand, data on the average number of judges employed in the regional courts from 2006 to 2021 were obtained directly from the Ministry of Justice through the public information access procedure. For the years 2002-2005, for which direct data on the number of judges was missing, linear interpolation was used between 2001 (CSO data) and 2006.

To estimate the outlays from the state budget for the operation of regional courts adjusted for inflation, it was necessary to conduct the appropriate calculations and use several sources. First, a time series was created for expenditures on the general judiciary in current prices (which includes district courts) based on data from the Ministry of Finance available at https://www.gov.pl/web/finanse/sprawozdania-roczne and https://mf-arch2.mf.gov.pl/web/bip/

ministerstwo-finansow/dzialalnosc/finanse-publiczne/budzet-panstwa/wykonanie-budzetu-panstwa/sprawozdanie-z-wykonania-budzetu-panstwa-roczne.

Second, the results of calculations presented in the work of Siemaszko & Ostaszewski (2013) were used to determine the proportion of expenditures on district courts to total expenditures on the general judiciary. Third, budget expenditures for district courts were estimated in current prices by multiplying total expenditures on the general judiciary by the established fraction allocated to the district judiciary. Finally, the values of this series were divided by the Consumer Price Index (CPI) deflator for 2015 to obtain the real value of these outlays[1].

4. Empirical analyses

The second column of Table 1 presents the efficiency scores obtained using the classic DEA model. As anticipated, these scores are the least discriminatory—not primarily due to substantive factors, but rather for technical reasons. In such cases, the discriminative power of the DEA model can be enhanced by employing the concept of super-efficiency. In this setup, efficiency scores may exceed the value of 1 to varying extents, allowing for greater discrimination among "classically" efficient DMUs that would otherwise be capped at 1. Rescaling these scores to set the highest score to "1" enables a more "traditional" interpretation of the results obtained.

Table 1 also presents the efficiency scores obtained through the DEA super-efficiency procedure, including both original and rescaled scores. At first glance, it appears that the results are quite satisfactory. Despite the limited number of DMUs, the analysis has seemingly allowed for a robust discrimination of their efficiency scores, resulting in a diverse empirical set of efficiency scores that may give an illusory impression of greater realism. In fact, this is often where researchers investigating court efficiency through DEA tend to stop, with the majority ceasing their analysis at the classic DEA stage.

One might wonder why one shouldn't interpret the results immediately. What would be wrong with such an interpretation? The adage, "The less people know about how sausages and laws are made, the better they'll sleep at night", attributed to Otto von Bismarck, can be paraphrased for our context: "The less DEA practitioners (and even more so, DEA stakeholders) know about the parameters and weights derived from their DEA analyses, the better they sleep at night". Indeed, it seems that few care about what might be perceived as "trivial" matters, such as the actual parameter estimates obtained in the DEA model. However, these are not trivial issues; they are crucial for trusting the obtained efficiency scores. The fact that only one

[1] Data available upon request.

of the publications referenced in this paper (Santos, Amado, 2014) explicitly addresses the issue of parameter estimates and weights—though not exhaustively—illustrates the extent of both intentional and unintentional ignorance on this matter.

Table 1.
Efficiency scores and absolute weights obtained in the classical and super-efficiency DEA

DMU	Efficiency scores			Absolute weights estimates in SE-DEA								
				INPUTS			OUTPUTS					
	Classical DEA	SE-DEA	Rescaled SE-DEA	*OUTLAY*	*JUDGE*	*CASELOAD*	*COMMERCE*	*LABOUR*	*CIVIL*	*FAMILY*	*CRIME*	*INSURANCE*
D02	1.0000	**1.1043**	0.9761	0.0003651	0	0	0.0004914	0.0002414	0	0.0004841	0	0
D03	1.0000	**1.1275**	0.9967	0.0003124	0	0	0	0.0020802	0	0	0	0.0047333
D04	1.0000	**1.0846**	0.9587	0	0.0001322	0	0	0	0	0	0.0002298	0.0092038
D05	1.0000	**1.0460**	0.9247	0	0	9.547E-05	0	0	0	0.0007915	0	0.0031389
D06	1.0000	**1.0220**	0.9034	0	0	9.456E-05	0	0.0003931	0	0	0.0004415	0
D07	1.0000	**1.0275**	0.9083	0	5.171E-05	5.41E-05	0	0	0	0	0.0004389	0
D08	1.0000	**1.0170**	0.8990	0	1.62E-05	7.394E-05	0	0	0	0.0007865	0	0
D09	1.0000	**1.0469**	0.9254	0.0001663	1.995E-05	1.609E-05	0	0	0	0.0004117	0.0001957	0
D10	1.0000	**1.0155**	0.8977	0	0	7.37E-05	0	0	9.82E-05	0.0002155	0	0
D11	0.9884	**0.9884**	0.8737	0	0	7.163E-05	4.556E-05	0	9.259E-05	0	0.0001086	0
D12	1.0000	**1.0278**	0.9086	6.55E-05	0	4.94E-05	0	0	0.0001072	4.512E-05	3.37E-05	0
D13	1.0000	**1.0177**	0.8996	0.0002549	0	0	0.0001885	0	2.791E-05	0.0003605	3.735E-08	0
D14	1.0000	**1.0398**	0.9191	3.415E-05	0.0001236	0	0	0.0009049	0	0	0.000372	0
D15	1.0000	**1.0344**	0.9144	0	1.474E-05	5.411E-05	0.0004108	0	0	0	0.000141	0
D16	1.0000	**1.0015**	0.8853	0	0.00015	0	2.188E-05	0	0	0.0004584	0	0.008921
D17	1.0000	**1.0986**	0.9712	2.068E-05	0.0001198	0	0.0005435	0	0	0	0	0
D18	0.9952	**0.9952**	0.8797	0	8.501E-06	5.683E-05	0	0	0.0001086	0	0	0.0006618
D19	1.0000	**1.1313**	1.0000	9.276E-06	0.0001259	0	0	0	9.531E-05	0	0	0
D20	0.9852	**0.9852**	0.8709	0	8.42E-06	5.629E-05	0	0	0.0001075	0	0	0.0006554
D21	0.9776	**0.9776**	0.8641	0	4.223E-05	4.453E-05	0	0	8.646E-05	0.0001631	0	0.0008154

Source: Own computations using processed data (see section *Data*) and *pydea* software.

Let's examine the weights and parameters attached to the outputs in the super-efficiency variant of DEA (for want of space only absolute weights estimates are reported in Table 1). It is evident that many weights assume the value of "0", and occasionally, all weights except one are "0". Interpreting these weights in an economic sense leads to a fully logical yet hardly realistic conclusion that there is no contribution from the factors (inputs/outputs) whose weights equal "0". Such a conclusion, which is unavoidable in this scenario, undermines the fundamentals of DEA as a credible tool for efficiency estimation. This is because all inputs and outputs included in the DEA must have explicit contributing power, otherwise, they should not have been included in the analysis at all!

Thus, a question arises as to whether such outcomes have any explanatory merit. If not—and this seems to be the only logical conclusion—the next question is what can be done about it. A self-evident and very general answer would be: to ensure that the estimated weights make sense. This can be accomplished with the help of constrained DEA, where the optimization of the efficiency scores takes into account certain logically and empirically sound restrictions imposed on the weights during the optimization process.

It seems quite straightforward to "price" the unit value of a given resolved case (by subject of law) according to the time spent on its disposition. After all, "time is money", especially when the actual costs incurred in resolving an average case cannot be credibly determined. In addition, with the help of the super-efficiency concept and the constraints imposed on absolute and virtual weights—both on the side of outputs and inputs—one can obtain apparently sound results regarding the ratings of individual decision-making units, with no anomalies

(0-1 values) concerning the weights attached to the production factors. The entire procedure is outlined in the following sections.

Let us start with a proposal made by Santos & Amado (2014), where the authors established appropriate minority/majority relations between the output weights assigned to various cases by subject of law in line with their average time absorption, as shown in formula (7). Consequently, using their approach leads us to the following set of relations regarding the price weights assigned to the respective cases by subject of law[2]:

INSURANCE / *LABOUR* >= 1;

LABOUR / *CRIME* >= 1;

CRIME / *CIVIL* >= 1;

CIVIL / *FAMILY* >= 1;

CIVIL / *COMMERCE* >= 1

Although novel compared to all previous work in the investigated field, the work of Santos & Amando (2014) does not appear to address the critical issue of the inadmissibility of output weights as proved by the outcomes obtained in this investigation: there are still numerous zero weights assigned to individual outputs (not reported here).

It is only when additional constraints are imposed—this time on the so-called virtual weights, which have a straightforward interpretation as they represent the proportion of total time spent on resolving all types of cases that was absorbed by cases of a given subject of law—that the resulting outcomes regarding output weights begin to make sense. These constraints are explicitly given by the following formula:

$$s_i = \frac{d_i \cdot n_i}{\sum_{j=1}^{6} d_i \cdot n_i} \tag{8}$$

where:

s_i – fraction of the courts' time devoted to resolving the cases of the *i*-th subject of law (i = 1, 2, ..., 6). By definition we have: $\sum_{i=1}^{6} s_i = 1$,

d_i – average processing time of cases for *i-th* subject of law, determined according to formula (7),

n_i – number of cases per *i-th* subject of law.

The empirical - and thus most realistic – ranges of virtual weights for the individual types by subject of law derived with the help of formula (8) are shown in Table 2.

[2] This notation is in line with commands fixed by *pydea* software with "self-speaking" weights names. It is tantamount to imposing the afore-mentioned constraints upon respective w_{tz} in formula (1). The reported minority/majority relationships between specific subjects of law has been derived by means of a comparative analysis carried out with the use of formula (7).

Table 2.
Constraints imposed on virtual weights

Virtual weights (minima)	Virtual weights (maxima)
VFAMILY >= 0.054	*VFAMILY* <= 0.115
VCOM >= 0.036	*VCOM* <= 0.140
VCRIME >= 0.087	*VCRIME* <= 0.28
VLABOUR >= 0.007	*VLABOUR* <= 0.064
VINSURANCE >= 0.006	*VINSURANCE* <= 0.021
VCIVIL >= 0.506	*VCIVIL* <= 0.748

Source: Own computations using processed data (see section *Data*).

Applying a variant of DEA with simultaneous restrictions on both price and virtual weights ultimately results in correct weights for the outputs (outcomes not reported here). However, the issue previously described persists concerning the weights assigned to inputs. This raises the question of whether such a situation is acceptable. Before addressing this question definitively, let us consider two rhetorical subsidiary questions that, while not challenging the essential role of judges in resolving court cases, aim to provide additional perspective:

1. Would judges, tasked with delivering judgments for all pending court cases, be willing to perform their duties without remuneration?
2. Would the institution of courts and judges be necessary at all if no legal cases were brought before them?

The negative answer is therefore self-imposing. The empirical realism of the input weights must therefore also be ensured in this case, as this is a necessary condition for the reliability of the scores, generated by DEA. This leads directly to a heuristic proposal that leverages the aforementioned observation to enable the determination of realistic, empirical price weights among the used inputs, with judges serving as the critical input.

The starting point involves determining the range of empirical variability for the ratios of outlays per judge and caseload per judge. The respective extreme values (based on data described is section *Data*) during the analyzed period (2002-2021) are as follows:

min (*CASELOAD/JUDGES*) = 1.408 max (*CASELOAD/JUDGES*) = 2.911

min (*OUTLAYS/JUDGES*) = 0.363 max (*OUTLAYS/JUDGES*) = 0.817

Thus, based on the assumption of the primary role of judges in the entire process of case disposition, the price weights assigned to the other two inputs should fall within the intervals defined by the previously reported extreme points, with the absolute weights assigned to the input "judges" serving as the reference category. If the weights were too large, it would imply that the relative role of the remaining inputs was greater than that of judges. Conversely, if the weights were too small, it would undervalue the empirical significance of those inputs. Consequently, the constraints imposed on the price weights of all the inputs are as follows:

ACASELOAD / AJUDGES >= 1.408 *ACASELOAD / AJUDGE* <= 2.911

AOUTLAYS / AJUDGES >= 0.363 *AOUTLAYS / AJUDGES* <= 0.817

Table 3.
Efficiency scores and virtual weights obtained in the constrained super-efficiency DEA variant with minority/majority relationships with price and virtual weights imposed on outputs and inputs

DMU	Efficiency scores		Virtual weights estimates in the constrained SE-DEA								
	Constrained SE-DEA	Rescaled	INPUTS			OUTPUTS					
			OUTLAY	*JUDGE*	*CASELOAD*	*LABOUR*	*COMMERCE*	*FAMILY*	*INSURANCE*	*CRIME*	*CIVIL*
D02	0.85719	0.84756	0.06415	0.21621	0.88624	0.06400	0.12231	0.10016	0.02100	0.18653	0.50600
D03	0.90008	0.88997	0.06451	0.19959	0.84692	0.06400	0.07500	0.05400	0.02100	0.28000	0.50600
D04	0.94970	0.93904	0.03045	0.19087	0.83164	0.06400	0.07500	0.05400	0.02100	0.28000	0.50600
D05	0.95654	0.94580	0.03332	0.19364	0.81848	0.06400	0.05943	0.06957	0.02100	0.28000	0.50600
D06	0.94202	0.93144	0.03525	0.19159	0.83472	0.06400	0.05685	0.07215	0.02100	0.28000	0.50600
D07	0.94804	0.93740	0.03444	0.18295	0.83741	0.05151	0.06481	0.08620	0.01148	0.28000	0.50600
D08	0.95752	0.94677	0.03327	0.16714	0.84395	0.03232	0.06827	0.10567	0.00774	0.28000	0.50600
D09	0.99351	0.98236	0.03052	0.15252	0.82350	0.03579	0.03626	0.05400	0.00806	0.28000	0.58589
D10	0.99434	0.98318	0.03022	0.14358	0.83190	0.02990	0.03948	0.05400	0.00769	0.27687	0.59205
D11	0.98538	0.97432	0.02867	0.13910	0.84707	0.02011	0.04922	0.05400	0.00600	0.28000	0.59066
D12	1.01135	1.00000	0.05810	0.12683	0.80384	0.00822	0.05323	0.05400	0.00600	0.19261	0.68595
D13	0.98806	0.97696	0.10028	0.21179	0.70002	0.00991	0.09686	0.09215	0.00600	0.22165	0.57342
D14	1.00837	0.99705	0.10127	0.20758	0.68285	0.03896	0.07114	0.06795	0.02100	0.28000	0.52096
D15	1.00589	0.99460	0.04830	0.21607	0.72977	0.00802	0.12098	0.05400	0.00944	0.17344	0.63411
D16	0.94520	0.93459	0.03871	0.16606	0.85320	0.00700	0.11491	0.10058	0.02100	0.16343	0.59309
D17	0.98458	0.97353	0.10212	0.19895	0.71459	0.00700	0.12833	0.05400	0.00600	0.14395	0.66072
D18	0.95819	0.94743	0.05341	0.22056	0.76967	0.00700	0.08001	0.05400	0.00600	0.14977	0.70322
D19	0.94634	0.93571	0.05178	0.19708	0.80784	0.00700	0.07327	0.05400	0.00600	0.12914	0.73059
D20	0.91228	0.90204	0.06339	0.22066	0.81211	0.00700	0.07621	0.05400	0.00600	0.12873	0.72805
D21	0.91949	0.90917	0.06536	0.22030	0.80190	0.00700	0.06101	0.05400	0.01311	0.14621	0.71866

Source: Own computations using processed data (see section *Data*) and *pydea* software.

Only now, once all the essential constraints have been imposed on the price and virtual weights regarding both outputs and inputs, can one arrive at the final results that are free from the articulated, crucial, and adverse properties which, if ignored, cast serious doubt on the credibility and interpretability of scores obtained using classic DEA. At this stage, no weight—neither on the side of outputs nor inputs—assumes the value of "0" or "1" (see Table 3; for want of space only virtual weights are reported). Moreover, because of the way the constraints were imposed on the weights, the range of estimated weight variability falls implicitly within the historical min-max intervals observed in the analyzed period. All of this leads us to claim that the final outcomes obtained in this empirical research are fully reliable and interpretable, enabling a sound general appraisal of the actual performance of the Polish district court system over a 20-year period.

5. Conclusions and final remarks

A natural question emerging from the DEA presented thus far—an answer to which holds primary practical and political importance—is whether there are actual differences in the efficiency scores obtained through the super-efficiency concept without consideration of the obtained weights, compared to those derived using the same super-efficiency concept while ensuring logical weights. Figure 1 presents the original and normalized scores of the two primary variants of DEA utilized in this investigation: unconstrained output-oriented CRS

super-efficiency DEA and its constrained counterpart. Additionally, simple trend regressions for both variants are depicted.

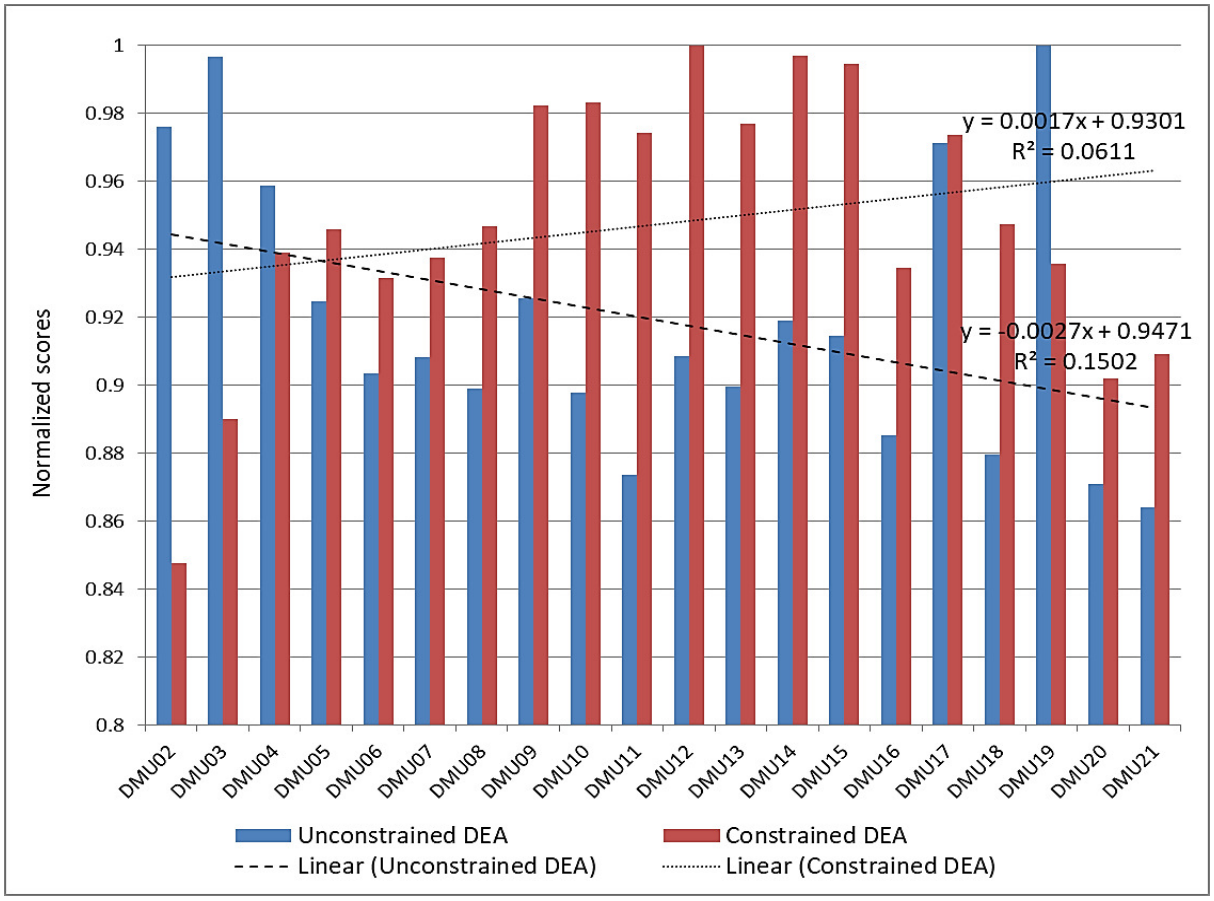


Figure 1. Bar-charts of normalized scores and simple trend regressions for constrained and unconstrained DEA outcomes.

Source: Own elaboration on the basis of research results.

The answer to the central question raised in the previous paragraph must be unequivocally affirmative! It suffices to use a simple "bare eye analysis" to draw this conclusion, which is further supported by formal correlation analysis. Here, both Pearson and Spearman correlation coefficients leave no doubt that the scores generated by the two versions of DEA have no correlation. The Pearson coefficient equals -0.26254390 (with a *t*-statistic of -1.15437 and a *p*-value of 0.2634), whereas the Spearman rank correlation coefficient is -0.04060150 (with a *z*-score of -0.176978 and a *p*-value of 0.8595). Thus, neither a linear nor a non-linear relationship links the obtained scores in any statistically significant manner.

Moreover, the state of affairs that emerges from the scores' estimates is qualitatively different. Many times, what might be regarded as a leading DMU/year in the unconstrained DEA appears to be quite the opposite in the constrained analysis. Even the overall tendencies that could be identified through trend analysis are quite different, showing a declining efficiency of the system in the unconstrained DEA, whereas a slightly increasing efficiency is observed in the constrained DEA. The variance of scores is clearly higher for the unconstrained DEA, which is due to the presence of extreme (and nonsensical) 0-1 weights assigned to numerous

outputs and inputs. Nevertheless, no regularities in the score estimates can be identified in either variant, with peaks and troughs occurring in entirely different years. All in all, forming practical and political recommendations based on one variant or the other would lead to completely different consequences. As mentioned many times before, only the constrained DEA results should be considered reliable and binding.

Let us then take a look at the obtained results solely through the prism of constrained DEA. Erratic as the scores are, one can nevertheless identify at least three performance stages concerning the efficiency of the Polish district courts system. The first sub-period, encompassing the pre-accession (EU) years (2002-2003) and the early years after accession, is characterized by relatively low efficiency. The next sub-period consists of high-efficiency years (i.e., 2009-2015), clustered around the year 2012, for which the highest efficiency was estimated. Finally, starting from 2016 up to the final year under investigation (2021), there is a noticeable decline in the obtained efficiencies.

On one hand, it is evident that the estimated scores exhibit relatively low variability, with mean values of 0.958 and 0.947 for the original and normalized variants, respectively, and variances of 0.0390 and 0.0386. Therefore, one should not have expected spectacular increases in system efficiency across individual DMUs/years, even if their efficiency had reached the levels observed in the most efficient peer years[3]. On the other hand, it is important to recognize that the system's load in a given year is recursively dependent on the load observed in the preceding year (due to the accumulation of unsolved cases). Consequently, if the size of incoming cases were independent of the standing efficiency of the judiciary system, then even slight to moderate increases in efficiency in a given year would lead to increased efficiency in the following year, as a result of a reduced stream of caseload due to the decrease in pending cases from the previous year (see formula (5)), assuming the same involvement of discretionary inputs. If such improvements, even if minor, were maintained over a few consecutive years, the long-term effects could significantly enhance actual access to the courts of justice.

Although it might be methodologically quite risky to extend the analysis this far, one might conclude from the empirical outcomes of this investigation — ceteris paribus, accounting for various meso and micro idiosyncrasies that may characterize individual courthouses — that the macro-level institutional, procedural, organizational, and judicial setup was most conducive to the efficiency of the regional courts system in the years 2012, 2014, and 2015, with 2012 standing out as the indisputable leader.

Identifying the most historically efficient benchmark years is, at best, just a preliminary step toward more qualitatively oriented research, which would aim to answer the question of why the distinguished DMUs/years were more efficient than others. However, such an endeavour would require interdisciplinary expertise and the involvement of various stakeholders.

[3] Peer count analysis points to only three efficient DMU-s/years, being 2012, 2014 and 2015, respectively, of which year 2012 appears as a peer 18 times, year 2014 – 3 times, and year 2015 – 8 times.

This is important because DEA is a descriptive method that estimates relative efficiencies among homogeneous DMUs. While it addresses the actual variation in the effectiveness of individual DMUs within the specified period, it does not provide insight into the underlying reasons for such variation. Adequately estimating the efficiencies of a set of DMUs is one thing; adequately identifying — and possibly quantifying — the causes affecting those efficiencies at various levels is quite another. However, failing in the first step will inevitably lead to misconceptions regarding the second stage.

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THE STATE OF YOUNG WORKERS – MEMBERS OF GENERATION Z FROM POLAND, SLOVAKIA AND FRANCE

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Purpose: The aim of this article is to examine the state of young workers, focusing on three aspects: internet usage, attitude to work and physical well-being.
Design/methodology/approach: Young adults now entering the workforce are members of Generation Z. They are characterised by a high level of competence in searching and processing information on the internet, thanks to their exposure to digital technologies from an early age. The research material consists of data collected among students studying business-related programmes (N = 151) from three countries: Poland, Slovakia, France.
Findings: The results of the study (N = 151) revealed intrinsic differences within the group of young people, which can be associated with the time spent online and the frequency of physical activity. These factors were subsequently reflected in the BMI, an indicator of physical well-being. Our findings indicate that viewing young workers in only one dimension – as 'digital individuals' – is insufficient. There is no doubt that what they have in common is the use of new technologies. As these are universal and global in nature, the country of residence is irrelevant when analysing Generation Z.
Originality/value: Analysis of economics students as young employees in terms of health, professional and time management. The paper is for labor market analysts, public health analysts and academic teachers.
Keywords: Generation Z, internet, work, physical well-being.
Category of the paper: research paper.

1. Introduction

Generation Z in the labour market is very different from the generations that came before. The main characteristic of this young population entering the workforce is a high level of familiarity with new technologies. Practically all of them have access to the internet and the time they spend online is steadily increasing (reaching more than 7 hours per day for the 16-24 age group) (Digital 2024. Global Overview Report). Research focusing on Generation Z as young workers, along with reports reflecting employers' perspectives, highlight various aspects that are directly or indirectly shaped by this unique characteristic. Overstimulation, digital addiction, but also the ease of finding new jobs, a strong drive for new challenges, heightened sensitivity to social and environmental issues, an expectation for instant gratification, and a demand for personalisation and transparency in interactions are some of the challenges facing employers today. However, it remains uncertain whether universal digital technologies reflect and determine the universal characteristics of Generation Z. One way to answer this question is to look at the general state of young people across a number of different dimensions in order to test the assumption of their homogeneity, regardless of the country in which they live. The aim of this article is to examine the state of young workers – members of Generation Z – from three European countries: Poland, Slovakia and France, focusing on three aspects: internet usage, attitude to work and physical well-being.

2. Generation Z in the labour market

The youngest participants in the labour market have a number of characteristics that clearly distinguish them from older generations (Table 1). Generation Z is recognised as a distinct cohort, particularly because of their relationship with new technology. As a result, they have been referred to as the digital generation, the network generation, the next generation or Generation C (connected), the Facebook generation or the global generation. This group consists of students and relative newcomers to the labour market, soon to become the leading workforce (Mladkova, 2017).

Table 1.
Comparison of Generations X, Y and Z

Generation X	Generation Y	Generation Z
Intelligent Educated Not afraid of change Courageous Able to work with new technology Eager to learn Have no problem changing jobs if there are additional benefits involved Constructive criticism is important to them Not very outgoing in interpersonal relationships	The most educated Eager to grow/develop Work-life balance is very important Proficient in modern technologies Work is supposed to be fun Have no problem with frequent job changes Expect help, support from their manager Have no problem with globalisation Do not like to be left out Have their own opinions Tend to use social media for communication	Work-life balance Individualists Reliant on technology Looking for stability Ambitious Competitive Sceptical Distrustful Expect clear objectives Prefer direct communication

Source: Ragin-Skorecka, Falfer, 2024, p. 292.

The age boundaries defining Generation Z are not clearly defined (Levickaitė, 2010; Żarczyńska-Dobiesz, Chomątowska, 2014; Goh, Lee, 2018). For the purposes of this article, Generation Z is defined as people born between the mid-1990s and 2010. When describing Generation Z, their immersion in new technologies and constant online presence are highlighted as key characteristics (Kall, 2015). Their social reality is mainly shaped by social media and platforms that act as new educators (Messyasz, 2021). No previous generation has lived in an era where technology has changed at such a rapid pace and been so readily available to young people (Turner, 2015). At the same time, this very characteristic often remains dominant in the description of Generation Z. However, it must be acknowledged that it can be seen as both a cause and an effect of young people's behaviours, consequently affecting their condition. Ultimately, they may not be such a homogeneous group and therefore may have different attitudes and expectations towards future employers.

From the employer's perspective, it is emphasised that the young workforce is increasingly exhibiting behaviours that were once considered marginal. These include mobility, frequent *job-hopping*, disengagement (*quiet quitting*), the *lazy girl job* mentality, and a preference for hybrid work. Generation Z places a high value on achieving a balance and harmonious integration of work and personal life, regardless of their country of residence. More important than the amount of money they earn are their well-being, personal growth and career prospects. Understanding their complex nature appears to be the key to building effective teams able to achieve business goals. Hence, the article attempts to diagnose the condition of young workers from three different perspectives:

1. as internet users, where more important than the question of access itself, which is a given, is how they engage with the global web, including social media and platforms, and the time they spend online, as more of their activities take place in the digital space,
2. as the future workforce, including jobs already held and career plans,
3. and as individuals with a specific level of physical well-being.

3. Material and methods

The research material consists of data collected among students studying business-related programmes (N = 151) from three countries: Poland n = 63 (24 male and 39 female), Slovakia n = 54 (15 male and 39 female) and France n = 34 (22 male and 12 female). Convenience sampling was used. Data collection consisted of respondents completing a questionnaire and non-invasive anthropometric measurements taken by the authors. The questionnaire was developed in 3 language versions: Polish, English and French. All respondents gave verbal consent to participate in the study. The research form (questionnaire and anthropometry) was anonymous.

Data analysis was conducted using descriptive statistics and Ward's agglomerative clustering method, based on Euclidean distance. Assuming the hypothesis that the Generation Z respondents form a homogeneous group, it was expected that a single cluster (group) would emerge. The calculations were performed using Statistica 13.3 data analysis software.

The variables representing each metric, together with the scales used, are presented in Table 2.

Table 2.
Metrics, variables and their scales

Metric	Variable	Scale
Internet usage	Hours spent online per day	0 1-3 4-6 7 and more
	Purpose of social media use	To be in touch For fun For education For travel Other (what)
	Purpose of website use	To find content To share content To create content
Attitude to work	Self-assessment of financial situation	Very bad Bad Average Good Very good
	Paid work	Yes No
	Erasmus participation	Yes No
	Career plans for next 5 years	Yes, I have No, I don't have I don't know what I want to do

Cont. table 2.

Physical well-being	Self-assessment of health status	Very bad Bad Average Good Very good
	Physical activity times [in h]/week	None 1 time 2-3 times 4 and more
	BMI body weight [in kg]/height^2 [in m]	underweight (< 18.49) normal weight (18.50-24.99) overweight ≥ 25.00

Source: own data and Physical status: the Use and Interpretation of Anthropometry. Report of a WHO expert committee. WHO Tech Rep Ser 854. Geneva 1995, p.452.

4. Results

In terms of geographic distribution, the largest proportion of respondents came from Poland (41%), followed by Slovakia (36%) and France (23%). The majority were female (63%). The mean calendar age of respondents was 20.95 years (max = 25.23; min = 17.24; Me = 20.71).

Most respondents rated their health as either good (48%) or very good (25%) and reported they exercised 2-3 times a week (45%). Almost half of those surveyed (48%) spend between four and six hours a day online. The objective assessment of respondents' health status is generally consistent with their subjective assessment – 60% of respondents had a normal BMI score.

Based on the dendrogram obtained, it can be concluded that, with the diagnostic variables used, three groups of greater homogeneity can be identified among the respondents: Group 1 with 39 respondents, Group 2 with 78 respondents and Group 3 with 34 respondents (Figure 1).

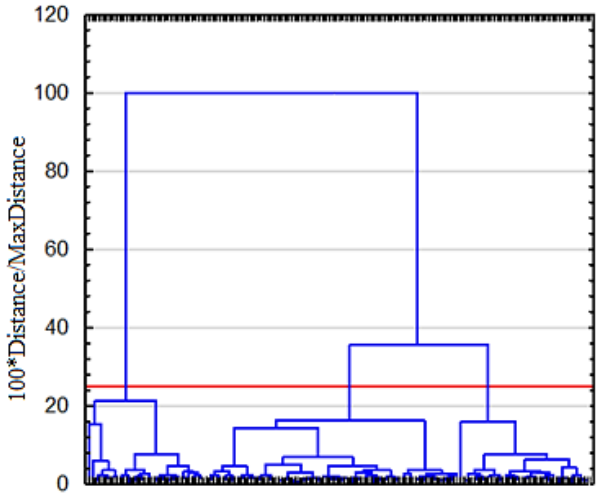


Figure 1. Division of respondents into three groups.

Source: own data.

In terms of country of origin, more than half of the students in Group 1 came from Slovakia, with Poland being the least represented nationality (Table 3). In turn, in Groups 2 and 3, students from Poland were the most numerous and about a third were from Slovakia. Respondents from France were least represented in Group 3.

Table 3.
Proportions of students from France, Slovakia and Poland in the three groups identified

Group	Country		
	France	**Slovakia**	**Poland**
1	11 (28.2%)	20 (51.3%)	8 (20.5%)
2	18 (23.1%)	24 (30.7%)	36 (46.2%)
3	5 (14.7%)	10 (29.4%)	19 (55.9%)

Source: own data.

In terms of gender, Group 1 had the highest proportion of females (Table 4). Group 2 was slightly more balanced (with just under 60% female) and Group 3 exhibited gender parity.

Table 4.
Respondents by group and gender

Group	Gender	
	Female	Male
1	32 (82.1%)	7 (11.9%)
2	46 (59.0%)	32 (41.0%)
3	17 (50.0%)	17 (50.0%)

Source: own data.

In terms of age, there were no statistically significant differences between the three groups (Kruskal-Wallis test: H = 1.724432; p = 0.4222, Table 5).

Table 5.
Respondents by age and gender

Calendar age						
Group	**N included**	**Mean**	**Me**	**Min**	**Max**	**SD**
1	39	20.79	20.70	18.40	23.66	1.50
2	78	20.89	20.66	17.24	25.23	1.79
3	34	21.30	21.31	18.46	25.23	1.66

Source: own data.

Respondents' self-assessment of their financial situation was also relatively consistent across the groups (Figure 2). More than half of the respondents in each group described their financial situation as at least good, with nearly all others rating it as average.

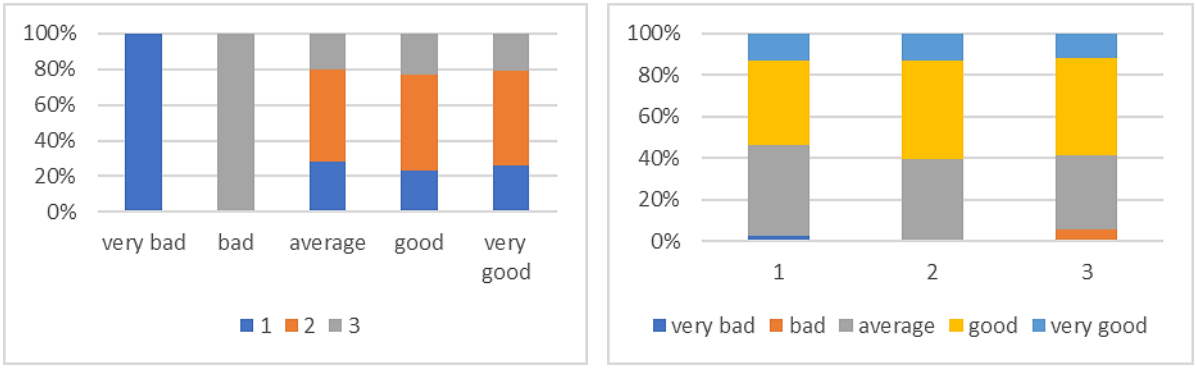


Figure 2. Proportions of respondents by self-assessment of financial situation and by groups.

Source: own data.

Across all groups, almost the same proportion of respondents (around 60%) reported having paid work during their studies (Figure 3).

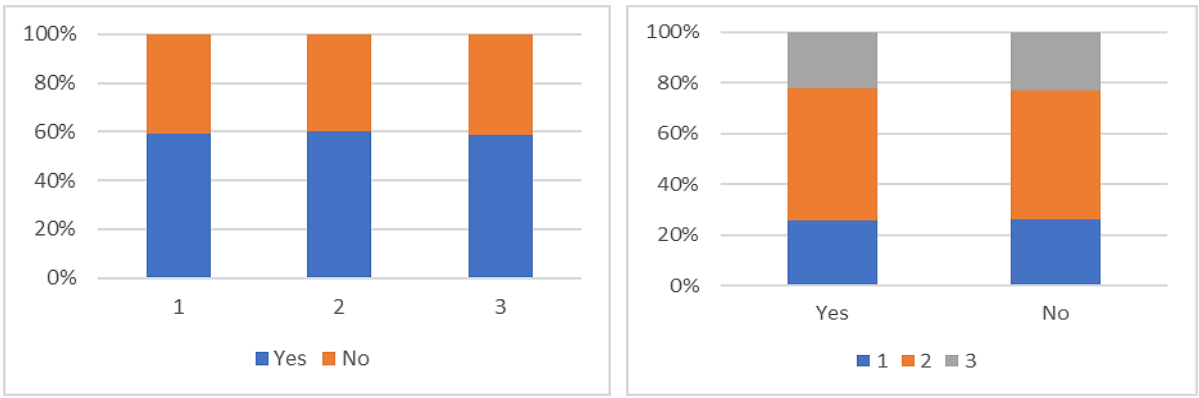


Figure 3. Proportions of respondents by paid work and by groups.

Source: own data.

Consistent results were also observed in response to the question about career plans for the next 5 years. In each of the identified groups, nearly three out of five respondents answered in the affirmative. The remainder were more likely to say that they did not know what they wanted to do than admit that they had no career plans (Figure 4).

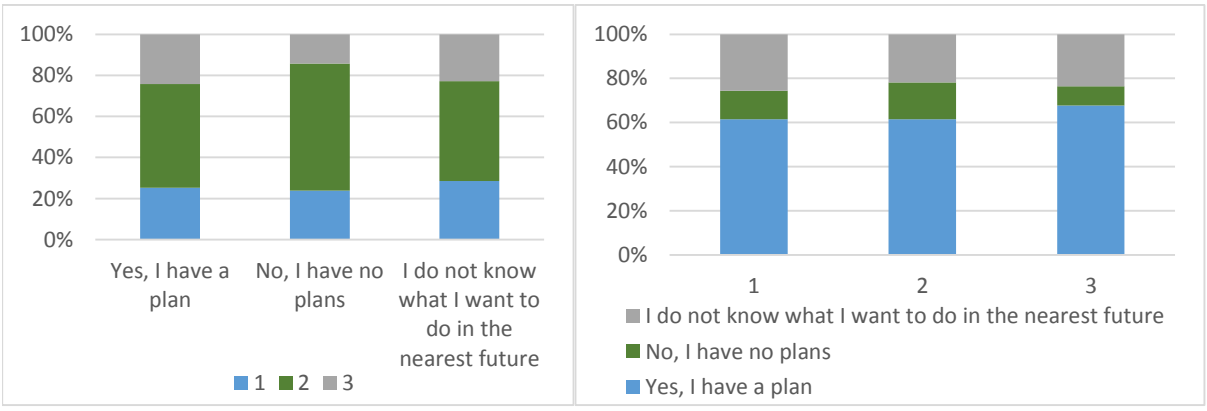


Figure 4. Proportions of respondents by career plans and by groups.

Source: own data.

Finally, statistically significant differences in BMI were found between respondents in each group (Table 6). This is demonstrated by both the Kruskal-Wallis test: H = 121.1441; p < 0.0005, performed on all three groups together, as well as the Mann-Whitney U test, which compared the groups in pairs (Group 1 – Group 2: Z = 8.5138; p < 5.0E-7; Group 1 – Group 3: Z = 7.3264; p < 5.0E-7; Group 2 – Group 3: Z = 8.2802; p < 5.0E).

There is a marked increase in BMI – from an average level (around 19) in Group 1 to over 30 in Group 3 (Figure 5). The BMI levels in Group 2 still fall within the normal range. The prevalence of overweight in young adults is a health concern, as a sedentary lifestyle – largely driven by the time spent online – contributes to weight gain.

Table 5.
BMI by group

Group	BMI					
	N included	Mean	Me	Min	Max	SD
1	39	18.92	19.51	16.59	21.27	3.33
2	78	23.32	23.37	19.66	26.46	1.68
3	34	31.02	29.60	25.41	55.96	5.59

Source: own data.

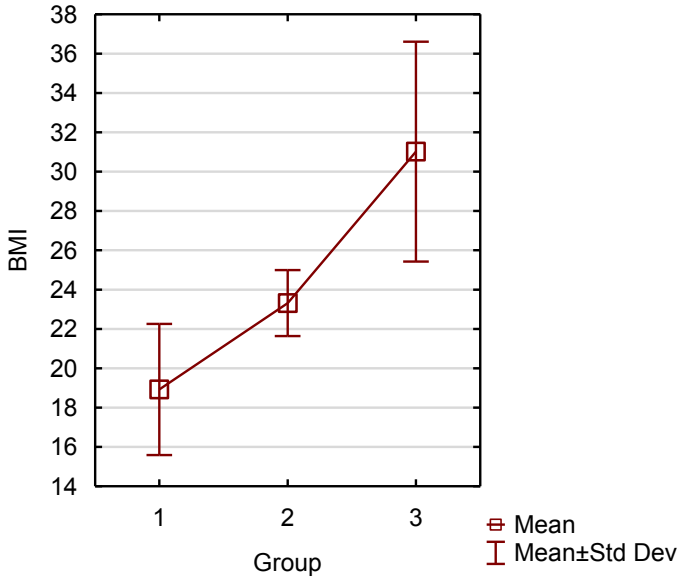


Figure 5. Distribution of BMI by group.

Source: own data.

Despite the statistically significant differences in BMI between the groups, these differences are not reflected in the respondents' self-reported health status. In each group, no more than one or two people described their health as poor or very poor, while three or four out of five described their health as at least good (Figure 6).

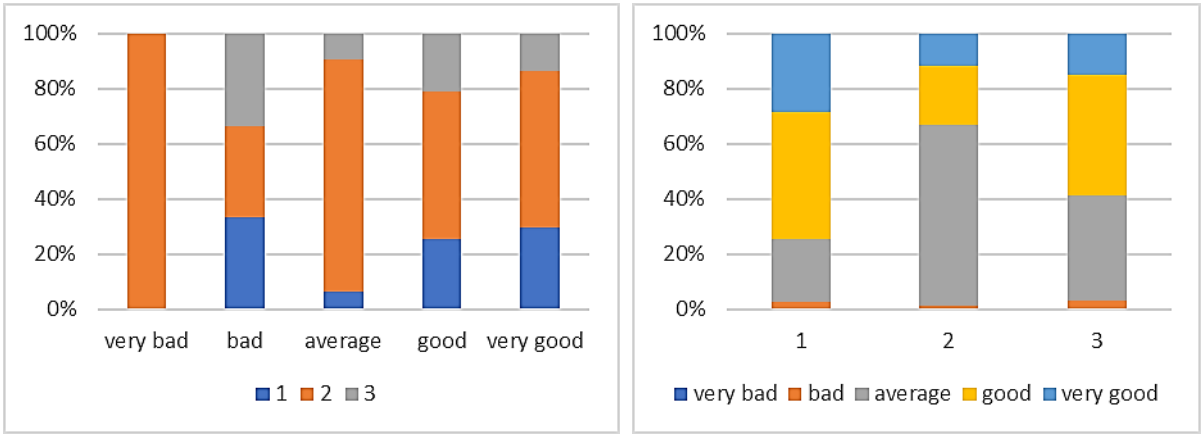


Figure 6. Proportions of respondents by self-assessment of health and by groups.
Source: own data.

The vast majority of respondents had not participated in the Erasmus international student exchange programme (Table 7). Participation in such programmes reflects a willingness to gain new experiences and an openness to challenges, qualities that are highly valued in future employees.

Table 7.
Participation in the Erasmus programme by group

Group	Erasmus participation	
	Yes	No
1	5 (12.8%)	34 (87.2%)
2	8 (10.3%)	70 (89.7%)
3	2 (5.9%)	32 (94.1%)

Source: own data.

The rise in BMI across the groups is clearly correlated with a rise in the proportion of respondents spending 7 or more hours per day online. While the increase in the percentage of such individuals in Group 2 compared to Group 1 is not yet statistically significant ($p = 0.0726$), the increase between Group 1 and Group 3 can be considered significant ($p = 0.0034$) (Table 8 and Figure 7).

Table 8.
Time spent online by group

Group	Number of hours online/day		
	1-3	4-6	7 and more
1	17 (43.6%)	21 (53.8%)	1 (2.6%)
2	35 (44.9%)	35 (44.9%)	8 (10.2%)
3	9 (26.5%)	17 (50%)	8 (23.5%)

Source: own data.

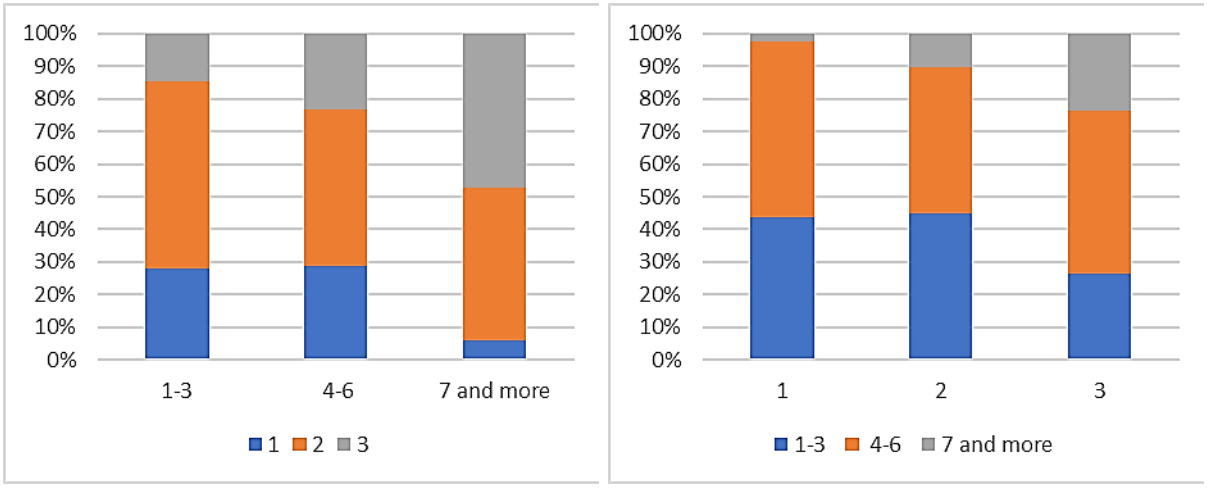


Figure 7. Proportions of respondents by time spent online and by groups.

Source: own data.

On the other hand, there are no significant differences between the groups in terms of how they use social media and websites (Figure 8).

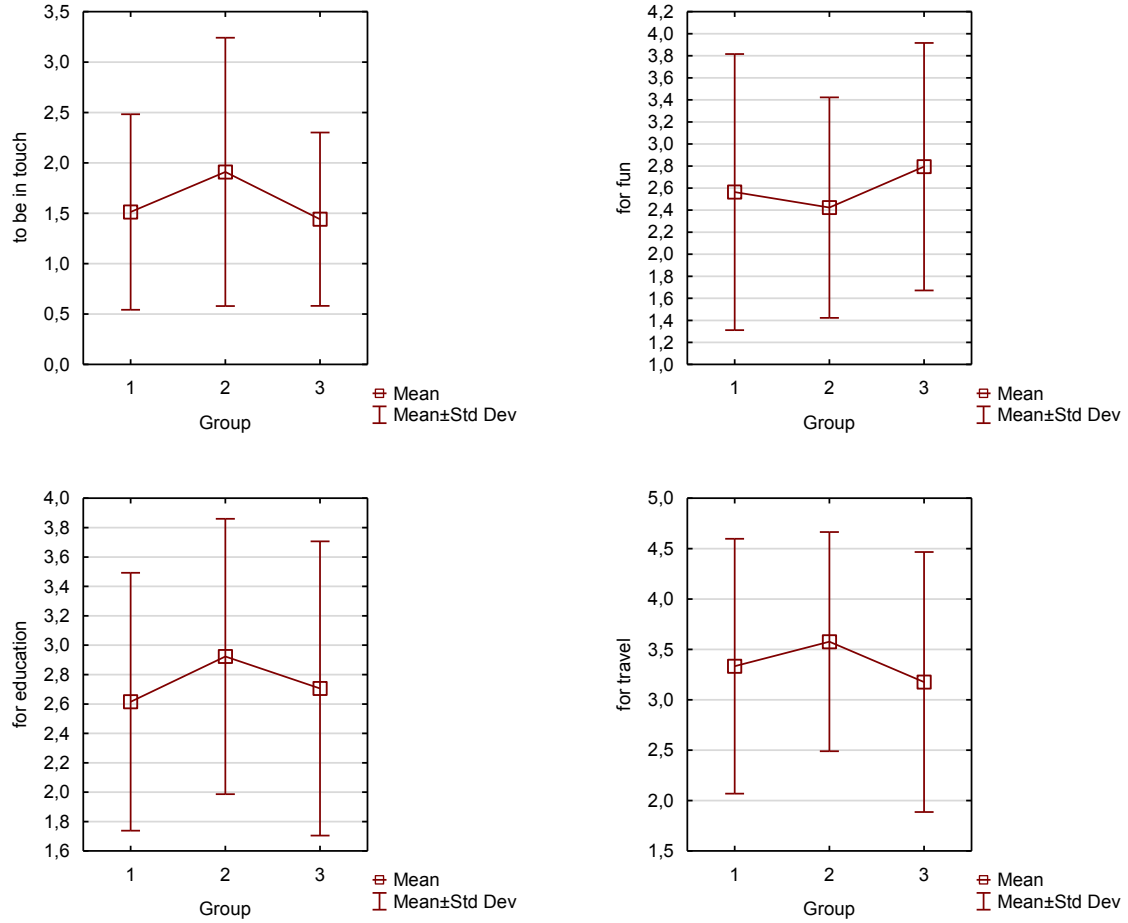


Figure 8. Distributions of purposes of social media use by group.

Source: own data.

Usage of internet websites is also nearly the same across all groups (Table 9). It is primarily used as a source of information, with respondents being least engaged in creating online content.

Table 9.
Purposes of website use by group

Group	Purpose		
	To find content	To share content	To create content
1	33 (84.6%)	4 (10.3%)	2 (5.1%)
2	68 (87.2%)	8 (10.3%)	2 (2.5%)
3	30 (88.2%)	3 (8.9%)	1 (2.9%)

Source: own data.

The majority of respondents reported that they engage in physical activity at least once a week. On the other hand, Group 3 has a significantly higher proportion of respondents who do not participate in sports at all compared to Group 1 ($p = 0.0299$) (Figure 9).

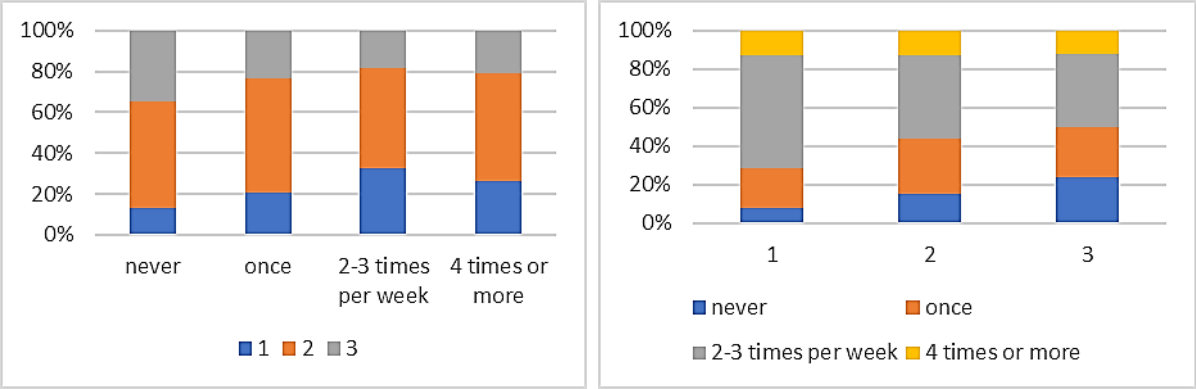


Figure 9. Proportions of respondents by frequency of exercise and by group.
Source: own data.

5. Discussion & Conclusions

Generation Z, like every generation that has gone before it, is inherently different from its predecessors in terms of world view, professional skills and interpersonal relationships. What sets them apart, however, is that they have been immersed in an online environment since birth. This defining characteristic often leads to an oversimplified analysis of Generation Z from a single perspective. This article seeks to challenge that approach by exploring other traits across three different aspects: internet usage, attitude to work and physical well-being.

Our findings indicate that viewing young workers in only one dimension – as 'digital individuals' – is insufficient. There is no doubt that what they have in common is the use of new technologies. As these are universal and global in nature, the country of residence is irrelevant when analysing Generation Z. This was confirmed in our study. There was not a single respondent who did not use the World Wide Web. Furthermore, the purposes for which

social media – popular among this group – and websites are used were similar across respondents. However, we observed differences in the number of hours spent online each day, again regardless of country. Respondents also differed in the frequency of physical activity, which is correlated with time spent online. As a result, this had an impact on their physical well-being, as reflected in their BMI. The more time spent online, the higher the BMI, suggesting an unfavourable (overweight) physique. On the other hand, our research has found that respondents share a number of similar characteristics in terms of variables describing attitudes to work. It therefore appears to be universally true that young people at work are concerned with three factors: satisfactory pay, opportunities for development and concern for their well-being (Money.pl).

These differences made it possible to distinguish three groups. In the first group, 'disengaged', virtually no one spent 7 hours or more a day online, and more than half of its members were physically active 2-3 times a week. They had the lowest BMI (both individual and average). The second group, 'balanced', was characterised by a normal BMI, its members usually spent up to 6 hours a day online and were physically active. Their average BMI was in the normal range. The third group, 'immersed', had the highest proportion of people who were physically inactive compared to the previous groups, and the lowest proportion of people who used the internet for less than 3 hours a day. The average BMI suggests that people in this group were overweight.

This analysis focuses on a specific fraction of Generation Z, namely business students. The different birth year ranges used to identify Generation Z also make it difficult to compare research findings.

A study by Pawar (2013) provides for six forms of employee well-being, namely; physical well-being, emotional/subjective well-being, psychological well-being, social well-being, ethical well-being and spiritual well-being. His results suggest that organisational behaviour and all forms of well-being included in the analysis are broadly linked to employee performance (Pawar, 2013).

Physical well-being is an essential aspect of a worker’s overall condition. Feeling fulfilled at work is the result of having the right skills, a positive working atmosphere, opportunities for self-fulfilment and personal satisfaction, along with other factors that may be subjective. Physical activity is crucial for maintaining physical well-being, whatever the age of the worker. Awareness of the importance and need for regular exercise can vary from person to person, but the opportunities provided by employers to promote physical activity play a crucial role in advancing preventive health. Sports participation reduces sickness absenteeism and employee turnover, boosting productivity and job satisfaction, as well as enhancing the company’s image and cost efficiency (Malińska, 2017). Therefore, health promotion programmes in the broadest sense are beneficial to both employers and employees. A study by Hamar et al. (2015) found that increased employer support for well-being was linked to improvements in both well-being and productivity. Over a two-year follow-up period, well-being and productivity increased,

while presenteeism (ineffective presence at work) and health risks decreased significantly (Hamar et al., 2015). Interesting findings were reported by the research team led by Fannin et al. (2024), showing that employees' emotional and psychological well-being are inversely correlated with self-reported sickness absences. Based on this, it can be concluded that employer initiatives aimed at improving overall workplace well-being should help reduce employee sick leave levels.

The concept of work-life balance, which originated in the USA in the late 1970s and early 1980s, is and should continue to be revised. Today, it is no longer just a question of balancing work with family and social commitments. The issue of overstimulation has emerged, as escaping the impact of computerisation and digitalisation seems impossible. For Generation Z, immersion in new technologies is already a reality, influencing both work activities and leisure time. Consequently, emphasis should be placed on the importance of leisure, with clear boundaries drawn between work focused on earning a living and other activities, particularly physical exercise and intellectual or cultural pursuits. A new role is emerging for employers in encouraging and supporting employees in areas such as sports, culture, health, and even hobbies. With mutual awareness and cooperation between employers and employees, it is possible to achieve and sustain comprehensive employee well-being. This is especially important for members of Generation Z who are already in the labour market. On the one hand, their familiarity and competence with digital and technological solutions make them valuable and indispensable. On the other hand, their hypersensitivity, impatience and difficulties in interpersonal relationships are evident. In light of the above and the findings of this study, there is a need to broaden and deepen the analysis of issues related to the overall well-being of workers from the perspective of employers and the labour market.

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THE IMPACT OF THE COVID-19 PANDEMIC ON THE FINANCIAL RISK OF HOSPITAL OPERATIONS IN POLAND

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* Correspondence author

Purpose: The main objective of the research was to find an answer to the research question: What impact on the financial risk of hospital operations in Poland was the COVID-19 pandemic?
Design/methodology/approach: The following research methods were used to achieve the research objective: critical analysis of the subject literature, financial data analysis, ratio analysis, statistical inference using selected statistical tests with the use of the IBM SPSS Statistics.
Findings: At the stage of analysis of the literature, it was shown that the pandemic theoretically had an impact on the financial situation of hospitals, as confirmed by other studies, therefore, the impact of the pandemic should also be visible in the area of financial risk of hospital operations. However, the literature review carried out did not confirm the existence of research in this area. In connection with the existing cognitive gap, we conducted empirical studies that did not confirm the adopted detailed hypotheses. It should be considered that the COVID-19 pandemic did not have a statistically significant impact on the financial risk of hospitals in Poland.
Research limitations/implications: It should be emphasized that three financial risk measures were adopted, the number of financial risk measures should be expanded in future studies. Authors also propose to extend the research to include the use of measures that take into account the sources of risk. Authors encountered limitations of the conducted research, although the research sample was statistically adequate, but it could be more numerous, however, for many hospital units full financial data was missing and had to be rejected from the analyzed sample.
Originality/value: The paper fills a research gap by empirically assessing the impact of the COVID-19 pandemic on hospital financial risk in Poland. It offers novel insights based on volatility measures and is addressed to healthcare managers, policymakers, and researchers in health economics.
Keywords: hospitals in Poland, financial situation of hospitals, financial risk of hospital operations, impact of the pandemic on hospital operations in Poland.
Category of the paper: Research paper.

1. Introduction

Hospitals, like other organizations, operate in a turbulent, unstable economic, economic and political environment where changes are sudden and unpredictable. The contemporary environment is characterized by researchers as fragile, restless, nonlinear and incomprehensible, in which there are phenomena of the "black swan" type, which included the COVID pandemic, which in Poland began officially with the announcement of the state of the epidemic by the Minister of Health in March 2020 and lasted until May 2022. Naruć (2023, p. 181) it points out that throughout Europe, the pandemic has not only had a negative impact on the economies of individual countries, but also on the financial situation of economic operators and thus on the lives of hundreds of millions of people around the world. The pandemic also had a significant impact on limiting access to healthcare and, consequently, on the financial and financial situation of hospitals. The aim of the article is to assess the impact of the COVID-19 pandemic on the financial risk of hospital operations in Poland, together with to present the results of research on this issue. The research covered the years 2018-2021, and financial data were obtained from the EMIS Platform. The test sample consisted of 362 entities classified as a hospital, according to PKD code 86.10.Z. The theoretical and empirical considerations allowed to verify the main research question: What impact on the financial risk of hospital operations in Poland was the Covid-19 pandemic?, by verifying the main research hypothesis: "The COVID-19 pandemic had an impact on the financial risk of hospital operations in Poland".

2. Hospital as an organization

Analyzing the literature items in the field of management sciences in the context of the definition of an organization, it can be noted that they are characterized by diversity, which results from the way the topic is treated. Bielski (1992, p.73) draws attention to two main approaches, which systematize the definition of an organization, occurring in the literature of the subject. The author distinguishes the pre-system and system categories, to which the concept of organization can be included. In the pre-system approach, the term organization occurs most often in three basic objective, attribute and functional meanings (Koźmiński, Piotrowski, 2000, p. 29; Zieleniewski, 1981, pp. 266-267). The system approach of an organization groups definitions derived from system theory and cybernetics. One of the most well-known, and according to Nyczaj (2001, p. 12) is the definition of R.L. Ackoff, from which it follows that an organization has the ability to change or correct its goals or methods and tools by which it is supposed to achieve its goals. Making a choice of purpose, methods or tools is

an unambiguous expression of will, characteristic of human behavior. This is due to the fact that the organization is man-made and its key element is people. The work station and organizational units listed in the literature as subsystems perform a specific function for which they are responsible. The organization, as well as each of its elements, undertakes activities oriented on purpose, the main goal is called a mission, is clearly defined and defines the meaning of the existence of the organization in its environment. The mere existence of a group of elements pursuing a common goal does not define an organization as a system. An organization is a set of elements between which certain relationships must occur. These relationships define the flow of information and resources needed for the functioning of components, and thus to achieve their goals, which in turn leads to the achievement of the goals of the organization, that is, the realization of its mission. The components of the organization are therefore dependent on each other and also characterized by mutual matching. The interconnectedness and interdependence of the elements of the system suggest the existence of a certain internal ordering of the whole, which manifests itself in the structuring of the organization. This means that the organization is hierarchical. In the organization as a system, there is not only an element of superior nature to the others, it also performs strictly defined managerial and control functions (Bielski, 1992, pp. 73, 82-83; Chudy, Kabat, Pietraszewski, 2006, p. 62; Koźmiński, Piotrowski, 2000, p. 30; Nyczaj, 2001, pp. 12-13).

The implementation of the research objective required the assumption that a hospital, which, in accordance with the Act on Medical Activity, is a[1] medical establishment *in which a medical entity performs medical activities such as hospital services,* is also an organization. In the light of the above considerations, a hospital will be defined as a specific type of system created by humans, in which people are the most important component of it. The hospital as a system consists of elements. These elements combined together carry out the mission, that is, the main purpose of the organization's existence, recorded in accordance with the applicable law. The elements stand out among each other goals, that is, they perform specific functions in the hospital. The hospital system is characterized by internal consistency and alignment of elements, as well as structuring and hierarchization. In a hospital, one of the subsystems must perform a controlling role, that is, manage the remaining elements in such a way as to achieve the desired effect, which is to carry out the mission and contribute to the success of the whole.

[1]Act of 15 April 2011 On medical activity, Journal of Laws of 2011, No. 112, item 654.

3. The hospital environment as an organization in the context of the COVID-19 pandemic

The hospital as an organization operates in an environment. The literature of the subject defines the environment of an organization as a collection of elements not forming part of the system, but at the same time remaining in some relation to it (Bielski, 1992, p. 134). These relationships are called relationships because the organization is an open system. They are bilateral in nature, expressed in the fact that the organization influences the environment and the environment affects the organization. The company draws from the environment specific resources, and at the same time returns to the environment elements created as a result of the processes taking place in it. Sudoł emphasizes that the company serves the environment and needs to learn the environment [...] It is a learning system of the environment (Sudol, 2002, p. 62), thanks to which it can increase its effectiveness.

An organization's environment consists of elements related to each other and the organization. These elements may directly or indirectly affect its activities. In the literature of the subject, the most common division of the whole environment of the organization is the division into the surrounding, closer and further environment, that is, due to the direction of action. The closer environment is called direct or task-oriented, it directly affects every organization and is a specific environment for each, moreover it is institutionalized. The environment, further called indirect or general, is characterized by universalism, that is, it is the same for all organizations. It contains elements that indirectly affect the situation of the company (Bielski, 1992, p. 136; Kautsch, 2010, p. 68; Witczak, 2009, p. 132).

Nowadays, knowledge of the environment is becoming increasingly important for the functioning of any organization, including hospitals, due to its variability over time. Literature studies in this area indicate that organizations currently operate in a hypervariable environment, which is defined by BANI's theory built on the basis of earlier scientific achievements – VUCA theory. The environment referred to as BANI is characterized by fragility, brittle), and restlessness (nonlinear, and is often incomprehensible) for participants of the organization. The functioning of enterprises, including hospitals, in the vicinity of BANI forces to take appropriate actions, within the framework of RAAT. The researchers indicate that this type of environment forces organizations and its participants to build organizational resilience, awareness of changes, ability to quickly adapt to changes and transparency of actions and processes in the organization, in order to reduce the misunderstanding of the external and internal environment (Wick, 2020).

In such an environment, phenomena called black swans appear. black swans). Kisielnicki (2021, p. 23) refers to the work of Table, which defines them as unpredictable events with a very low probability of occurrence, resulting in extremely negative economic and social consequences. It should be noted that the COVID-19 pandemic, which is an event classified as a "black swan" phenomenon, had a significant impact on each of the components of the closer and further environment, and thus on the operations of hospitals in Poland. In this context, considering the characteristics of the environment due to its variability, it should be noted that the occurrence of the pandemic has also exacerbated the negative effects of ambient variability, increasing uncertainty about future events and, as a consequence, may have contributed to increased risks for hospital operations, including financial risks.

4. Financial risk of hospitals and measures

Risk is an ambiguous and complex concept used in many fields of science, not only in social sciences. Hadyniak (Monkiewicz, Gąsiorkiewicz, 2012, p. 34) emphasizes that risk accompanies any action, and results from uncertainty about its results. The author refers to Knight's breakthrough work, who first organized these two concepts – risk and uncertainty, specifying that risk is measurable, that is, it concerns future events whose probability of occurrence is calculable, uncertainty cannot be approximated by statistical methods, it is not subject to mathematical estimates (Kuziak, 2011, p. 16). The literature of the subject characterizes different concepts, approaches and types of risk, and defines the risk management process. In the context of this Article, it is necessary to define the financial risk of hospital operations and to set the measures to determine its level.

Jajuga, Jajuga (1996, p. 99) presents financial risk as part of the internal risk of an organization and defines it as arising from the use of largely foreign capital to finance its operations. Dudycz also expresses this view (2011, p. 197), who notes that in strengthening adverse effects in conditions of weak economic situation there is mainly a risk associated with the acquisition of foreign capital. In subsequent works, Jajuga (2018, p. 26) defines financial risk as risk causing financial effects in an entity that is exposed to them, and this group includes market, credit, operational, liquidity, legal and business risks and events. The author also points out that some of the listed risks are specific to a given type of activity and do not occur in the case of other entities. In this paper, we will consider the financial risk of the hospital as defined by Jajuga, Jajuga (1996, p. 99), taking into account the liquidity risk (as the possibility of the entity not paying current liabilities on time) and the solvency risk of the entity (the value of the entity's assets is not higher than the value of liabilities) (Jajuga, 2018, pp. 37-38).

Since there are many types of risk in an organization's operations, there are also many risk measures that can be distinguished by the nature of the random variable, the dimension of the risk analyzed, as well as the analysis of the effects and sources of risk (Kuziak, 2011, p. 98). For the purposes of answering the research question, we take the measure taking into account the effects of risk, i.e. the coefficient of variation, as the most appropriate tool for measuring financial risk. Jajuga points out that the idea of measuring risk using volatility measures comes from Makowitz's portfolio theory. According to it, the greater the volatility of the rate of return (or other variable risk), the greater the risk (2018, p. 62). Dudycz, on the other hand, emphasizes that the coefficient of variation, unlike the standard deviation, has the value of comparability, because regardless of the size of the expected value, it shows what part of this value is the standard deviation (Dudycz, 2011, p. 186).

After conducting the literature research, including *ex post studies*, we will focus on the effects of the pandemic by measuring financial risk using the volatility index, examining the volatility of leverage, liquidity volatility and volatility of the general debt ratio of hospitals.

5. The COVID-19 pandemic and the operation of hospitals

According to the World Health Organization (WHO) (WHO Coronavirus (COVID-19) Dashboard…), the coronavirus has been reported in 223 countries, areas and territories of the world, and the total number of confirmed cases of coronavirus infection in Europe at the end of 2022 exceeded 269 million people, of which more than 2.2 million people died. The development of the coronavirus pandemic resulted in far-reaching socio-economic disruptions, including the economic crisis (Flag-Geruszyńska, 2020, p. 389; Demirbaş, Bozkurt, Yorğun, 2020, p. 153; Kowalski, 2020, p. 254). The scale of the pandemic, the observed failure of health systems related to the number of cases, the desire to reduce the number of victims and the escalation of the pandemic forced most countries to introduce a number of restrictions, restrictions, prohibitions and orders (Tachmatzidis, 2020, p .ix), which negatively affected the socio-economic situation without leaving out any country. Governments have begun to implement a variety of compensatory measures, intervening in the markets to maintain the existence of businesses and jobs. A number of support programs have appeared in various areas of the state's functioning, from the economy, through culture, sport, as well as health protection (SPOZ; Kotliński, Mizak, Żukowska, 2020, p. 619). To sum up, from the point of view of the subject of this article dealing with the impact of the pandemic on the financial risk of hospitals, it is important to take into account the characteristics of the government's actions in support of the health care system in Poland, as they were a factor determining the financial situation of hospitals.

When considering the impact of the pandemic on hospital finances, it should be pointed out that the increased number of hospitalized infected with coronavirus is a burden, but on the other hand, a number of planned treatments were canceled, which relieved the system. Working in life-threatening conditions forced the introduction of financial incentives for medical staff, which increased the cost of employment, even despite the lack of employment growth. On the other hand, the state budget reacted and allocated higher expenditures on the health care system, at the expense of increasing the deficit. In Poland, the consequence of this state of affairs was the amendment in 2021 of the "Act on health care services financed from public funds", which included, among other things, a plan to increase expenditures on health care, which, ultimately, in 2027, are to reach 7%. It should be noted that in the years before the pandemic this level oscillated around 5% of GDP.

Analyzing the statistical data covering health care expenditures included in the National Health Account in the years 2013-2023 we can see a clear, steady annual increase, with the highest increases both in nominal and percentage terms compared to the previous year, taking place in the years 2021 and 2022, as presented in Figure 1. that when analyzing public expenditure, neither private nor direct household expenditure was taken into account, considering that it had no significant impact on the financial situation of hospitals.

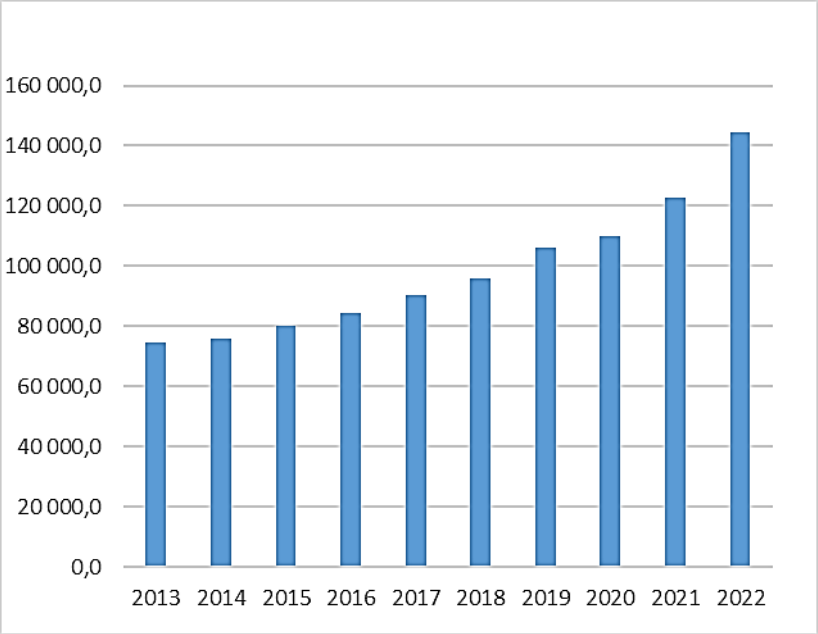


Figure 1. Public expenditure on health care in Poland in the years 2013-2022 [in PLN m].

Source: Own study based on data from CSO.

When assessing the increase in health care expenditures, we conclude that during the pandemic it was noticeable, but when analyzing the level of spending as a percentage of GDP, in relative terms, the increases were not so pronounced.

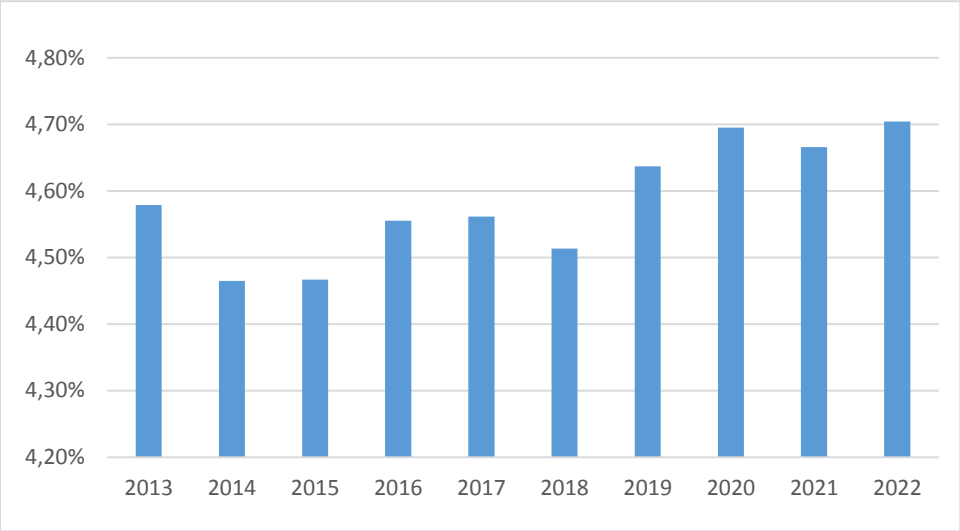


Figure 2. Public expenditure on health care in Poland in 2013-2022 as % of GDP.

Source: Own study based on data from CSO.

Between 2013 and 2022, health care expenditure represents between less than 4.4% and 4.7% of GDP, an increase of almost 0.2% of GDP is visible between 2018 and 2020, but it can be clearly stated, that the percentage of expenditure in relation to GDP was stable and during the pandemic we are noticing a slight increase. The effect of the pandemic and the adopted amendments to the financing Act should be visible only in the following years, according to estimates in 2023 public expenditure in relation to GDP accounted for about 5.8% and here there is a clear increase, while this period is not the subject of research and the data are estimates.

The nominal increase in public health spending has been significant and the percentage increases in this spending year-on-year during the pandemic are clear. A deeper analysis shows in this respect a clear correlation with the GDP growth of the country in nominal terms.

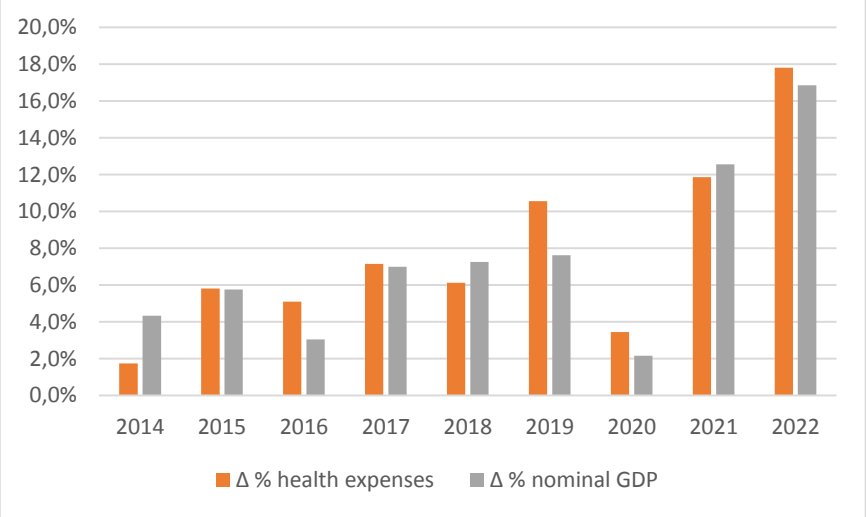


Figure 3. Percentage change in nominal public expenditure on health care with a percentage change in nominal GDP level in Poland in the years 2013-2022.

Source: Own study based on data from CSO.

In conclusion, a significant increase in spending in percentage terms occurred in 2021 and 2022. It should be noted that the increase in spending in percentage terms between 2019 and 2022, with the exception of 2021, was higher than the increase in nominal GDP. We also noted that nominal growth in public health spending was largely the result of a significant increase in GDP, with a relatively slight increase in the percentage of health spending relative to GDP. Referring the obtained results to the research results presented in the literature (Bukowski, 2020, pp. 29-31), we note that the real results do not coincide with the models of expenditure prediction where the linear regression based on GDP showed a negative slope.

Due to the need to provide a broad view on the examined issues, the importance of cost factors, which resulted from the number of hospitalizations caused by complications resulting from SARS-CoV-2 coronavirus infection, at the same time reducing the number of planned treatments, as well as increasing the salaries of medical staff.

By the end of 2022, when we consider the number of infections during the pandemic, we note that significant waves of infections occurred in 2020, 2021 and 2022.

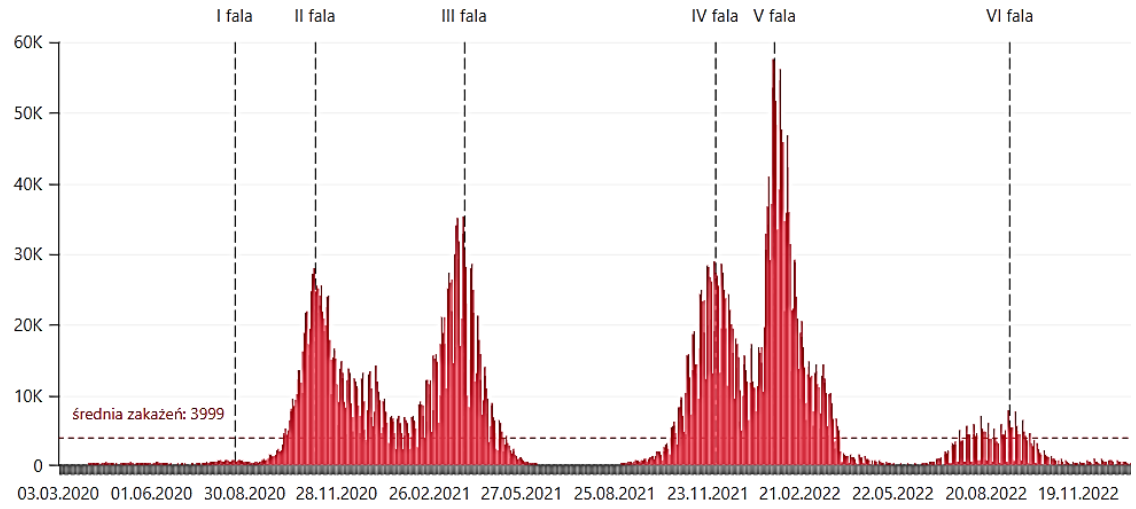


Figure 4. Daily number of confirmed SARS-CoV-2 infections in Poland.

Source: https://koronawirusunas.pl/, 25.01.2025.

Important from the perspective of cost factors analysis is information about how much the pandemic increased the number of health services, as presented in subsequent charts.

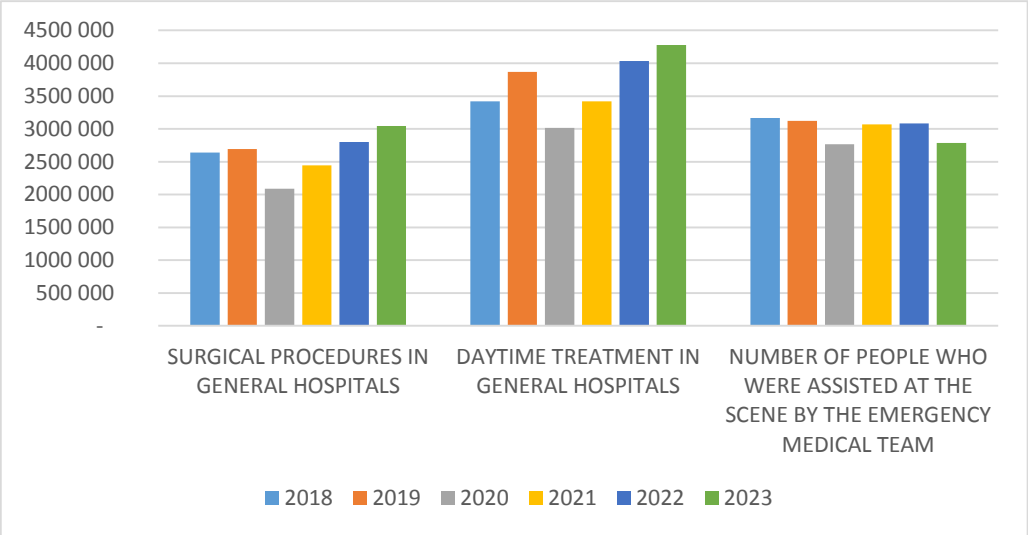


Figure 5. Selected statistics of health benefits [in units/persons].

Source: Own study based on data from the Central Statistical Office, 25.01.2025.

The presented statistics clearly show that the number of benefits in 2019 and 2020 was lower than in years before the pandemic. Only in 2022 did the number of benefits increase compared to 2019. However, the services provided by the emergency medical services show a downward trend. In general, it can be concluded that during the pandemic the number of services decreased, with increasing public expenditure on health care. The considerations are complemented by data on person-days in hospitals, which with the pandemic decreased and by 2023 did not return to the level of 2019.

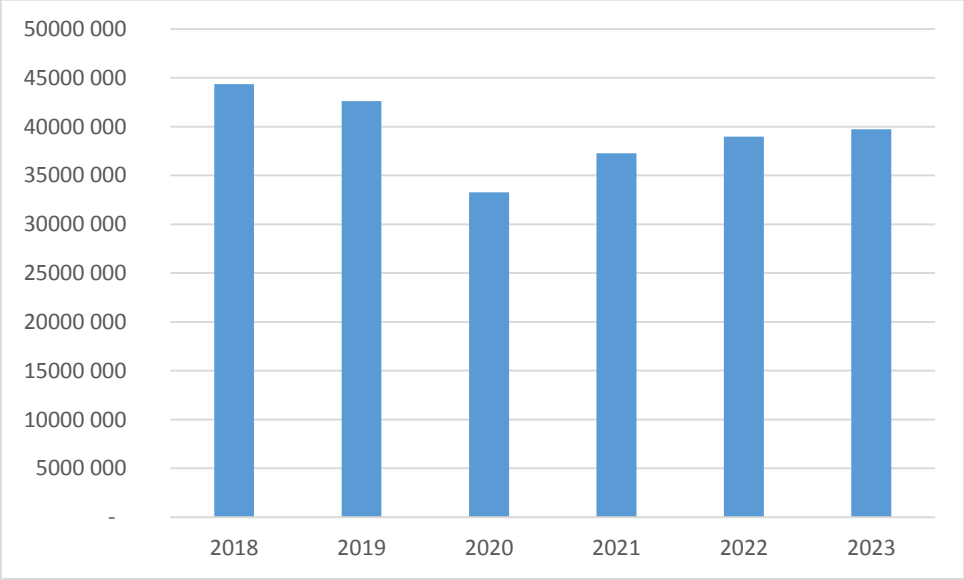


Figure 6. Number of person-days in hospitals.

Source: Own study based on GUS.

Based on the analyzes conducted, there are grounds to assume that the increase in public expenditure on health care should have a positive impact on the financial situation of hospitals, especially as the real level of expenditure, taking into account inflation, also increased.

According to the data presented, the situation of hospitals during the pandemic improved, which can be explained by the increase in nominal expenditures for health care, together with a slight increase in the percentage of public spending in GDP, with a reduced number of health services, especially visible in the number of person-days in hospitals. In the context of the research question under consideration, one can assume the research hypothesis that the COVID-19 pandemic had an impact on the financial risk of hospital operations in Poland.

6. Research results and conclusions

In the introduction, the research problem was outlined, which was reduced to the main research question: What impact on the financial risk of hospital operations in Poland had the Covid-19 pandemic? Conclusions from the literature allowed to outline the main research hypothesis H1: The COVID-19 pandemic had an impact on the financial risk of hospitals in Poland. In order to verify the main research hypothesis, we constructed specific hypotheses: HS1: The COVID pandemic had an impact on the level of financial risk measured by the volatility of financial leverage, HS2: The COVID pandemic had an impact on the level of financial risk measured by the volatility of the liquidity ratio, HS3: The COVID pandemic had an impact on the level of financial risk measured by the volatility of the solvency ratio. At the stage of formulating the conceptual model, three categories of variables that are not measurable (latent variables – no direct measurement) were proposed: Leverage, liquidity ratio and solvency ratio. All indicators are based on selected observable variables, which are then calculated in accordance with the formulas adopted in the literature of the subject, thanks to which we infer the size of the tested variable. The measure of the financial leverage of the audited hospital is the ratio of the operating profit to the gross profit (EBIT/EBT) in a given reporting year. The current liquidity ratio measure is the ratio of current assets to current liabilities in a given reporting year. The measure of the hospital solvency ratio is the ratio of the balance sheet total to the total liabilities of the hospital in a given reporting year.

In the procedure, we decided on the deliberate selection of the research sample, which constituted hospitals within the meaning of the Act on Medical Activity from the territory of the Republic of Poland. Data from the Central Statistical Office indicate that in the years 2018-2021 the average number of entities was 896 units. The research was conducted on a group of 362 hospitals, which is 40.40% of the research sample. Bearing in mind the need to maintain a 95% confidence level, with the assumed fraction size 0.5 and a maximum error of 5%, the minimum size of the test sample was met ($N > 296$). The research covered the years 2018-2021, and financial data were obtained from the EMIS Platform. The analysis of the acquired data was carried out using the IBM SPSS Statistical package.

The results of Kolmogorov-Smirnov tests showed that the distributions of all risk measures studied do not coincide with the normal distribution ($p<0.01$), which forced the need to select non-parametric statistical tools for statistical inference of assumed research hypotheses.

In order to verify the first HS1 specific hypothesis: The COVID pandemic had an impact on the level of financial risk measured by the volatility of financial leverage, a non-parametric Mann-Whitney U test was used for two independent trials, which allowed for verification of the HT1 statistical hypothesis: the average spread of the leverage ratio before the pandemic is not equal to the average spread of the volatility ratio during the pandemic. The alternative hypothesis test showed that there are no grounds for rejecting it, so there are no significant differences between the distribution of the leverage ratio before the pandemic and during the pandemic ($U = 60499.000$, $p = 0.074 > 0.05$).

In order to verify the second HS2 specific hypothesis: The COVID pandemic had an impact on the level of financial risk measured by the volatility of the liquidity ratio, a non-parametric Mann-Whitney U test was used for two independent trials, which allowed verification of the HT1 statistical hypothesis: the average distribution of the volatility ratio before the pandemic is not equal to the average spread of the volatility ratio over the pandemic period. The alternative hypothesis test showed that there are no grounds for rejecting it, so there are no significant differences between the distribution of the liquidity ratio before the pandemic and during the pandemic ($U = 68257.500$, $p = 0.215 > 0.05$).

In order to verify the third specific hypothesis of HS3: The COVID pandemic had an impact on the level of financial risk measured by the volatility of the solvency ratio, a non-parametric Mann-Whitney U test was used for two independent trials, which allowed verification of the statistical hypothesis HT1: the average distribution of the solvency ratio variation coefficient before the pandemic is not equal to the average spread of the coefficient of variation over the pandemic period. The alternative hypothesis test showed that there are no grounds for rejecting it, so there are no significant differences between the distribution of the solvency ratio before the pandemic and during the pandemic ($U = 69495.500$, $p = 0.106 > 0.05$).

To sum up the results obtained, we conclude that none of the three detailed hypotheses have been confirmed. The study showed that there is no statistical basis to conclude that the COVID-19 pandemic had a significant impact on financial risk measured by the volatility of financial leverage, liquidity and solvency of hospitals in Poland.

7. Summary

The main objective of the research was to find an answer to the research question: What impact on the financial risk of hospital operations in Poland was the COVID-19 pandemic? At the stage of analysis of the literature, it was shown that the pandemic theoretically

had an impact on the financial situation of hospitals, as confirmed by other studies (Naruć, 2023, pp. 185-192), therefore, the impact of the pandemic should also be visible in the area of financial risk of hospital operations. However, the literature review carried out did not confirm the existence of research in this area. In connection with the existing cognitive gap, we conducted empirical studies that did not confirm the adopted detailed hypotheses. It should therefore be considered that the COVID-19 pandemic did not have a statistically significant impact on the financial risk of hospitals in Poland. It should be emphasized that three financial risk measures were adopted, and the studies concerned differences in the distribution of the coefficient of variation of these indicators. We believe that the number of financial risk measures should be expanded in future studies. We also propose to extend the research to include the use of measures that take into account the sources of risk.

Finally, it should be added that the authors encountered limitations of the conducted research, although the research sample was statistically adequate, but it could be more numerous, however, for many hospital units full financial data was missing and had to be rejected from the analyzed sample.

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GENERATION Z AS A RECIPIENT OF JOB OFFERS

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Purpose: The purpose of the article is to define the areas of EB activity and the formation of employment offers aimed at Generation Z. An additional goal is to identify the dissimilarity of Generation Z's expectations resulting from employment status.
Design/methodology/approach: The study used an electronic questionnaire, distributed to a random sample of working and non-working students. The study was conducted on a sample of 234 Generation Z people, of whom 106 were non-working and 128 were working. The study was conducted in 2024. The collected data were subjected to basket analysis, r-Pearson correlation, and mathematical analysis.
Findings: The analysis indicates that special attention should be paid to issues of pay, work atmosphere, safe working conditions and equal treatment (fairness) when constructing Employee Value Proposition offers aimed at Zetas. The r-Pearson correlation analysis indicates that the EVP need to include: addition elements relating to the concept of fairness - for non-working Generation Z respondents and elements of autonomy and a culture of cooperation and helpfulness - for working Zetas.
Research limitations/implications: The study is not representative of the entire Gen Z population, but only of those studying, whether they are working or not. The study was conducted on a group of students, among whom those who are working do not have much professional experience, which means that their expectations shaped by the delivery of work are not stabilized.
Practical implications: The practical value of the research conducted lies in determining the basis for the formation of EB strategies and the content of job offers in the recruitment process corresponding to the expectations of Generation Z from the perspective of employed and non-employed people with higher education.
Originality/value: The article is addressed to researchers dealing with employee expectations and practitioners shaping working conditions, EB and recruiting generation Z employees. The value of the article is to identify the importance of factors shaping working conditions (including their most expected set) for generation Z for people working and not working.
Keywords: Generation Z, empowerment, employer branding, recruitment, job offers.
Category of the paper: research paper.

1. Introduction

The youngest participants in the labor market, born after 1996, belong to Generation Z, which is growing more resiliently in the labor force every year (Konkel, 2023). Trend studies conducted in foreign markets suggest that the Zetas will become the engine of economic growth in the next 10 years (Ławińska, Korombel, 2023). This generation presents different attitudes toward work, and has different preferences related to it than previous generations. This poses a challenge for employers, who should subordinate the process of acquiring these employees to their needs. The specific characteristics and preferences of this generation should prompt managers to build an employer brand that will be positively perceived by the Zetas. The idea, therefore, is to highlight unique aspects of the employment offering that will differentiate the company from its competitors, which, as indicated, should result in the ability to retain current employees and attract potential employees (Backhaus, Tikoo, 2004). This can be achieved by creating unique benefits for employees, which are referred to as the so-called "employer value proposition - EVP". EVP is not only an appropriately tailored financial package, but also other important benefits promised to employees in connection with their work at a particular company (Edwards, 2010). The literature indicates that at work, Zetas value freedom, creativity, lack of monotony in the tasks assigned to them, seek diversity, are willing to go on foreign internships, experiment, want to learn about different cultures and new methods of work. Among the factors they look at when choosing a future employer are the prestige of the workplace, the ability to perform tasks with flexible working hours, or remote working (Konkel, 2023). The youngest generation of workers, Gen Zs, prioritize job security and do not change jobs because of disloyalty, but because employers are not meeting their needs or expectations (Ayoobzadeh, 2024). Since this is the case, the offers directed to the labor market should take into account these very needs. At the same time, it should be emphasized that within Generation Z there is a diversity of expectations based on education level, professional status or gender.

The purpose of the article is to define the areas of EB activity and the formation of employment offers aimed at Generation Z. An additional goal is to identify the dissimilarity of Generation Z's expectations resulting from employment status. In order to achieve the purpose of the paper, a survey was conducted, the results of which are described in the article. Data analysis was conducted using in-depth analysis and r-Pearson correlation assessment. A basket method was also used to take a deeper look at the problem at hand.

2. Importance of Employer Branding (EB) in attracting Generation Z employees

Lloyd (2002) understands by EB the sum of the efforts a company makes to communicate to current as well as future employees that it is creating an attractive and desirable workplace. It is a key element in building competitive advantage and attracting attractive employees. Employee acquisition usually consists of fixed elements, such as recruitment, selection and adaptation activities aimed at integrating the employee into the company's structure (Mikolajczak). The activities undertaken here should take into account the specifics of the target group that the employer is interested in hiring. The group of interest to us are representatives of Generation Z. It is pointed out that they are able to search and process information quickly, are creative, are able to work in teams, are not afraid to change their place of employment, while they connect finding a new one with their specific skills and qualifications (Ulrych, 2022, p. 69). Zetas think about their careers from an early age, they willingly participate in internships or apprenticeships, thanks to which they make decisions quite quickly regarding the realization of their professional path (Lipinski, Koczy, 2023). Zetas, when undertaking specific activities, take care to plan them effectively in time (Szymczyk), they value the opportunity to maintain a balance between work and private life hence the importance for them of flexible working hours. It guarantees freedom of work, increases free time, which is particularly important for Zetas (Konkel, 2023). Often their loyalty is dictated by meeting their expectations by the employer so the challenge for employers is to keep them in the organization for the long term. Zetas are referred to as the generation without the “loyalty gene” (Żarczyńska-Dobiesz, Chomątowska, 2016).

3. Methodology

For the survey, an electronic questionnaire was used, made available to a random sample, which is considered to be the student community. In this way, the research was limited to people with higher education. The survey was conducted on a sample of 234 Generation Z people, of which 106 were non-working and 128 were working. The research was conducted in 2024. From a cognitive perspective, we can observe the evolution of expectations expressed by people with higher education from being not employed to being employed

The survey, in addition to the label questions, included 2 series of questions with 23 questions each (see Table 1). The first series dealt with the positive perspective, which is important. The second series dealt with a negative perspective, which is irrelevant. The questions were 0/1. To find out the profiles of expectations, in-depth data analysis and

basket analysis were conducted, and the r-Pearson correlation method was used to find out the variables that distinguish the profiles of expectations. Table 1 shows detailed results on the expectations of Generation Z respondents, broken down by working and non-working.

Another research method used in the study is the r-Pearson correlation method. In this study, the independent variable is work situation (current). I work denotes 1, I don't work denotes 0. And the dependent variables are the survey questions illustrated in Table 1.

It should be noted that correlation analysis considers the relationship between variables. It does not identify the significance or numerosity of responses. The analysis was carried out for all responses, in the perspective of the variable professional situation. Table 2 shows the obtained results of the correlation analysis for the entire sample.

Another method used to verify the hypotheses was basket analysis. The basic basket is a set containing YES responses in the area of, pay adequate to the duties performed and, at the same time, a good working atmosphere. These two variables were chosen as the foundation of the basket due to the fact that they are the most significant variables in the eyes of the respondents. Responses from the surveyed range were selected for this basket. Table 3 illustrates the basket thus constructed.

4. Research

The results of the in-depth analysis can be divided according to three criteria: the importance given to each variable in the working and non-working groups, the difference in these expectations, and the difference in the cross-section of significant, insignificant.

In the first perspective, we can separate (the marking means that the feature has the indicated value for one of the groups):

- Most significant variables represented by more than 50% of respondents:
  - Wages adequate to the duties performed.
  - Good atmosphere at work.
  - For not working - Equal treatment.
- Variables important more than 30% less than 50%.
  - Safe and hygienic working conditions.
  - For not working - Transparent rules of promotion.
  - For working - Help from superiors and co-workers.
  - For working - Equal treatment.
  - For working - Efficient flow of information "top-down", "bottom-top".
- Variables of average weight more than 10% less than 30%:
  - Employment protection.
  - Training at the employer's expense.

- Influence on the organization of working time.
- Organizing meetings, gatherings with the staff.
- Informing about important issues concerning the functioning of the company.
- Health benefits at the employer's expense.
- Programs for adaptation of new employees.
- Participation in decision-making processes.
- For not working - Protection (securing) of social benefits.
- For working - Transparent rules of promotion.
- For not working - Efficient flow of information "top-down", "bottom-top".
- For not working - Providing assistance to employees in a difficult situation.

- Variables of low importance-less than 10%:
  - For working - Protection (securing) of social benefits.
  - For not working - Providing assistance to employees in a difficult situation.
  - Mentoring programs for employees.
  - Organizing integration events.
  - Assistance with dismissals (outplacement).
  - Empowerment.
  - Formal procedures for expressing opinions.
  - Functioning of trade unions.

The second group of analyses concerned the identification of differences in the expectations expressed by working and non-working. Here we can separate (a check mark means that the factor is given greater importance by the group of employed people, a without a check mark means that the factor is given greater importance by the group of non-employed people):

- Large differences, 9.9% or more:
  - Equal treatment – not working.
  - Help from superiors and co-workers – working.
  - Employment protection – not working.
  - Influence on the organization of working time – working.
- Significant differences more than 5% and less than 9.9%:
  - Transparent rules of promotion – not working.
  - Efficient flow of information "top-down", "bottom-top" – working.
  - Wages adequate to the duties performed – working.
  - Informing about important issues concerning the functioning of the company – not working.
  - Providing assistance to employees in a difficult situation – not working.
  - Protection (securing) of social benefits – not working.
- Small differences of 1% to 5%:
  - Good atmosphere at work – working.
  - Safe and hygienic working conditions – not working.

- Training at the employer's expense – working.
- Organizing meetings, gatherings with the staff – not working.
- Health benefits at the employer's expense – not working.
- Programs for adaptation of new employees – not working.
- Participation in decision-making processes – working.
- Organizing integration events – working.
- Empowerment – working.
- Formal procedures for expressing opinions – working.

- Negligible differences of less than 1%:
  - Mentoring programs for employees- working.
  - Assistance with dismissals (outplacement) – not working.
  - Functioning of trade unions – not working.

The analysis indicates that special attention should be paid to issues of pay, work atmosphere, safe working conditions and equal treatment (fairness) when constructing pacy offers aimed at Zetas. Equal treatment is of particular importance to non-workers, as are unambiguous career paths or employment protection, which means seeking some kind of justice and fairness in the rules of career advancement. Here we observe an evolution of views because for employed people the importance of these three factors is somewhat declining. In contrast, autonomy-related aspects such as flexible working hours, support from superiors and co-workers or participation in decision-making play a greater role.

In the perspective of these results, it should be emphasized that the company, building its image as an employer, should emphasize building an organizational culture that has cooperation, helpfulness, fairness and autonomy at its core. Of course, as we have shown a certain difference should be characterized by job offers aimed at working and non-working Zetas.

An r-Pearson correlation analysis indicates that a statistically significant relationship is shown for working people, as a significant variable - flexible working hours, as a non-significant variable - holding meetings with the crew. So for them, announcements should include this information, and management solutions should reinforce autonomy. On the other hand, for non-employed Zetas, employment protection is important. On the other hand, the indications of non-significant expectations, and which are statistically significant, do not have much cognitive value due to the small number of answers given mainly by the non-employed.

The table 1 highlights the fields with significant differences between the expectations of those who work and those who don't.

Table 1.
Analysis of expectations of Generation Z respondents by working and non-working generation

	Z (item)	Wages adequate to the duties performed	Good atmosphere at work	Equal treatment	Safe and hygienic working conditions	Transparent rules of promotion	Help from superiors and co-workers	Employment protection	Training at the employer's expense	Efficient flow of information "top-down", "bottom-top"	Influence on the organization of working time	Organizing meetings, gatherings with the staf	Informing about important issues concerning the functioning of the company	Health benefits at the employer's expense	Programs for adaptation of new employees	Providing assistance to employees in a difficult situation	Participation in decision-making processes	Protection (securing) of social benefits	Mentoring programs for employees	Organizing integration events	Assistance with dismissals (outplacement)	Empowerment	Formal procedures for expressing opinions	Functioning of trade unions
important																								
not working	106	84	89	56	40	36	29	28	25	24	17	17	17	13	13	13	12	11	9	6	1	1	0	0
working	128	110	113	55	46	34	49	14	36	39	36	15	13	13	14	8	20	5	11	10	1	7	2	0
total	234	194	202	111	86	70	78	42	61	63	53	32	30	26	27	21	32	16	20	16	2	8	2	0
not working	**1**	**79,2%**	**84,0%**	**52,8%**	**37,7%**	**34,0%**	**27,4%**	**26,4%**	**23,6%**	**22,6%**	**16,0%**	**16,0%**	**16,0%**	**12,3%**	**12,3%**	**12,3%**	**11,3%**	**10,4%**	**8,5%**	**5,7%**	**0,9%**	**0,9%**	**0,0%**	**0,0%**
working	**1**	**85,9%**	**88,3%**	**43,0%**	**35,9%**	**26,6%**	**38,3%**	**10,9%**	**28,1%**	**30,5%**	**28,1%**	**11,7%**	**10,2%**	**10,2%**	**10,9%**	**6,3%**	**15,6%**	**3,9%**	**8,6%**	**7,8%**	**0,8%**	**5,5%**	**1,6%**	**0,0%**
total	**1**	**82,9%**	**86,3%**	**47,4%**	**36,8%**	**29,9%**	**33,3%**	**17,9%**	**26,1%**	**26,9%**	**22,6%**	**13,7%**	**12,8%**	**11,1%**	**11,5%**	**9,0%**	**13,7%**	**6,8%**	**8,5%**	**6,8%**	**0,9%**	**3,4%**	**0,9%**	**0,0%**
difference not working-working		**-6,7%**	**-4,3%**	**9,9%**	**1,8%**	**7,4%**	**-10,9%**	**15,5%**	**-4,5%**	**-7,8%**	**-12,1%**	**4,3%**	**5,9%**	**2,1%**	**1,3%**	**6,0%**	**-4,3%**	**6,5%**	**-0,1%**	**-2,2%**	**0,2%**	**-4,5%**	**-1,6%**	**0,0%**
not important																								
not working	106	-2	-4	-4	-4	-10	-7	-12	-17	-10	-24	-21	-8	-16	-26	-16	-19	-28	-36	-62	-40	-17	-51	-65
working	128	-1	0	-4	-7	-7	-2	-12	-15	-15	-20	-46	-18	-34	-19	-25	-15	-33	-49	-74	-66	-14	-58	-87
total	234	-3	-4	-8	-11	-17	-9	-24	-32	-25	-44	-67	-26	-50	-45	-41	-34	-61	-85	-136	-106	-31	-109	-152
not working	**1**	**-1,9%**	**-3,8%**	**-3,8%**	**-3,8%**	**-9,4%**	**-6,6%**	**-11,3%**	**-16%**	**-9,4%**	**-22,6%**	**-19,8%**	**-7,5%**	**-15,1%**	**-24,5%**	**-15%**	**-18%**	**-26,4%**	**-34%**	**-58,5%**	**-38%**	**-16%**	**-48%**	**-61%**
working	**1**	**-0,8%**	**0,0%**	**-3,1%**	**-5,5%**	**-5,5%**	**-1,6%**	**-9,4%**	**-11,7%**	**-11,7%**	**-15,6%**	**-36%**	**-14,1%**	**-26,6%**	**-14,8%**	**-19,5%**	**-11,7%**	**-25,8%**	**-38,3%**	**-57,8%**	**-51,6%**	**-11%**	**-45,3%**	**-68,0%**
total	**1**	**-1,3%**	**-1,7%**	**-3,4%**	**-4,7%**	**-7,3%**	**-3,8%**	**-10,3%**	**-13,7%**	**-10,7%**	**-18,8%**	**-28,6%**	**-11,1%**	**-21,4%**	**-19,2%**	**-17,5%**	**-14,5%**	**-26,1%**	**-36,3%**	**-58,1%**	**-45,3%**	**-13,2%**	**-46,6%**	**-65%**
difference not working-working		**-1,10%**	**-3,80%**	**-0,70%**	**1,70%**	**-3,90%**	**-5,00%**	**-1,90%**	**-4,30%**	**2,30%**	**-7,00%**	**16,1%**	**6,60%**	**11,5%**	**-9,7%**	**4,40%**	**-6,20%**	**-0,60%**	**4,30%**	**-0,70%**	**13,9%**	**-5,10%**	**-2,80%**	**6,70%**

Source: own study.

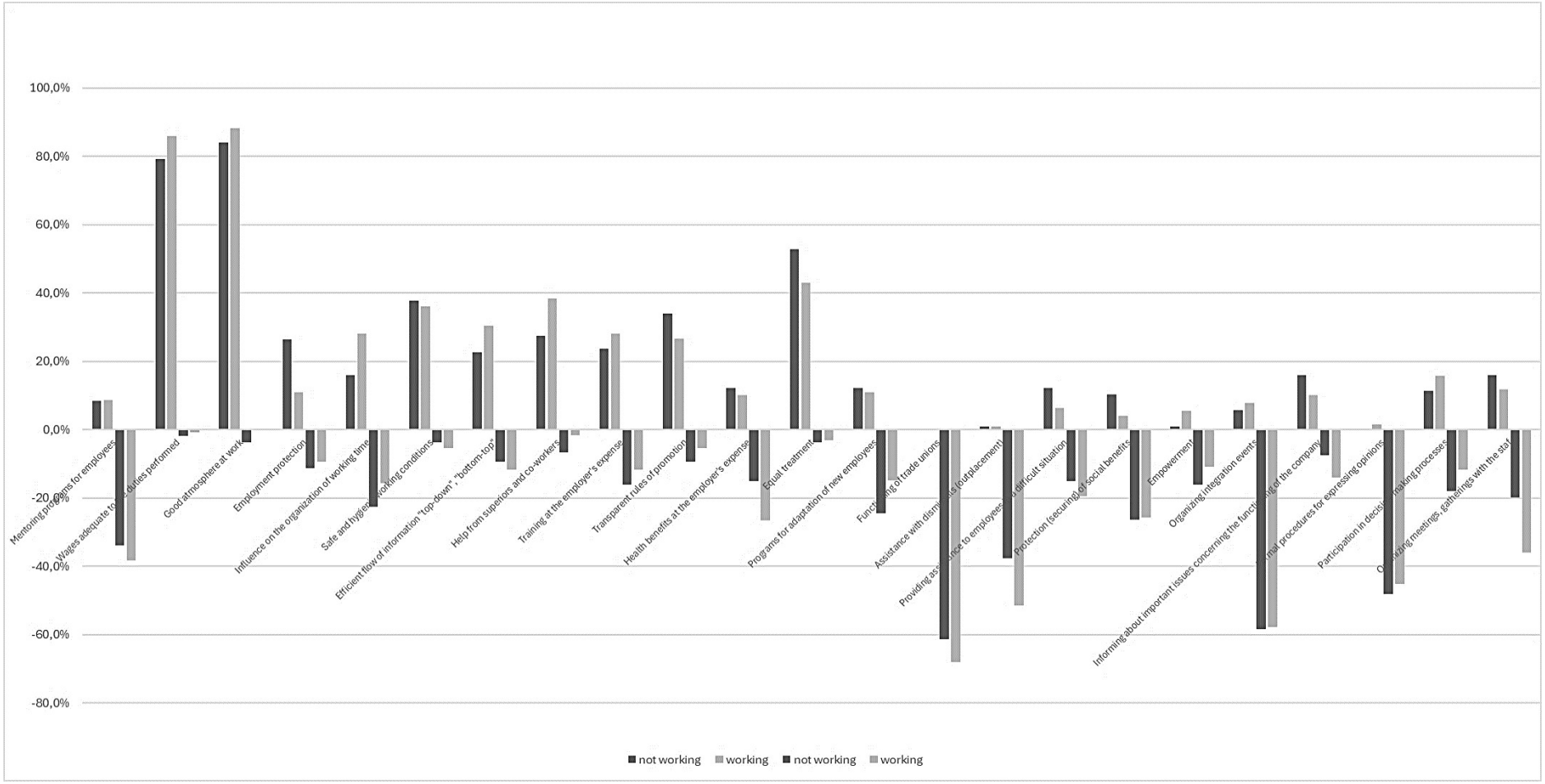


Figure 1. Analysis of expectations of Generation Z respondents by working and non-working generation.

Source: own study.

Table 2.
The r-Pearson correlation matrix for age groups in the working/non-working category

	Work situation (current), Pearson's r Generation Z	
	IMPORTANT	**NOT IMPORTANT**
Mentoring programs for employees	0.002	0.045
Salary commensurate with the duties performed	0.088	-0,049
Good atmosphere in the workplace	0.063	-0.145*
Employment protection	-0.201**	-0.032
Influence on the organization of working time	0.144*	-0.089
Safe and sanitary working conditions	-0.019	0.040
Efficient flow of information "top-down", "bottom-up"	0.088	0.037
Assistance from superiors and co-workers	0.115	-0.130*
Training at the expense of the employer	0.051	-0.063
Transparent rules for promotion	-0.080	-0.076
Health benefits at the employer's expense	-0.033	0.139*
Equal treatment	-0.098	-0.018
Adaptation programs for new employees	-0.021	-0.122
Organizing meetings, gatherings with the crew	-0.063	0.178**
Participation in decision-making processes	0.062	-0.088
Formal procedures for expressing opinions	0.084	-0.028
Informing on important issues concerning the functioning of fi	-0.088	0.103
Organizing team-building events	0.042	-0.007
Empowerment	0.124	-0.075
Protecting (securing) social benefits	-0.128	-0.007
Providing assistance to employees in difficult situations	-0.105	0.058
Assistance with layoffs (outplacement)	-0.009	0.138*
Functioning of trade unions	-0.072	0.069

Source: own study.

Another method used in the study is basket analysis. The basic basket consisted of 75% working and 65% non-working. Using it, it was determined that those who value a good working atmosphere and the adequacy of pay to work, whether from the working or non-working group, at a similar level value equal treatment, safe working conditions, transparent promotion criteria. Working people value the help of superiors and influence over working time significantly higher, noted the concept of empowerment.

Table 3.
Basket analysis for respondents born after 1996

	Total		**I work**		**I don`t work**	
Salary adequate to the duties performed==1, Good atmosphere in the workplace==1 and	234		128		106	
Important	**abundance**	**support**	**abundance**	**support**	**abundance**	**support**
Salary adequate to the duties performed	165	71%	96	75%	69	65%
Good atmosphere in the workplace	165	71%	96	75%	69	65%
Equal treatment	77	33%	38	30%	39	37%
Safe and hygienic working conditions	56	24%	31	24%	25	24%
Assistance from superiors and co-workers	53	23%	35	27%	18	17%
Transparent rules for promotion	51	22%	28	22%	23	22%
Training at the employer's expense	43	18%	26	20%	17	16%
Efficient flow of information "top-down," "bottom-up"	40	17%	26	20%	14	13%
Influence on the organization of working time	39	17%	28	22%	11	10%

Cont. table 3.

Employment protection	25	11%	11	9%	14	13%
Organizing meetings, meetings with the crew	22	9%	11	9%	11	10%
Informing on important issues concerning the functioning of the company	20	9%	11	9%	9	8%
Participation in decision-making processes	19	8%	12	9%	7	7%
Adaptation programs for new employees	14	6%	9	7%	5	5%
Health benefits at the employer's expense	13	6%	6	5%	7	7%
Organizing team-building events	13	6%	8	6%	5	5%
Providing assistance to employees in difficult situations	12	5%	5	4%	7	7%
Mentoring programs for employees	10	4%	6	5%	4	4%
Protection (security) of social benefits	6	3%	0	0%	6	6%
Empowerment	5	2%	5	4%	0	0%
Assistance with layoffs (outplacement)	2	1%	1	1%	1	1%
Formal procedures for expressing opinions	1	0%	1	1%	0	0%
Functioning of trade unions	0	0%	0	0%	0	0%
Not important						
Functioning of trade unions A	109	47%	65	51%	44	42%
Organizing team-building events A	96	41%	57	45%	39	37%
Formal procedures for expressing opinions A	84	36%	46	36%	38	36%
Assistance with layoffs (outplacement) A	77	33%	52	41%	25	24%
Mentoring programs for employees A	61	26%	34	27%	27	25%
Protection (security) of social benefits A	48	21%	30	23%	18	17%
Organizing meetings, gatherings with the crew A	47	20%	32	25%	15	14%
Health benefits at the expense of the employer A	34	15%	25	20%	9	8%
Influence on the organization of working time A	32	14%	17	13%	15	14%
Adaptation programs for new employees A	30	13%	15	12%	15	14%
Providing assistance to employees in difficult situations A	28	12%	18	14%	10	9%
Participation in decision-making processes A	20	9%	9	7%	11	10%
Employment protection A	18	8%	8	6%	10	9%
Empowerment A	18	8%	10	8%	8	8%
Efficient flow of information “top-down,” “bottom-up” A	17	7%	12	9%	5	5%
Information on important issues concerning the operation of the company A	16	7%	12	9%	4	4%
Training at the employer's expense A	15	6%	7	5%	8	8%
Transparent rules for promotion A	12	5%	5	4%	7	7%
Safe and hygienic working conditions A	11	5%	7	5%	4	4%
Assistance from superiors and co-workers A	5	2%	1	1%	4	4%
Equal treatment A	5	2%	2	2%	3	3%
Salary adequate to the duties performed A	2	1%	0	0%	2	2%
Good atmosphere in the workplace A	0	0%	0	0%	0	0%

Source: own study.

5. Discussion

As we indicated above within Generation Z, there is a variation in expectations due to, educational level, occupational status or gender. Thus, different studies find slightly different distributions of responses related to the needs of the younger generation. A study by Gajda (2017) found the following hierarchy of Zetas' needs. As many as 91% of respondents prioritized a high salary (which is consistent with our survey results, both among the working

and non-working population). In the referenced survey, one-time benefits and access to insurance and medical care were also found to be equally important (which our survey does not confirm). As in our survey, a significant majority (87%) expect a friendly and relaxed atmosphere in the workplace, which allows them to feel comfortable (90%). The surveys analyzed emphasize that job satisfaction, mutual help, and a sense of being appreciated and needed increase Zetas' commitment. Challenging, developing practical tasks are also important (72%), while 64% note the need for personal development and participation in additional training. As Saxena (2024) points out to meet the need for development, zetas expect modern solutions, traditional methods of training and development are not enough. Work-life balance remains crucial for 92% of respondents. At the same time, 82% say they are willing to change jobs if pay or organizational conditions are unsatisfactory. In Ratajczak's study (2020), Zetas' expectations of work turned out to be moderate and independent of the type of school they completed or their educational plans. Of key importance (as in our study) were adequate pay and a good atmosphere. In addition, respondents indicated the importance of employer respect and, somewhat surprisingly in this generational group in the context of Generation Z's frequent job changes, employment stability. It is worth pointing out that in our survey, non-workers were more likely to indicate the importance of employment protection than working people, which corresponds in some ways to this stability. Courses, a work contract, flexible hours and work-life balance were also important, the survey reads. One in ten students expected additional benefits (e.g., sports cards, movie tickets). In research. In terms of the importance of a good atmosphere, it is worth pointing out, following Wasiluk and Kojta (2023), that it is a factor that determines the younger generation to stay in the organization.

6. Summary

The cognitive value of the study lies in learning the profile of relevant and irrelevant expectations in the perspective of the employment status of the respondents. The results indicate a change in expectations due to work experience, although these changes are mostly not statistically significant. Job offers for Zetas starting out should emphasize, in addition to shared factors with working Zetas, elements relating to the concept of fairness. For working Zetas, on the other hand, the importance of elements of autonomy (influence over working hours, participation in decision-making processes) and a culture of cooperation and helpfulness should be emphasized. Of course, building an EP that suits Zetas requires interference with organizational culture and management systems.

Directions for further research: the conclusions derived indicate, the importance of the issue of consistency of job offers with the shaped image of the company. It is also possible to ask whether the very form of the job announcement and the channels of transmission of this

information shape the image of the enterprise. Conducting research on Zetek's expectations from the perspective of different levels of education. A very interesting thread that emerges in the context of the conducted research is to conduct an analysis of the evolution of expectations with increasing work experience.

Limitation: the study was conducted on a group of students, among whom those in the workforce do not have much work experience, which means that their expectations formed through the provision of work are not fixed. The survey is not representative of the entire population of Generation Z, but only of the portion of it with higher education.

The practical value of the research conducted lies in determining the basis for the formation of EB strategies and the content of job offers in the recruitment process corresponding to the expectations of Generation Z from the perspective of employed and non-employed people with higher education.

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DOES PROXIMITY MATTER FOR INNOVATION? EVIDENCE FROM ICT CLUSTER IN POLAND

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Purpose: The purpose of this paper is to explore different aspects of proximity that are most important for fostering innovation within ICT firms located in clusters.
Design/methodology/approach: To achieve the research objectives, semi-structured interviews were conducted with ICT firms in the Pomeranian region's Interizon cluster. The theoretical scope of the paper is based on the concept of proximity, specifically as it relates to the spatial organization of clusters and their effect on innovation.
Findings: The study shows that cognitive and social proximity are the key factors driving collaboration and innovation within the ICT firms in the Pomeranian cluster. Cluster membership plays a lesser role, suggesting that geographical proximity and cluster initiatives do not play as big a role as one might expect for supporting ICT sector innovation. The same applies to institutional proximity.
Research limitations/implications: The primary limitation of this research is the small sample size, which restricts the ability to generalize the findings. The study's focus on one ICT cluster in Poland limits its broader applicability, although the conclusions can offer insights for policymakers and cluster organizers. Future research with a larger, more representative sample is recommended to validate the findings and further investigate the role of proximity in different regions/sectors/countries.
Practical implications: Policymakers and business leaders can apply the findings of the paper to foster innovation in the ICT sector by creating environments that encourage collaboration through shared knowledge and social ties rather than just relying on spatial closeness.
Originality/value: This paper contributes new insights into the role of different types of proximity in innovation, specifically within the context of ICT firms in a cluster.
Keywords: ICT clusters, spatial proximity, non-spatial proximity, innovation, Poland.
Category of the paper: research paper, case study.

1. Introduction

Innovation is an interactive collaborative process involving a network of actors. Despite many empirical studies, evidence on geographical patterns of collaboration and knowledge spillovers is still fragmented. Most studies focus on advanced regional economies.

Sectoral trends or differences across industries are overlooked. The concept of proximity provides a framework for analyzing the different spatial organizations, like clusters.

The paper aims to answer the question of which aspect of proximity is most important for the innovation process in ICT firms. The study is based on semi-structured interviews conducted in one of the ICT clusters in Poland located in Pomeranian region. Section 1 provides an overview of the relevant literature on proximity and clusters and review of empirical research. Section 2 presents the methodology used in the research. Section 3 presents case studies of firms interviewed. The last section concludes.

2. Theoretical framework

Proximity is a key factor in determining where firms choose to establish their production units. In the 1990s, the French School of Proximity Dynamics made a notable impact on knowledge on innovation, by suggesting that proximity encompasses several dimensions (Boschma, 2005). Short distances bring people closer together, facilitate the transfer of information, and foster the exchange of knowledge. Boschma suggests that the significance of geographical proximity should not be considered in isolation, but rather in conjunction with other proximity dimensions that may offer alternative solutions (Boschma, 2005). In many cases, companies that are not geographically close can still collaborate successfully due to shared skills, experiences, social or institutional backgrounds. There are different typologies of proximities in the literature. Some of them are presented below. Among others, there is a distinction between:

- geographical proximity, referring to the spatial location of the partners; institutional proximity, referring to the proximity of the partners' institutional framework: including norms and routines; and cognitive proximity, i.e. the similar and complementary knowledge of the partners (Rynes, Bartunek, Daft, 2001; Nooteboom, 2000).
- geographical, cultural, organizational, technological, cognitive and institutional proximity (Torre, Rallet, 2005).
- spatial and non-spatial proximity, in case of the latter: organized proximity (Torre, Rallet, 2005), socio-economic proximity (Bouba-Olga, Grossetti, 2008) and institutional and organizational proximities (Boschma, 2005).

All the dimensions of proximity are certainly not identical but refer to ‘being close to something’ measured on a certain dimension (Knoben, Oerlemans, 2006). The dimensions of proximity are strongly linked to each other. What unites the different dimensions of proximity is that they reduce uncertainty and solve the problem of coordination. Geographical proximity is a key factor in cluster dynamics, facilitating knowledge spillovers and interactive learning among local networks (Bell, Zaheer, 2007). However, the benefits of proximity depend on

a firm's position within the network, and proximity's impact on innovativeness changes over time (Presutti et al., 2019). Due to Boschma (2005), geographical proximity alone is neither a necessary nor sufficient condition for effective learning to take place. The author proves that its importance arises only when it facilitates the development of non-geographical proximities. Han and Xu (2024) found that cognitive and social proximities are crucial factors driving green technology innovations. Presutti et al. (2019) confirmed the positive effect of cognitive proximity on innovation performance of small- and medium-sized high-tech industrial clusters in Italy. Royo-Vela and Mazandarani (2022), based on an analysis of 99 European clusters, confirmed the lack of significant links between all dimensions of non-geographical proximity. In some cases, geographical proximity is not necessary for innovation. Studies show that once networks are established, other forms of proximity, like social and organizational, become more important than geographic closeness (Rallet, Torre, 1999). The findings of a study based on an analysis of four cluster organisations from the metal and the ICT industries in Poland confirmed that geographical proximity is crucial in the early stages of cluster collaboration, as it lays the foundations for the development of other forms of proximity. As the collaboration progresses, the importance of geographical proximity decreases in favour of social and competence proximity due to access to resources such as knowledge and information (Lis, 2020). Overall, proximity is a complex and multifaceted factor in innovation, with non-geographical forms often playing a greater role as cooperation deepens.

3. Methodology

ICT is one of the most dynamically growing industries in Pomerania. Already, IT and R&D centers account for more than half of the companies in the Tri-City's modern business services sector. The region has a total of 129 companies employing more than 10 employees, most of which are located in the Tri-City. Pomeranian ICT cluster Interizon was established in 2009 to create a strong network of ICT companies and institutions in the Pomeranian region. The cluster has an open character: firms can join it on an ongoing basis. It is located in Gdańsk, a city within the Tri-city area. Interizon consists of 95 participants (mostly from ICT sector): 6 large companies, 12 medium-sized companies, 22 small companies, 32 micro-companies, 14 educational and scientific institutions, 9 other entities.

The results presented in the paper are based on semi-structured interviews (face-to-face conversations, online interviews) conducted with cluster member firms. It is treated as pilot study due to sample size. Purposive sampling approach framework was applied (selection of people who obtain required experience or knowledge). In the selection of the sample, there was close cooperation with the Interizon board (Jarosław Parzuchowski) and the member of the Programme Board of the Pomeranian Science and Technology Park (dr Andrzej Poszewiecki).

The companies selected differ in size, type of business and the specifics and intensity of cooperation. The result is 5 case studies.

The following typology of proximity was used in the study:

- geographical: spatial distance between actors, both in an absolute and relative meaning, (Boschma, 2005),
- cognitive: the extent to which two actors share the same knowledge base (Nooteboom, 2000),
- social: associated with personal relationships between actors (Uzzi, 1996), for example, resulting from past collaboration, friendship etc. (Breschi, Lissoni, 2009),
- institutional: high when actors operate under the same set of norms and incentives, for example, when co-located in the same country (Hoekman, Frenken K., Van Oort, 2009), or operating in the same social subsystem in particular within academia, industry, or government (Etzkowitz, Leydesdorff, 2000),
- organisational: refers to the membership to the same organizational entity, for example cluster, or for two subsidiaries of the same parent company (Balland, 2012).

4. Results

Case study 1. Visionx

Person interviewed: Tomasz Michalski, founder and CEO.

The firm, established in 2018 (11 employees) is located in Gdańsk. It implements automation for industry. It provides quality control systems and camera-based vision systems. It also supplies machines based on vision systems. Visionx joined the cluster in 2022. Joining the cluster resulted from the application for EU subsidies conditioned by the company's affiliation with smart specializations, the presence of the company's customers in the cluster and the desire to attract new partners. According to the person interviewed „the cluster does not initiate cooperation on a wider scale". The company expected partner matchmaking actions and actions to attract buyers, however, the latter (factories) do not belong to the cluster. In case of Visionx, no permanent business cooperation was established with either research units or institutions. The company carries out research activities and develops new products on its own, without partners. The barrier to cooperation is low product quality of local and domestic companies.

The current model of cooperation is subcontracting. The collaboration results in a new product where the company provides the software and the rest is up to the partner. Most often such a combination occurs in electronics, furniture, automotive, food, cosmetics (interdisciplinary partnership). Ready-made components are ordered and integrated. Electronic components are imported from abroad: China, Japan, Korea, metal components from

Pomerania. Occasionally there is cooperation, for example, in the case of automation companies. If they cannot operate the camera systems, they ask the company to cooperate.

Table 1.
Importance of proximity to the company

Type	Role of proximities
Geographical	Matters, but there are a lot of barriers here, there are intentions to cooperate.
Cognitive	No cooperation.
Social	Based on long-term cooperation.
Organizational	No cooperation.
Institutional	Industrial background, but open to academia.

Source: own elaboration.

Case study 2. ISS RFID

Person interviewed: Alicja Starnawska, Operational Director.

The firm, established in 2016 (11 employees) is located in Gdynia. It builds on the more than 30 years of experience of its parent company in the security and packaging sector. Intelligent Security Solutions RFID (Radio-Frequency Identification) is a technology company working in the field of intelligent systems using radio technology. ISS is used in the supervision of production, delivery, inventory and logistics systems. Joining the cluster was motivated by the desire to attract industry partners, to establish partnerships but also to find customers for services. According to the person interviewed, Interizon has fulfilled these hopes. All this allows the company to reach a wider range of recipients of services. The cluster has allowed the company to find not only service recipients but also partners.

The company cooperates with domestic and foreign companies, research and development centers, domestic and foreign scientific units. It works in consortia, carries out innovative projects co-financed by EU funds. There are two models of cooperation with partners. Universities support the firm with knowledge and technical know-how, partnership companies provide complementary solutions.

Table 2.
Importance of proximity to the company

Type	Role of proximities
Geographical	Local cooperation is considered the easiest, which is due to proximity and physical contact, personal contacts very important for the company.
Cognitive	Related to the company's cooperation model and very important.
Social	Social proximity is very important for the company. At the same time, the company is not afraid to establish new cooperation by, for example, participating in trade fairs.
Organizational	Partners within the cluster are very important but not the only ones. Cooperation with the parent company is not leading, another important geographic scope of cooperation is the national one.
Institutional	Mixed environments: academic and commercial, not necessarily from the same area of knowledge (interdisciplinary cooperation).

Source: own elaboration.

Case study 3. WiRan

Person interviewed: Maciej Król, Co-founder and President of WiRan.

The firm, established in 2002 (27 employees) is located in Gdynia, in the Pomeranian Science and Technology Park. WiRan, specializing in radio and electronic equipment design, offers proven solutions in RF technology, telemetry, and EMC testing. Its designs serve industries such as space, military, rail, industrial, and IoT. WiRan carries out two activities on the commercial market: 1. preparation of a new design, the intellectual property rights of which are finally received by the contracting company and then produced, and 2. preparation of a solution used in a particular company, e.g. for a production line, to be integrated in the company.

It has been a member of the cluster since 2009. The role of the cluster is seen as informational. The firm is pursuing multi-faceted cooperation with the Marine Technology Center. WiRan has already proven itself as a supplier. At the same time, there was a proposal to prepare a solution in consortium with the Military University of Technology, for which MTC has a client. The third level of cooperation is the test platform. The company makes commercial use of a well-equipped test lab in its R&D activities.

Research and development activity represents the company's largest turnover. It intends to become a research and development centre in the future.

Table 3.

Importance of proximity to the company

Type	Role of proximities
Geographical	It cares about partners located close by, both solution partners and suppliers. The proximity and personal contacts make it possible to understand the needs. With 10 years of experience in the military industry, particularly providing naval solutions for Pomerania, geographical closeness is crucial.
Cognitive	The second most important.
Social	Relationships and trust are hugely important to the company. It seeks to work with proven companies with which the company has relationships.
Organizational	Considered secondarily.
Institutional	Companies and universities (Gdansk University of Technology, University of Gdansk).

Source: own elaboration.

Case study 4. TMA Automation

Person interviewed: Marek Łangowski, Co-founder and President of TMA Automation.

The firm, established in 2010 (35 employees) is located in Gdynia, in the Pomeranian Science and Technology Park. The majority shareholder is the Austrian company ENGEL (since 2022). TMA Automation provides solutions for the automation of manufacturing processes. It designs and implements modern solutions in the areas of robotics, automation, mechanics and vision systems (robots, dedicated automation and vision systems). The company designs, manufactures, programmes and delivers automation and robotics. The firm is present in the cluster since its establishment. According to the person interviewed, Interizon participates in numerous regional, national and European bodies defining the development directions of the industry. Currently, Marek Łangowski is on the Cluster Council. It plans to develop networking

towards the development of product and service sales between cluster member companies. TMA Automation cooperates with companies from the cluster.

The company has specialized in design, programming and assembling (assembly). The company does not perform non-critical activities such as welding, painting, sheet metal bending. This is done by cooperators sourced mainly on the local market. TMA Automation has permanent cooperation with 2 universities: Gdansk University of Technology and Gdynia Maritime University, 10 companies and 3 companies from the cluster. The cooperation mostly concerns subcontracting.

Table 4.
Importance of proximity to the company

Type	Role of proximities
Geographical	Distance is no longer a barrier for cooperation or clients; specialized needs make geographical proximity less important.
Cognitive	The most important.
Social	The second most important.
Organizational	Cooperation with cluster companies. TMA benefits from the market experience of its Austrian partner and its 85 years of development, focusing on adapting its solutions to the Polish market, rather than imitating them.
Institutional	Companies and universities.

Source: own elaboration.

Case study 5. OKE SOFTWARE/POLAND

Person interviewed: Artur Pytlasinski, Co-owner, CEO.

The firm, established in 2004 (70 employees, including b2b employment) is located in Gdańsk. Company has 28 years of experience in the IT industry specializing in software for hybrid TV systems, Big Data and AI. In outsourcing, TV solutions are the core of the company's business. OKE focuses on the development of Apps, software for smart TVs, software for boxes, etc.

It entered the cluster in 2014. The company initiated various activities but received no support from the cluster. In business activities, OKE initiated a group on smart city solutions (20 companies). The company became the leader of the group. This venture has proved successful in talks with cities. One example is Gdańsk, which has agreed to launch a test district for smart city solutions.

The company carries out 3 types of activities:

- Outsourcing and Nearshoring: The company has always focused on outsourcing, and now essentially nearshoring.
- In February 2022 the firm merged with the Dutch company Triple to jointly execute projects. The company is responsible for software development and provides a comprehensive service for establishing an online presence.
- Products for Public Administration, currently for cities. The company has developed an artificial intelligence system that analyzes video and audio. The AI analyzes what is happening in the city and signals alarming situations.

Table 5.
Importance of proximity to the company

Type	Role of proximities
Geographical	Does not matter much.
Cognitive	The second most important.
Social	„If there is no trust and social proximity, no one starts cooperation". Cooperation with towns: social proximity is very important. For large contracts, trust is essential.
Organizational	Group on smart city solutions within cluster as an example.
Institutional	Cooperation with national universities is based on the principle of gaining a partner for a project application.

Source: own elaboration.

The ranking of the importance of proximity types for innovative project collaboration shows that most respondents consider cognitive and social proximity to be the most important, while spatial proximity, cluster membership and organizational proximity are of lesser importance. (see Table 6).

Table 6.
Ranking of the importance of proximity types

Case studies	Proximity				
	geographical	cognitive	social	organizational	institutional
VISIONX	3	1	2	4	5
ISS RFID	4	1	2	3	5
WiRan	1	2	3	5	4
TMA	3	1	2	4	5
OKE	4	2	1	5	3

Source: own elaboration.

5. Discussion

Interviews in the Pomeranian ICT cluster Interizon reveal that cognitive and social proximity are key for collaboration. Geographical proximity is less important. Cluster membership (organizational proximity) plays a lesser role, suggesting that geographical proximity and cluster initiatives do not play as big a role as one might expect for supporting ICT sector innovation. However, it should be noted that the ICT industry differs from traditional industries. Its products can be developed over larger geographic distances and sent anywhere using information and communication technologies. Cluster members seeking synergies should build informal relationships to foster proximity in other areas. Although the study was conducted for Poland, its results may also be applied in cluster policies of other countries. It would be worthwhile to consider the role of different types of proximity, which may not create innovation "but serve as an enabling factor for it to happen" (Runiewicz-Wardyn, 2024). The study's small sample limits generalization, but its aim is to verify theory in practice. Further research with a larger, representative sample is recommended.

6. Summary

The concept of proximity provides a framework for analysing different spatial organisations such as clusters. The aim of the paper is to answer the question of which aspect of proximity is crucial for innovative projects carried out in ICT firms located in clusters. The study is based on interviews conducted in the Pomeranian cluster Interizon. The results confirmed that cognitive and social proximity are crucial for collaboration, while geographical proximity plays a lesser role in the innovation process.

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SYSTEMIC SHAPING OF OCCUPATIONAL SAFETY AS A FACTOR FOR THE FUNCTIONING OF INDUSTRY 4.0 (I4.0)

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Purpose: The aim of this article is to indicate the possibilities of reducing the burdens related to the lack of safety, occurring in I4.0 enterprises.
Design/methodology/approach: The study links the guidelines for the systemic management of occupational safety, indicated in the ISO 45001 standard, with the conditions of operation of I4.0 of enterprises.
Findings: The study indicates key factors that determine the efficient functioning of Industry 4.0. The diagnosis showed that taking into account OHS guidelines may be an important condition for ensuring the efficient operation of machines and technical devices. This condition also occurs when a person only performs support functions related to maintenance.
Research limitations/implications: It seems reasonable to specify the existing relationships, e.g. the positive and negative impact of the industrial revolution on the consequences related to the state of occupational safety should be determined. It is necessary to consider the impact of new technologies on individual groups of employees.
Practical implications: The obtained results indicate the need to take into account safety issues in order to ensure effective implementation of the I4.0 guidelines. This should be considered as important information for people (entities) involved in purchasing, launching technical devices and ensuring the maintenance of machines used in I4.0.
Originality/value: The limitations affecting the effective use of technical equipment were identified. It was indicated that the improvement could be based on the guidelines of the systemic management of occupational health and safety. The obtained indications are addressed to people in I4.0 enterprises who make decisions related to the purchase and use of machines and technical equipment.
Keywords: operation of technical equipment, Industry 4.0 (I4.0), improving the conditions of use of technical devices, work safety, occupational safety management.
Category of the paper: Research paper.

1. Introduction

Ensuring safety at work constitutes a crucial factor in the effective functioning of industrial enterprises. It can be perceived as a way to reduce losses due to the lack of provided working conditions for efficient performance of occupational duties. Most often, such losses are the consequence of incidents that were that were the effect of existing hazards or lack of supervision over the performed tasks.

Based on the characteristics of severity of incidents, it can be clearly concluded that the most serious consequences are generated by contact with technical equipment (Górny, 2024a; Singh, et al., 2025). Usually, such injuries are characterized by a high level of consequence, causing significant burden to all the parties of the realized workflows. It also refers to an environment that involves the use of technical equipment, if its proper functioning requires human involvement.

When implementing improvement measures, it is necessary to acknowledge their purpose, effectiveness, nature, existing interrelationship, possibility to make ongoing changes and the competence requirements determining the realization of production tasks according to the guidelines adopted within the organization in scope of its functioning. In this sense, it is particularly important to take into consideration the solutions which reduce the number and severity of incidents. The areas for improvement can be determined through the application of systemic work safety management. This will ensure the proper choice of technical equipment, with the acknowledgment of the possibility to implement production-related tasks and, at the same time, minimize the existing burden. In order to ensure efficiency of the adopted solutions, it is necessary to identify the needs and indicate the validity as to their choice.

In particular, incidents play a major role in the shaping of the economic position of the enterprise. It is estimated that losses related to accidents at work amount several percent of the day-to-day operating costs of enterprises. When analyzing the existing losses, one should also take into consideration the employer's civil liability for the resulting losses. In the recent years, the size of the losses has not change in any significant way, despite of the implemented automation and robotization. However, the reasons for incidents have changed. Usually, they are the consequence of employees' improper behavior in the area where technical equipment is being used. A considerable proportion of the losses is constituted by situations related to inadequate choice of technical equipment.

2. The role of issue description

The aim of the elaboration is to indicate the crucial issues determining the ensured safety of employees in conditions of functioning and development in line with the provisions of new paradigms regarding technical development of companies. This is particularly important in the case of companies which utilize technical equipment and reduce the scope of tasks performed directly by humans, i.e., companies that apply solutions according to the I4.0 guidelines.

This dissertation characterizes the proposed sustainable safety management at a I4.0 organization. This elaboration has been based on a proceeding methodology in line with the need to ensure safety, realized on a systemic basis, taking into consideration the conditions in which an industrial organization operates.

The dissertation has been concentrated on the discussion concerning the possible application of the guidelines of systemic occupational safety management in I4.0, indicating the key conclusions for managers and decision makers, employees of OH&S departments as well as researchers.

3. Theoretical background

3.1. Safety in the operation of Industry 4.0

The end of the 20th century and the beginning of the 21st century determine a period characterized by a rapidly increased pace of technological development. Due to the changes, the mechanization of work positions and the realized processes has increased and is still growing. One of the methods to extend automation of labor is by implementing the solutions provided for in Industry 4.0. It is a new concept of realization of production-related tasks as part of which the efficiency of conducted processes is increased through automation and digitization (Arana-Landín et al., 2023). The intended effect is accomplished with digitization and integration, undertaken vertically, horizontally and comprehensively (Ghobakhloo, 2018; Wang et al., 2023). This involves the need to introduce changes in production systems, IT and communication technologies, utilization of the Internet of Things and machines used in cyber-physical systems (CPS), which then allows for the required integration (Lu, 2017; Pandey et al., 2024). The process creates possibilities in the scope of optimized operations, reduced costs and faster response to the market demand (Singh et al., 2025). The I4.0 approach allows for establishing an intelligent factory where cyber-physical systems control physical processes, creating virtual (digital) copies of the real world and making decentralized decisions. What is more, the said systems, with the use of the Internet of things, communicate and cooperate with humans and with one another (Wang et al., 2023). At the same time, they ensure

performance of internal services and interoperations thanks to cloud processing (Yin et al., 2018). The implemented processes are becoming more and more complex, leading to new security risks in the scope of the performed tasks (Aceto et al., 2020; Charalambous et al., 2015).

Based on the loss analysis, a significant proportion of such hazards is generated by behavior of the employees and situations resulting from an inadequate choice of technical equipment. The problem becomes more and more evident in companies that increase the use of technical equipment while reducing the scope of tasks performed directly by people.

The ensured safety, acknowledged in the guidelines for the functioning of I4.0, should be understood as the lack of situations leading to disruptions, limiting the effective performance of tasks through the related technical facilities. However, in any case when people participate in any scope of the realized tasks, the said state must be also considered with regard to the human factor (Górny, 2024a).

The changes should be associated with automation of work stands and implemented processes. Humans are no longer the performers – they become verifiers of the proper operation of technical equipment, monitoring its proper functioning. Thus, it is necessary to provide the employees with conditions characterized by efficient implementation of the new type of professional duties. Usually, it results in the need to care for the safety of persons working with technical equipment and realizing tasks that are to maintain the proper level of efficiency of such technical equipment. It becomes crucial to identify the key factors concerning humans and affecting the effectiveness of implementation of new technologies. The basic axiom of the conducted activity, i.e., the need to limit the burdens, including losses related to machine downtime and accident rate remains the same (Górny, 2024a).

In this scope, safety requirements determine the possible functioning of a human being that is a user and operator of technical devices. Safe realization of tasks assigned to humans should be considered as an important condition of the efficiency of the conducted production-related duties (Górny, 2024a). The literature provides the reasons for the risks and their impact on the identified state of work safety that has been associated with the I4.0 implementation guidelines (Arana-Landín et al., 2023; Badri et al., 2018; Górny, 2024a; Otitolaiye, Abd Aziz, 2024). The most commonly acknowledged limitations in efficient operations include:

- Functional lack of preparation of the operator and other people involved in the exploitation of technical equipment and functional ambiguity.
- Actions performed under time pressure and stress connected with the need to make complex decisions.
- Disruption of the operator's work time rhythm.
- Psychosocial burden being the consequence of an excessive amount of information.
- Excessive strain on the musculoskeletal system, partially due to the pace of the performed tasks.
- Environmental hazards related to the impact of physical factors.

- Mechanical hazards generated by direct contact with technical equipment.
- Electrical hazards connected with the use of technical equipment powered with electricity.

It has been indicated that many hazards can be prevented through the application of protective measures that take into consideration the nature of the existing hazards and instructions on how to adjust the working conditions to the needs of the participants in the conducted processes (Demir et al., 2019; Sadłowska-Wrzesińska et al., 2016; Keshvarparast et al., 2024). Technological development allowed for automatization of tasks which had been carried out by humans, reducing the entailed occupational hazards (Fantini et al., 2020; Kumar, 2024). However, the applied solutions, if implemented incorrectly, may lead to new hazards, usually related to the required presence in the environment with the used technical equipment. It needs a clear specification of the risk related to the conducted operations as well as the indication of possible improvements. When undertaking improvement actions, one must pay attention to the relations between the realized tasks, the employees and the technical equipment.

3.2. Systematic occupational safety principles related to Industry 4.0 (I4.0) guidelines

The rapid growth of automation and robotization requires solutions which will result in the effective collaboration between humans and technical equipment, ensuring safe realization of the assigned tasks. At the same time, it becomes necessary to prevent waste and losses. The production capacity of machines and the potential of people functioning in a synergetic environment should be prioritized (Górny, 2023; Jagódka, 2024). Safety in such an environment is a by-product of efficient implementation of tasks (Arana-Landín et al., 2023; Górny, 2024a). The well-being of people present in the center of production systems should be deemed as a necessity (Górny, 2023). The nature of the undertaken action, taking into account the specificity of the existing hazards, must ensure:

- Inclusion of safety requirements at all stages of the lifecycle of technical facilities, equipment and the conducted processes.
- The use of modern technical solutions which increase the efficiency of safety measures and the effectiveness of actions aimed at reducing the size of possible losses.
- Streamlining the analysis of incidents connected with the exploitation of technical equipment.
- Improving the safety culture, e.g., through increasing the work safety competence, including aspects beyond the legal requirements, and through encouraging employees to report incidents and irregularities and drawing improving conclusions.

The acknowledgment of own experience and benchmarking is an indispensable part of the undertaken action. It allows identifying problems characteristic for the type of operations and, at the same time, take into consideration the opportunities to reduce losses. The used solutions must be in line with the safety guidelines, limiting the chance of risks at their source.

When it is impossible to eliminate risks, it obligates to conduct a risk assessment to identify the most adequate methods of use of the technical equipment. Solutions based on the results of risk assessment must ensure:

- Reduction of the consequences of risks resulting from the nature, scope and way of performance of occupational tasks and exploitation of technical equipment.
- Adjusting the conditions and course of work to the individual capabilities (and limitations) of employees.
- The application of solutions eliminating the need for use of hazardous devices that are inconsistent with the desired level of technical safety.
- Prioritizing the use of collective technical protection measures over other possible protective solutions that can be implemented.

The undertaken actions should have regard to the guidelines of the adopted preventive policy and be consistent with each other.

By undertaking systemic solutions in favor of improved working conditions, it is necessary to ensure that they take place within a system of mutually related actions that increase the chances of success of the assumed objectives. The management system must ensure proper functioning of technical equipment. The elements of such system must take into consideration:

- The structure of the organization functioning according to I4.0 guidelines.
- The role and responsibility of people appointed to perform specific tasks related to exploitation of technical equipment.
- Operational activities related to ensuring the possibility of ongoing realization of manufacturing tasks.
- Training that allows for obtaining or increasing competence required to perform the assigned tasks.
- The assessment of undertaken actions, confirming the relevance of the used solutions and indicating the area of further improvements.

Providing the proper flow of information can be considered as the key action that allows reducing the impact of risks (Arana-Landín et al., 2023). The undertaken actions result in achieving compliance with systemic requirements that were previously deemed necessary. Such actions should be included in the structure of continuous improvement in order to increase the chance of gaining advantage. This requires them to be measurable in order to compare them with the determined needs.

4. Research methodology and results. Objectives and guidelines for developing systemic safety requirements in I4.0 organizations

The application of systemic management rules related to the standard risk assessment methodology is possible in the case of acknowledgment of provisions provided for in ISO 45001 and ISO 31010 standards. The standards highlight the need to comprehend the nature of the existing risks and opportunities which affect the organization's performance in the scope of creating work safety in conditions integrating new technologies. In particular, they indicate that hazards and risks should be minimized and the opportunities for improvement – maximized. This is particularly important in the case of the need for integrating I4.0 with business processes, transformation of working conditions and other conditions that directly influence the risk and need for the implementation of new solutions. An important part of the undertaken actions is the possibility of eliminating incidents or reducing their consequences.

Detailed guidelines for the realization of requirements regarding work safety management which are crucial in the analyzed situation depend on the nature of the performed tasks. The choice of the procedure option depends on the intended goals, the desired level of complexity, and the accessibility and reliability of the used data. The applied technologies must be adequately adjusted to the context of the operations and allow for clear, traceable, reproducible, and verifiable results. This also refers to ensuring the realization of tasks as part of I4.0. In order to provide safe use of technical equipment, it is necessary to acknowledge the requirements provided for in the applicable legal and technical regulations which refer to individual categories of technical equipment. For instance, due to the fact that the implementation of I4.0 is most often associated with investments in robotization of labor, it must take into consideration the possibility of involving collaborative robots (so-called cobots) (9). It is equally important to acknowledge the scope of performed tasks by people responsible for:

- The integration and commissioning of technical equipment.
- Maintaining the workflow and efficiency of technical equipment.
- Carrying out ongoing exploitation, including collaboration of employees.
- Maintaining organization and proper organization of work.

The issues in scope of I4.0 should be a part of the identification of the organization's operations. Selected guidelines for the realization of systemic work safety management depend on the nature of the carried-out tasks. Their scope has been presented in Table 1.

Table 1.
Systemic occupational health and safety management guidelines which are relevant to ensure safety at I4.0 enterprises

Scope of requirements	Guidelines for realization of requirements
Realization of systemic requirements	- Realized activities based on the adopted policy and objectives as well as processes and actions that allow achieving the pre-determined goals in the scope of implementation and use of technical equipment. - Inclusion of the aspects indicated by all the participants in the realization of I4.0 in the management system. - Acknowledgment of the relations between the human factor and the technical aspect of the conducted operations.
Identification of risks and risk assessment	- Acknowledgment of the functioning context of a I4.0 organization in the carried-out activities. - Acknowledgment of all potential hazards (e.g. mechanical, physical, mental) and their influence on the health and safety of the employees. - Implementation of solutions aimed at eliminating or reducing the impact of hazards.
Control and supervision	- Regular inspections of the technical condition of machines, devices and installations and the influence of technical solutions on the employees
Documentation and revisions	- Implementation of a system for reporting and monitoring of irregularities. - Keeping records of undertaken actions after a situation that led to limited functioning of technical equipment.
Ensuring protective measures	- Providing access to proper protective measures and implementation of solutions that ensure their proper use during the performed occupational tasks.
Training and awareness raising	- Acknowledgment of problems regarding safe exploitation of technical equipment in training programs. - Promoting culture of safety and involvement undertaken to increased comfort at work.
Accident and critical situation management	- Implementation of solutions that allow for fast reaction to all dangerous situations. - Keeping a log of accidents and incidents at work to analyze and eliminate (reduce) their cause.
Shaping of safety culture	- Supporting the involvement of employees in caring for the safe use of technical equipment. - Acknowledgment of the employees' opinions on improvement activities. - Promoting responsibility for own actions and their influence on the co-workers' safety.
Ensuring compliance of procedures with regulations of law	- Compliance with the labor law, OH&S norms and standards. - Monitoring of changes in the applicable regulations and adjusting the procedures to the new guidelines.
Ensuring continuous improvements	- Ensuring sharing experience and best practices with other entities in the scope of task performance conditions. - Implementation of assessment criteria for the efficiency of undertaken actions. - Regular audits and implementation of improvements based on the results of the conducted analyses.

Source: Source: own analysis based on (Górny, 2024a; 2024b; ISO 45001; Otitolaiye et al., 2024; Wang et al., 2023).

5. Discussion of the results

The application of I4.0 solutions may reduce the number of physical, mechanical and psychosocial hazards and improve the work ergonomics. This refers to the issues that are an integral part of the traditional performance of occupational duties in an environment

involving the use of technical equipment. However, in order to obtain the intended results, a verification of the impact of the used solutions on the potential safety improvement is needed. The application of systemic safety rules requires acknowledgement of the comprehensive nature and complexity of the used solutions, an integration of the used technologies, protection of the available data and information, as well as ensuring the employees' proper conduct.

Full automation of factories allows reducing risk. It is possible since the used machines are more and more frequently facilitated with technical measures for parameter monitoring, which is important for the process flow. Usually, the used solutions make it possible to react immediately after any occurring dysfunction. They are characterized by a self-control capability as well as the ability to monitor the surroundings and send information indicating the need for an intervention (Mattsson et al., 2016). As a result, it is possible to include such new technologies into the system of actions undertaken in order to improve health and safety and increase human efficiency in the working environment. The applied solutions can be treated as contributing to reduced burden connected with the lack of safe conditions for the performed occupational duties.

Nowadays, a large proportion of companies which declare the implementation of the I4.0 rules and solutions identifies this with investments in robots, production management systems, and other dedicated solutions. However, it very often turns out that the above-mentioned components remain unrelated and their functioning is based on the use of human factor. In practice, it means that the information used as the basis for manufacturing activities are generated and introduced by humans. Thus, it can hardly be considered as a complete implementation of the I4.0 principles. One should bear in mind, however, that the acknowledgment of human needs remains the condition for success regardless of the degree of implementation of technical solutions (Górny, 2024a; 2024b). It is impossible to ensure the effective functioning of technical equipment without human involvement, even if people are only used for monitoring and maintenance tasks.

Efforts in order to improve safety (taking into account I4.0) require:

- A verification of the level of integration of human labor with the used technical equipment.
- Conducting an analysis of the impact of existing hazards on the development of social accountability of companies and the effective functioning of new technologies.
- Assessing the consequence of the impact of applied solution on work organization and the existence of psychosocial risks.
- Determining standards of procedure to adjust working conditions to the new reality.
- Applying solutions that distribute tasks among employees and intelligent machines, taking into consideration the physical and cognitive capabilities of the workers.
- Ensuring effective and continuously improved protective measures against an unauthorized access to recorded data and information.

Regardless of the used technical solutions, it is crucial to implement a psychosocial environment based on cooperation. This incorporates:

- Improving specialist knowledge and motivation of the employees, promoting safe collaboration between the employees and the technical equipment.
- Developing adaptive interfaces and emotion sensors that allow monitoring the employees and ensuring their ongoing safety.
- Shaping human behaviors, reactions to stress, difficulties and hesitation.

The undertaken initiatives must combine a virtual task analysis, dynamic risk assessment and a workload analysis (Górny, 2024b).

Regardless of the nature of the adopted solutions, the work environment configuration must be concentrated on people, their security and comfort. This condition is needed for the efficient realization of the tasks assigned to them. Improvement activities must acknowledge the possibility of technical equipment performing the tasks and should be adjusted to the limitations on the human side. The said requirements should be juxtaposed with the nature of tasks carried out by individual groups of employees.

6. Conclusion and future research directions

The efficiency of the used solutions depends on their nature and the reasons for the implementation that must be thoroughly identified as well as on the method of implementation of the requirements. The use of systemic management guidelines helps ensure a safe and friendly working environment. The resulting advantages can have a considerable impact on the efficiency of the I4.0 activities. Their application can lead to lower losses and, consequently, improved conditions of the realized production tasks.

The conducted diagnosis of the problem presented in the title of this elaboration helped identify the conditions for development of manufacturing activities where work safety aspects are recognized as the decisive factor for their successful completion while improvements are introduced through systemic approach guidelines. To assess whether the above-mentioned effects are possible, further in-depth search is needed to determine the existing dependencies and their practical verification, taking into consideration the actual circumstances, existing in industrial in industrial organizations that grow their operations according to the I4.0 guidelines. In particular, it is needed to acknowledge the guidelines of systemic occupational health and safety management during the process of putting technical equipment into operation. It should be considered as assistance in the conducted processes, realized with regard to the efforts aimed at ensuring resources necessary to gain advantage in all the areas of operations of the enterprise.

Acknowledging the existing dependencies, one should determine the positive and the negative impact of the industrial revolution on the consequences connected with the state of work safety. The influence of new technologies on individual employee groups should be analyzed. The characterization of the issues related to the implementation of solutions based on the I4.0 guidelines should not refer solely to problems regarding efficiency, quality and competitiveness. It should acknowledge all the requirements that might have a negative effect on the realization of occupational duties. This includes requirements that relate to ensuring work safety. One should bear in mind that the implemented technology generates its own specific hazards.

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CHALLENGES FOR SOCIAL CAPITAL IN THE TIMES OF GLOBALIZATION – THE EXAMPLE OF MICRO AND SMALL ENTERPRISES

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Purpose: The aim of the article is to identify the challenges faced by social capital in the group of micro and small enterprises against the background of ongoing globalization processes.
Methodology: The research methods used to prepare this study were critical analysis of the literature and own research carried out using the CAWI method on a group of over 360 respondents from micro and small enterprises. The research results described in the article are part of a multi-stage research project on the role of social capital in economic processes in Poland, which has been carried out since 2023.
Findings: With the development of globalization, there are new challenges with adaptation to new conditions for the micro and small companies. As it results from the conducted analysis, one of such resources allowing to survive in the world of dynamic globalization processes, that can contribute not only to maintaining the continuity of economic processes, but also to increasing competitiveness is social capital.
Research limitations: The conducted research, due to the multithreaded nature of the issues raised, imposes limitations on the level of detail of the presented problems, while at the same time opening up the possibility of deepening them in subsequent stages of the conducted research.
Originality: The growing role of social capital in micro and small enterprises and the perception of this resource as a remedy for dealing with the challenges posed by dynamic globalization processes allows for a positive verification of the assumption adopted in the research in question and allows for the recognition of the goal adopted in the introduction to the article as achieved.
Keywords: globalization, economic entities, enterprises, social capital.
Category of the paper: Research paper.

1. Introduction

Globalization is a consequence of contemporary civilization processes. Although some authors point to the 16th-17th century and the rise of colonialism as the first signals of ongoing globalization, it was not until the second half of the 20th century that we observed the dynamic development of globalization processes (Miszewski, 2019, p. 9). Globalization has taken place in all aspects of socio-economic life. The complexity of global processes is evidenced by the discussion on the definition of the concept that has been going on for many years. According to G. Kołodko, "in the economic sense, globalization is a historical and spontaneous process of liberalization and integration of previously functioning to a certain extent in isolation markets and national economies into one interconnected, interdependent global market of goods, capital and technology" (Kołodko, 2022, pp. 303-304). The bonds that unite the essence of globalization are the liberalization, integration and interdependence of markets and economic entities operating on them. In turn, J. Kleer emphasizes that "globalization manifests itself mainly in increasingly stronger market links between the economies of sovereign {states}, which enable the flow of goods, capital, modern technologies, and labor. Such flows, as well as the emergence of numerous forms of cooperation between entrepreneurs from different countries, force the creation and relatively good functioning of international institutions" (Kleer, 2013, p. 63). Globalization is supposed to, on the one hand, enable the flow of various forms of capital and their allocation to places where they are optimally used, and on the other hand, change institutions that are supposed to enable cooperation between states and economic entities within the framework of the exchange of resources and making decisions on their allocation.

Globalization processes favor the development of transnational corporations, which, thanks to incomparably greater resources, are able to reach the farthest corners of the world, creating new sales markets and thus achieve an even stronger competitive position, thus weakening micro and small enterprises. This spiral, driven by increasing market disproportions and asymmetries, means that some of the smallest entities lose and withdraw from the global village in which economic processes dominated by large players take place. Other companies, wanting to ensure the continuity of their economic processes, are looking for new opportunities and business solutions that can ensure their survival and strengthen their market positions in the long term. One of such resources that allows these smallest entities to survive and develop in times of globalization is social capital. In the environment of micro and small companies, awareness of social capital is growing, which, like other resources, can bring measurable economic benefits. The foundations of social capital are trust, networks of relationships, cooperation based on a win-win model, reinforced by values such as reliability and responsibility, assistance in achieving individual and collective goals. Social capital built in this way by entrepreneurs can contribute to strengthening the competitive position in the local

environment. By using the effects of globalization, such as digital tools that support the development of international networks of relationships, social capital can create opportunities for companies to enter markets previously perceived by them as inaccessible.

2. Methods

The aim of the study is therefore to identify the challenges posed by globalization processes, especially in relation to the smallest economic entities (i.e. micro and small companies) and to attempt to determine the role of social capital as an economic resource that can help small enterprises maintain a competitive position not only in the local environment.

The article uses the method of critical analysis of the subject and analysis of the results of own research conducted using the CAWI method on a group of over 360 entities. The research results presented in the article are part of a multi-stage research project on the role of social capital in economic processes in Poland, which has been conducted since 2023.

3. The Challenges of Globalization and Social Capital – an Example of Micro and Small Enterprises – discussion

Globalization has introduced both numerous benefits and new challenges, significantly influencing economic processes. The most important advantages include:

- the development of large market players (transnational, international corporations), for whom globalization processes have enabled faster development by reaching the most distant sales markets, thanks to which they consolidate their positions in the global economy,
- more efficient use of the resources of individual societies in the production of goods meeting global demand, which has influenced the increase in the quality of products and services,
- optimization of production chains while reducing production and transaction costs,
- increased competitiveness of economic entities in the domestic and international arena,
- greater openness to cultural diversity (thanks to the development of technology and digitization, cultures interpenetrate each other),
- unlimited access to technology, achievements of science, culture and art,
- mutual economic dependence of states, which facilitates the formation of alliances and at the same time limits conflicts,

- international cooperation, which alleviates economic disparities (for example, foreign investments create jobs, thus mitigating the effects of local unemployment levels).

The main weaknesses of globalization include:

- growing crises and lack of institutional solutions,
- disparities in economic and social development resulting from, among others, polarization of investments in developed countries or from different demographic situations, such as demographic growth, especially in poor countries, while in developed countries – higher life expectancy (social dimension),
- loss of cultural differences,
- degradation of the natural environment, which is a consequence of the development of global industry and urbanization; stagnation and weakening economic growth dynamics, especially in developed countries,
- greater market asymmetries (including information asymmetries causing, among other things, chaos in rational decision-making by economic entities),
- increasing degree of risk related to uncertainty and instability of economic processes (Mączyńska, 2018, p. 309).

Globalization processes have posed the greatest challenges to the smallest economic entities, i.e. micro and small companies. Limited access to technological or capital resources often prevents opening up to new sales markets, which puts them in the shadow of strong competition from large global players. Small companies, in the face of growing challenges from the global world, such as digitization, automation, rapidly changing trends in consumer behavior, economic instability, must seek solutions within their capabilities that will ensure the continuity of their economic processes in the long term. Therefore, entrepreneurs are becoming more aware of cooperation and, consequently, of the role of social capital in economic processes. Social capital is defined as an economic resource (Bourdieu, 1986, p. 248; Putnam, 1995, p. 258; Coleman, 1998, p. 109) that can be used in economic processes in the era of globalization and that can help entities survive in unpredictable situations, including those related to the risk of losing economic continuity. Seen as a multidimensional aggregate of informal and formal institutions, it enables entities to cooperate with others and supports the implementation of common goals in conditions of unstable market mechanisms (Grabowska-Powaga, 2019, p. 116). The analysis of social capital can take place at various levels of its impact: trust, communication, interpersonal relations, and social involvement (Figure 1).

Social capital defined in this way is becoming increasingly important in conditions of uncertainty caused by the occurrence of market asymmetries, which can erode crises and lead to the destabilization of entire economies in the long term (Grabowska-Powaga, 2024, p. 26).

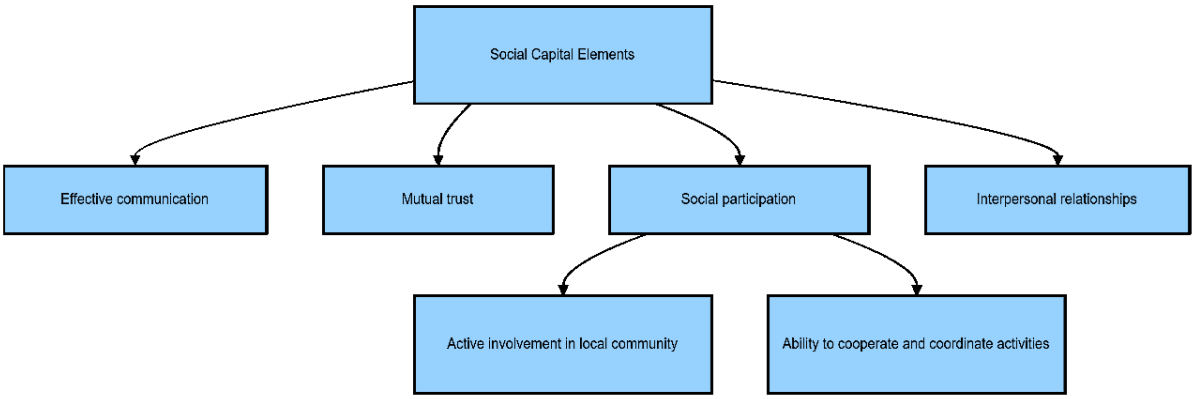


Figure 1. Elements of social capital in enterprises.

Source: own study.

Social capital is defined as an accelerator of economic and social progress (Jędrych, Klimek, 2018, p. 228; dialogkig.pl, 2017) or can also affect the increase in the competitiveness of economic entities. Social capital should be developed in particular in the smallest enterprises, which, due to limited resources, should see in it the benefits enabling development and maintaining the continuity of conducted economic activities. Social capital strengthens employees' trust in each other, facilitates the flow of information, increases motivation and commitment to achieving the organization's goals. Important advantages of social capital built in this way in enterprises are the reduction of transaction costs, increased innovation, and building a positive image of the company. It should be remembered that a deficiency or distortion of the foundations of social capital may constitute a significant threat to the stability and effectiveness of the functioning of an organization. Information asymmetry, lack of trust of employees in the enterprise may lead to conflicts that will thwart the achievement of the company's goals. In turn, too strong relationships may distort the objective perception in decision-making by entrepreneurs or lead to the marginalization of individuals outside the group in which social capital was created (Table 1).

Table 1.
Advantages and disadvantages of social capital in micro and small enterprises

Attributes of social capital	Advantages	Disadvantages
Communication	Reliable information that is characterized by symmetry among its recipients can increase the responsibility and involvement of individuals in the joint achievement of the company's goals.	Lack of information or its asymmetric flow may become a source of misunderstandings and conflicts among individuals.
Trust	Trust influences the development of relationships, motivation, creativity, and identification with a group.	Lack of trust or its limitation can lead to demotivation, discouragement or disorganization of work in the company.
Interpersonal relations	Dense networks of relationships make it easier for entities to access resources, and thus increase the competitiveness of companies.	Relationships that are too strong can make it difficult to make objective decisions.
Social participation	Belonging to a given group implies an increased level of commitment to achieving common goals.	In a group that is linked by strong relationships, there is a risk of marginalizing people outside the group.

Source: own study based on: Jędrych, Klimek, 2018, p. 228; dialogkig.pl, 2017, own research.

With the advent of the globalization era, the conditions shaping resources and their use in economic processes have changed. Factors influencing the formation of social capital have also changed, posing new challenges to it. First of all, globalization processes have caused market asymmetries through uneven access of entities to resources. The role of the largest market players has increased significantly, who, thanks to unrivaled resources, have strengthened their monopolistic positions in the global economy. At the same time, globalization has forced micro and small enterprises to seek new opportunities that would ensure the continuity of economic processes in the long term. As a result, awareness of the importance of social capital has increased among entrepreneurs of micro and small companies, who increasingly strive to build a management culture in their organization based on trust and cooperation with other entities. Globalization and, along with it, the progressive process of digitization and the dynamic development of artificial intelligence (AI) have influenced the development of the information society, in which communication, creativity, and knowledge play an important role, which directly create intellectual capital - another important component of social capital (Jedlińska, 2013, p. 27). Digital tools have enabled economic entities to establish relationships with other entities around the world. Such tools include various social media platforms (such as Facebook, Instagram), communication platforms (Google Meet, Teams, etc.). In establishing business relationships, platforms supporting the development of relational networks (such as Meetup) or platforms intended for thematic groups (such as crowdfunding, marketing platforms, etc.) are also used. Their conscious and effective use in establishing relationships and cooperation can successfully serve to build and consolidate bonds that build social capital. The consequence of globalization processes is the migration of people (Baszczak, Kiełczewska, Rozbicka, Wincewicz-Price, Zyzik, 2024), and consequently an increase in cultural diversity on labor markets or in business cooperation. Cultural diversity based on tolerance (Jedlińska, 2013, p. 27) and trust can contribute to the development of bonding social capital or bridging social capital. Bridging capital is particularly important in the development of the competitiveness of micro and small companies. It allows for leaving a certain relational and information bubble, enables establishing relationships with external entities, which can, by making their resources available, create completely different conditions for building a competitive advantage for micro and small companies than before. Companies that are unable to establish bridging capital may be less innovative on the market.

The above observations became the premise for conducting in-depth own research, the guiding hypothesis of which was the growing role of social capital in micro and small enterprises as a certain antidote to coping with the challenges posed to them by dynamic globalization processes.

4. Social capital in micro and small enterprises – selected results

The presented research results are part of a multi-year project focusing on the role of social capital in economic processes in micro and small enterprises. Over 360 entities representing this sector participated in the research stage on shaping social capital in micro and small enterprises in the era of global processes. The research was conducted using the CAWI method in 2023-2024. Due to the editorial limitations of this study, arbitrary excerpts from a wide range of research problems identified during the implementation of the project are presented below. Due to the analyzed problem, respondents were asked about the ability to establish and maintain relationships with other local entities (creating the so-called bonding capital) and with external entities - supra-local (shaping the so-called bridging capital). Among the respondents, 78.5% declared local cooperation, 53% supra-local (Figure 2).

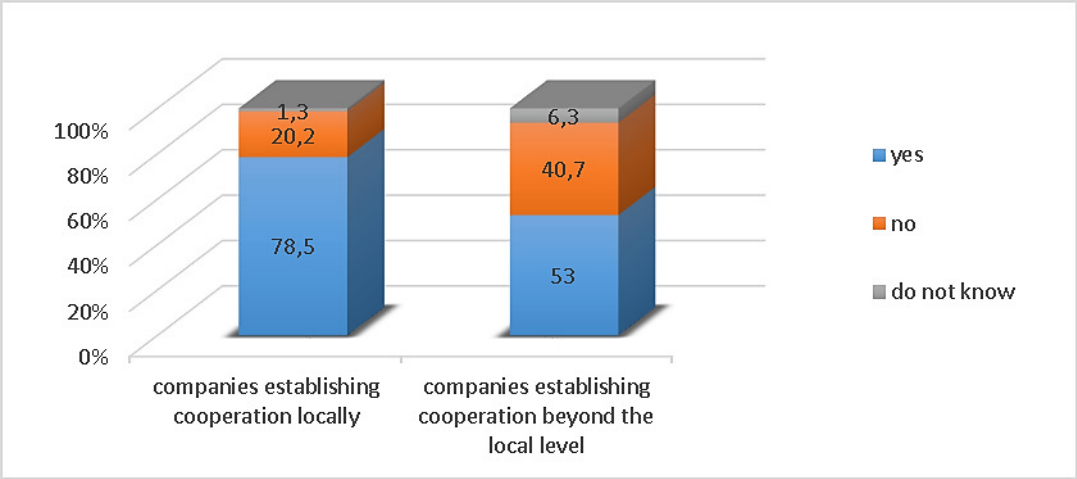


Figure 2. Companies establishing cooperation in total.

Source: own study.

These results resonate with the observations presented earlier. Stronger bonding capital certainly increases the efficiency of a given group of entities, but it is bridging capital that can, by expanding the cooperation network, enable faster development and affect the competitive position of a given company. It should be noted, however, that the assessment of supra-local cooperation has significantly increased in times of global crises (such as the COVID-19 pandemic or the war in Ukraine) from 10% to 35% of respondents assessing it as good (a similar measurement indicated a lower level of satisfaction with local cooperation - from 65% of respondents assessing it as good before the COVID-19 pandemic to 55% of respondents satisfied with cooperation during the crisis) (Figure 3).

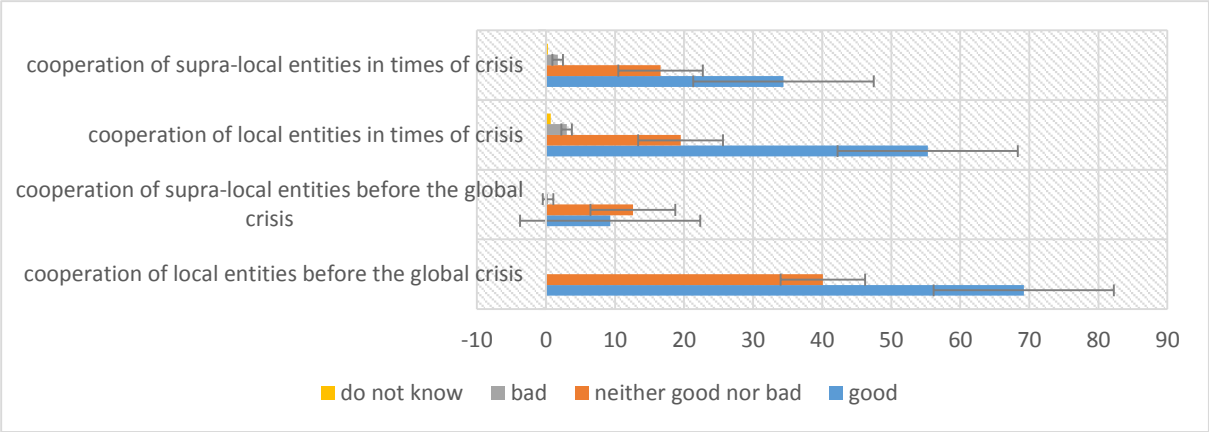


Figure 3. Assessment of business cooperation before and during the global crisis.

Source: own study.

The research results indicate that 67% of respondents representing this group of entities use digital tools to establish and maintain business relationships. These are most often social media platforms like LinkedIn, Nextdoor, Instagram (84%), communication platforms like Slack, Zoom, Google Meet (67%), thematic platforms like Reddtit, Quora (17%) or business networking platforms (6%). There are crowdfunding platforms like Patreon or marketing platforms like Google My Business, Etsy, which are used by Respondents very seldom (1%) (Figure 4).

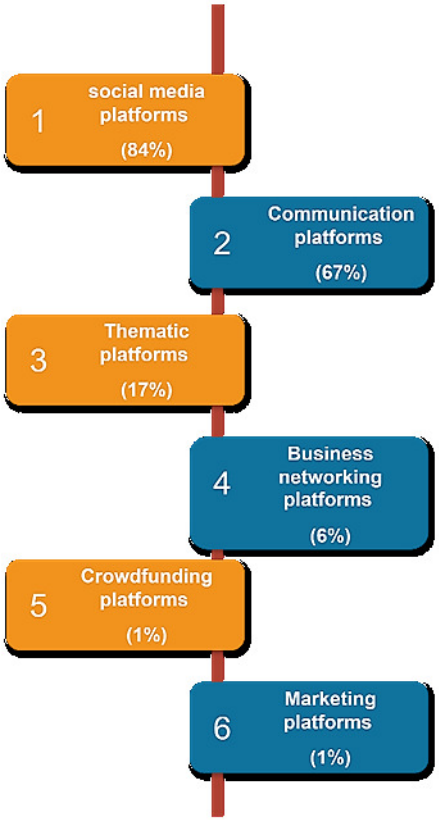


Figure 4. Digital tools used by micro and small companies to build relationships with the other entrepreneurs.

Source: own study.

The foundation shaping social capital is the trust of entrepreneurs in other entities. It is higher in the group of local entities (66%) than supra-local ones (43%) (Figure 5).

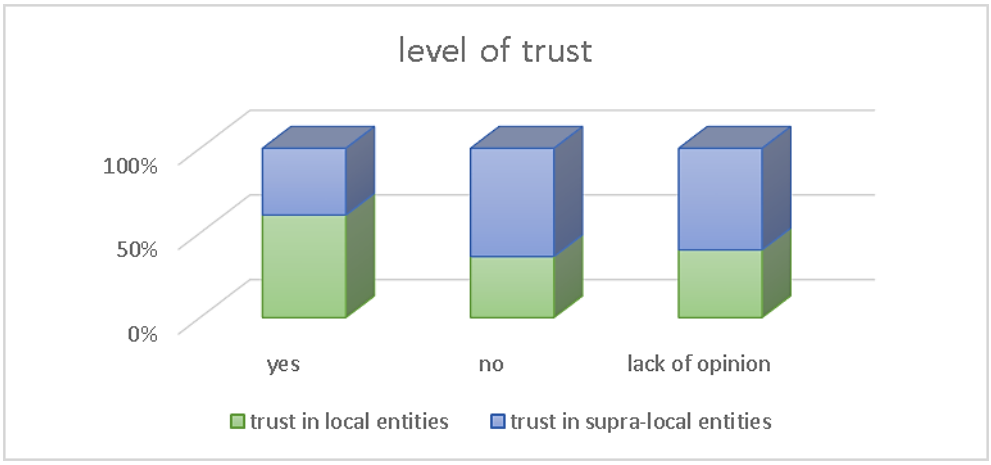


Figure 5. Respondents' trust in local and supra-local entities.

Source: own study.

Lower trust in supra-local entities may result from a certain fear of anonymity, diversity of entities, risk of established relationships. Social capital is also characterized by the network of relationships that entities establish locally and supra-locally. The results of the conducted research indicate that both in the context of bonding and bridging capital, entities most often build numerous lasting ties, over one year (44% in the case of local entities, 38% among supra-local entities). The rarest in the group of local entities are single, short relationships, up to one year (8%), in the group of supra-local entities, numerous, short-term relationships are sporadically established (11.3%) (Figure 6).

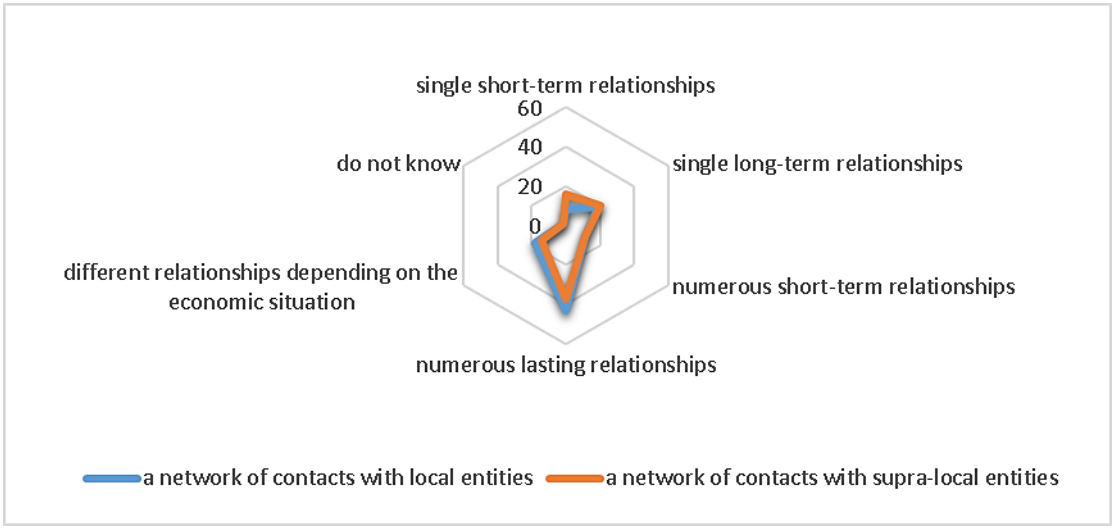


Figure 6. A network of relationships between local and supra-local entities.

Source: own study.

Based on the research results, it can be concluded that the relationships established among local entities can be homogeneous, closed, based on mutual trust, similar values and goals, while among supra-local entities, the bonds built are open, diverse, characterized by limited

trust. However, as the research shows, the networks of relationships in the local and supra-local environment can be identified as dense and long-lasting. This observation is crucial for the social capital itself and its ability to survive in the long term.

5. Summary

The conducted research, due to the multithreaded nature of the issues raised, imposes limitations on the level of detail of the presented problems, while at the same time opening up the possibility of deepening them in subsequent stages of the conducted research. At the same time, the results obtained so far allow for conclusions that are important in relation to the subject.

Globalization has changed processes at all levels of socio-economic life, has caused an even greater dichotomy between large market players and the smallest entities that are looking for opportunities to continue their economic processes in an increasingly automated and digital global reality.

As it results from the conducted analysis, one of the possibilities allowing for maintaining in the world of dynamic globalization processes has become social capital and perceiving it as a resource used by entrepreneurs in economic processes. and globalization itself through network communication of social communities (often using digital tools) has become an opportunity for its development.

The growing role of social capital in micro and small enterprises and perceiving this resource as a certain remedy for dealing with the challenges posed to them by dynamic globalization processes allows for a positive verification of the assumption adopted in the research in question. In turn, the identification of the challenges posed to social capital by the contemporary global world (including deepening market and information asymmetries, the accompanying automation and digitization, the multi-dimensional diversity of interpenetrating cultures) allows us to consider the goal adopted in the introduction to the article as achieved.

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RELATIONSHIP BANKING AND POST – CRISIS RECOVERY: EVIDENCE FROM THE POLISH SME SECTOR

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Purpose: The article examines a possible influence of relationship banking on financial situation of Polish small and medium-sized enterprises during the post-crisis recovery period.
Design/methodology/approach: An analysis of existing data and original data (survey) regarding banking relationships and financial situation of companies was conducted with the use of panel regression models.
Findings: There exists an adverse effect of banking relationships on companies' financial situation during the post-crisis recovery period. Firms that closely cooperated with their lenders in the studied period suffered due to higher cost of credit and excessive debt. No statistically significant correlation between relationship banking and SMEs' profitability was found, though.
Research limitations/implications: Due to the low response rate in the survey the size of the sample is limited. There might be also other factors that were not included in the models, which may have some impact on the results. Including other banking relationship's characteristics, such as their duration, scope or number of relationship in which a company is engaged might be possible future directions for further research.
Practical implications: The results might be significant from the perspective of companies when selecting their source of capital. Findings of the study suggest that relationship banking may not be the optimal choice for companies during the recovery period and other forms of financing should be also considered.
Originality/value: The conducted study shows that banking relationships might have a negative impact on borrower's financial situation during the post-crisis recovery period. Such problem has been rarely studied in the existing literature and the results were ambiguous. Furthermore such problem has not yet been studied in the context of Poland.
Keywords: relationship banking, financial crisis, information asymmetry.
Category of the paper: Research paper.

1. Introduction

The COVID-19 pandemic and the Russian invasion of Ukraine have plunged the global economy into crisis. One of the sectors that has suffered the most is the small and medium-sized enterprise (SME) sector. With the onset of the economic crisis, many companies urgently needed additional funds to help them survive this period and allow them to return to growth in the post-crisis recovery phase. One potential source of funding is relationship banking. This form, based on a close relationship between lender and borrower, can provide a solution to problems of access to capital.

The existing results of research in this area indicate that relationship banking enables companies (including SMEs) to count on easier access to capital and more favourable terms during the economic crisis. This, in turn, is an important aid for companies affected by the crisis and allows them to survive this period. This is related to the fact that through long-term cooperation, based on repeated interactions between both parties, the negative effects of information asymmetries and transaction costs, which are particularly acute during a downturn, are reduced. Rosenfeld (2014) argues that these benefits also occur during economic upturns, when companies begin to recover from the crisis.

The purpose of this article is to analyse whether and, if it does, how the use of relationship banking by companies in the Polish SME sector influences their financial situation during the post-crisis recovery period. This research problem has so far been rarely analysed, especially in the context of Central and Eastern European economies. Existing literature has not been able to clearly determine the existence of such relation. Therefore, there exists a noticeable research gap. The analysis covers three issues: the cost of capital for companies, their profitability and their debt level. To verify the impact of banking relationships on these three issues three hypotheses were formulated. First hypothesis states that banking relationships have a positive impact on the cost of credit for the borrower, second hypothesis says that banking relationships have a positive impact on the borrower's profitability and third hypothesis implies a positive impact of banking relationships on the borrower's debt level during the post-crisis recovery period. Panel regression models with random effects based on a random sample of Polish small and medium-sized enterprises in the period 2010-2015 were used to verify the hypotheses.

The findings indicate that not only does relationship banking not have a beneficial effect on the situation of small and medium-sized firms during the economic recovery, but the effect is the opposite. Companies using this form of cooperation had a higher cost of capital and excessive debt, which contrasts with the results of Rosenfeld (2014).

2. The importance of relationship banking in corporate finance

Relationship banking can be defined as the offering of financial services by a financial intermediary who makes an investment in the acquisition and collection information about the client and evaluates the potential returns on that investment during repeated interactions with him that take place over time (Boot, 2000). Given this definition, there are essential elements to it: the acquisition and collection of information about the client and a long-term relationship based on repeated interactions. The financial intermediary (usually a bank) obtains information about the client primarily during the initial screening process of its potential client and during the subsequent monitoring process. Among the relevant information that is collected by the financial intermediary is soft information, i.e. information that is not usable by any other person than the one who produced it (Stein, 2002). This is due to their subjective nature. Such information can include, for example, rumours, opinions, assessments. This distinguishes relationship banking from transaction banking, which is based purely on hard information, i.e. figures extracted from sources such as financial statements. The second point important from the perspective of relationship banking is its long-term nature. It allows for the accumulation of an ever-increasing body of knowledge about the client and the use of this knowledge in subsequent interactions with the client. This is important since it reduces information asymmetry and transaction costs (Beck, 2013).

Reducing the adverse effects of information asymmetry can result in improved credit availability and more favourable credit terms for borrowers (Boot, Thakor, 1994; Brick, Palia, 2007; Bonfim, Dai, Franco, 2018). In addition, banks incur transaction costs in the lending process, which are mainly fixed. This ability to reuse previously collected information makes it possible to reduce these costs in subsequent transactions with a given client. This may also improve accessibility, terms and conditions of credit services for businesses (Angori, Aristei, Gallo, 2020). The aforementioned benefits can be particularly relevant from the perspective of small and medium-sized enterprises, i.e. entities that are characterised by greater opacity and therefore have more difficult access to external sources of finance (Hasan et al., 2017). Relationship banking, however, is not necessarily always beneficial for the borrower. The danger associated with a close relationship with a bank is the hold-up problem. As the relationship develops, the information asymmetry regarding the borrower between its bank and the other banks increases. Then the lender with which the company cooperates can take advantage of its dominant position and begin to offer its services on increasingly worse terms. The company, in turn, is unable to turn to other banks, which will refuse for fear of the so-called winner's curse. They will believe that the company has approached them on the grounds that it had been refused by their relationship bank due to some factors of which they are unaware. The client is then forced to continue cooperation with their current lender or give up the financing completely (Sharpe, 1990; Mattes, Steffen, Wahrenburg, 2013; Zhang, Song, Zhong, 2016).

Initial analyses of the impact of relationship banking on the situation of companies were primarily concerned with periods of prosperity. It was not until the onset of the global financial crisis in 2007-2009 that there was a significant increase in interest in analysing this problem from the perspective of the crisis period. When there is a widespread economic crisis, it is necessary to consider both the party providing the financing and the party making demand for this financing. Companies affected by the crisis will report a need for this financing. Companies affected by the crisis will report a need for additional funds that could allow them to survive the downturn. Due to the unfavourable situation in the sector, banks, in turn, will have limited opportunities to finance companies (especially those that are less transparent and therefore higher risk) and will have to select their clients more carefully. In such a situation, a prior relationship with a lender may provide an advantage for businesses over their competitors. A bank that has additional information about its clients is better at estimating the risk of the loan and assess whether the company in question can survive an unfavaourable period, and be a profitable client later on. Current empirical results mostly indicate that companies, previously using relationship banking during the crisis, could count on, among others, better credit availability (Albertazzi, Bottero, 2014; Sette, Gobbi, 2015; Bolton et al., 2016; Meslier, Sauviat, Yuan, 2020; Flögel, Gärtner, 2020) and lower price for their credit services (Gambacorta, Mistrulli, 2014; Sette, Gobbi, 2015).

While the importance of relationship banking in the context of an economic crisis a frequent subject of empirical studies, the recovery period following the crisis has so far rarely been analysed. As Rosenfeld (2014) demonstrates, relationship banking also adds value for companies in this phase. The author points out that companies using this form of financing were more likely to be able to recover from the crisis than other entities and were characterised by better financial performance. Accordingly, three research hypotheses are formulated:

1. H1: Banking relationships have a positive impact on the cost of credit for SMEs during the post-crisis recovery.
2. H2: Banking relationships have a positive impact on SMEs' profitability during the post-crisis recovery.
3. H3: Banking relationships have a positive impact on SMEs' debt level during post-crisis recovery.

3. Data and methodology

In order to verify the research hypotheses, a panel of data covering a random sample of small and medium-sized enterprises from Poland was constructed. The data cover the period from 2010 to 2015, i.e. the period of recovery from the global financial crisis. The financial data was gathered from the Amadeus database owned by Bureau van Dijk. Data relating to

banking relationships, on the other hand, were obtained from a survey of the drawn companies. The sampling process took place in three stages. First, those entities that remained active at the end of the survey period were identified. Second, firms that did not meet the European Commission's definition of small and medium-sized enterprises were rejected (according to the accepted definition, SMEs are companies with fewer than 250 employees and annual turnover of less than EUR 50 million and/or an annual balance sheet of no more than EUR 43 million). From the remaining 26,411 entities, a sample of 1000 companies was drawn (including: 248 micro, 545 small and 207 medium-sized enterprises). A survey was conducted among these entities, in which company representatives were asked to answer a set of questions on whether they use relationship banking and the nature of this cooperation. 315 companies chose to participate in the survey. 161 companies (51.11%) responded that they had used this form of financing during the surveyed period.

Three dependent variables were constructed for the study. The variable *Cost_of_credit*, defined as the company's interest expenditures divided by its total liabilities, is used to verify the H1 hypothesis. The generalised model is presented in the following formula:

$$Cost_of_credit_{i,t} = \beta_0 + \beta_1 C_{i,t} + \beta_2 R_{i,t} + \beta_3 T_{i,t} + \beta_4 I_{i,t} + \varepsilon_{i,t} \quad (1)$$

The dependent variable is the ratio of interest expenditures to total liabilities of firm i in year t, $C_{i,t}$ is a set of variables controlling for various firm characteristics, $R_{i,t}$ is a variable indicating the fact of using relationship banking, $T_{i,t}$ are time dummies, $I_{i,t}$ are industry dummies.

The second explanatory variable is *Profitability*, which is the return on sales ratio (ROS) calculated as the ratio of operating profit to sales revenue. The generalised model is defined by the following formula:

$$Profitability_{i,t} = \beta_0 + \beta_1 C_{i,t} + \beta_2 R_{i,t} + \beta_3 T_{i,t} + \beta_4 I_{i,t} + \varepsilon_{i,t} \quad (2)$$

The dependent variable is EBIT to sales ratio of firm i in year t, $C_{i,t}$ is a set of variables controlling for various firm characteristics, $R_{i,t}$ is a variable indicating the fact of using relationship banking, $T_{i,t}$ are time dummies, $I_{i,t}$ are industry dummies.

The third variable used to verify the H3 hypothesis is the variable *Debt*. The ratio of total debt to total assets of the entity was used to calculate it. The generalised formula is defined by the equation below:

$$Debt_{i,t} = \beta_0 + \beta_1 C_{i,t} + \beta_2 R_{i,t} + \beta_3 T_{i,t} + \beta_4 I_{i,t} + \varepsilon_{i,t} \quad (2)$$

The dependent variable is total debt to total assets ratio of firm i in year t, $C_{i,t}$ is a set of variables controlling for various firm characteristics, $R_{i,t}$ is a variable indicating the fact of using relationship banking, $T_{i,t}$ are time dummies, $I_{i,t}$ are industry dummies.

Table 1 provides a description of the variables used in all models. The variables *Size* refers to the size of enterprise and is measured as the natural logarithm of its total assets. The values of this variable have been deflated by the consumer price index (CPI). The variable *Profitability*

is an indicator of profitability from sales (return on sales, ROS). The variable *Assets_efficiency* is measured as the ratio of sales revenue to total assets (total assets turnover, TAT). The variable *Equity* measures the ratio of equity to total assets. The variable is excluded from the model relating to the level of companies' debt. The next variable is *Cash*, which is measured by the ratio of cash and cash equivalents to total assets. The final control variable is *Fixed_assets*, which is defined as a ratio of company's fixed assets to its total assets. The most relevant variable from the perspective of the study is *Relationship*. This is a binary variable that determines whether or not an entity uses relationship banking. A variable defined in this manner will allow the hypotheses to be verified.

Table 1.
Variables description

Name	Description	Source
Cost_of_credit	Interest expenditures to total liabilities ratio	Amadeus
Profitability	EBIT to sales ratio	Amadeus
Debt	Total debt to total assets ratio	Amadeus
Size	Natural logarithm of total assets (deflated by CPI)	Amadeus
Assets_efficiency	Sales to total assets ratio	Amadeus
Equity	Equity to total assets ratio	Amadeus
Cash	Cash and cash equivalents to total assets ratio	Amadeus
Fixed_assets	Fixed assets to total assets ratio	Amadeus
Relationship	Use of relationship banking ('0' - no, '1' - yes)	Survey

Source: Author's data.

4. Empirical results

Random effects panel regression models based on the generalised least squares (GLS) method were used to verify the research hypotheses. The results of all estimations are presented in Table 2. Each of the three models refers to one of the research hypotheses and used a different dependent variable. Model 1 relates to hypothesis H1 (the variable *Credit_cost* was used as the explanatory variable), model 2 to hypothesis H2 (the explanatory variable is *Profitability*) and model 3 to hypothesis H3 (the explanatory variable is *Debt*).

According to the estimation results for model 1, maintaining a relationship with the bank is positively correlated with the cost of credit that firm incurs. This indicates the opposite correlation than that assumed in hypothesis H1. Firms that cooperate closely with their lenders not only cannot count on cheaper credit, but it appears that it is more expensive during the recovery period. This correlation is statistically significant at the 5% level. The use of relationship banking increases the cost of credit by 0.0073 compared to companies that do not use this form of financing their activities. The results therefore suggest that there was the hold-up problem during the period studied. Lenders took advantage of their dominant position over

clients by imposing higher prices for their services. Clients, in turn, had to agree to such conditions due to the winner's curse.

The results of the calculation of the control variables for the first model indicate that the cost of credit is negatively correlated with the variables *Size*, *Assets_efficiency* and *Equity*. An increase in the value of the first of these variables by a unit results in a decrease in the cost incurred for credit by 0.0033. This correlation is statistically significant at the 1% level. This suggests that larger, more established companies can count on preferential treatment from the lender. As the indicator improves by a unit, a company can expect the cost of capital to decrease by 0.0016 (at a statistical significance level of 10%). Furthermore, an in increase in the value of *Equity* is reflected in a decrease in the dependent variable of 0.0153 (statistical significance level of 1%). Companies that have an adequate amount of equity and are characterised by lower insolvency risk level will also receive a more favourable offer to finance their economic activity. In contrast, a correlation of the opposite direction is shown by the variables *Cash* and *Fixed_assets*. The results of the estimates are statistically significant at level, in both cases, equal to 5%. In the case of the first variable, the cost of capital is expected to increase by 0.0153. In the second case, on the other hand, a change in the explanatory variable by a unit will result in an increase in the independent variable by 0.0116. It is possible that this phenomenon is due to the fact that the companies in the sample are characterised by an assets structure that is suboptimal from a lender's perspective, i.e. companies accumulate cash instead of reinvesting it and have too high share of fixed assets, which worsens their flexibility in a crisis situation.

The estimation results of the second model showed no statistically significant correlation between the profitability of companies and the fact that they cooperated with their lenders within a banking relationship. The control variables are also mostly not correlated with the dependent variable in a statistically significant way. A positive significant correlation at the 10% level is only shown by the variables *Equity* and *Cash*. An increase in the first of these variables by a unit improves the return on sales ratio by 0.0342, and the second by 0.0422. Companies with a stable source of financing in the form of equity and not at risk of liquidity problems during the recovery period are also characterised by a higher level of profitability. The positive correlation between the dependent variable and *Equity* may also suggest that overuse of external sources such as bank credit is unfavourable.

The last model analyses the potential impact of the use of relationship banking on companies' debt levels. In this variant, the variable *Relationship* is positively correlated with the dependent variable. This correlation is statistically significant at the 1% level. Such a result suggests that maintaining relationship with a bank during post-crisis recovery period leads companies to becoming more indebted. These companies do so at a higher rate than firms that use transaction banking or other forms of financing. The companies thus expose themselves to an increased level of leverage risk, which, in an extreme situation, can even lead to their bankruptcy instead of an improvement in business performance and recovery from the crisis.

Among the control variables, a statistically significant correlation has been recorded for the variables *Assets_efficiency* and *Cash*. The first variable is positively correlated (at a level of statistical significance equal to 5%). As the value of this variable increases, the dependent variable increases by 0.0054. This leads to the conclusion that companies which manage their assets more efficiently are characterised by higher debt level. However, it is possible that this is due to the fact that companies took more aggressive measures in order to recover faster, and such strategy was financed using debt. A second possibility is they were subject to the hold-up problem. Banks are more likely to exploit firms with such characteristics in order to generate interest income (this applies to firms using relationship banking). The variable *Cash*, on the other hand, is negatively correlated (at a statistical significance level of 5%), so firms with a higher level of liquidity are less likely to increase debt during the recovery period. An increase in the value of this variable by a unit leads to a decrease in *Debt* by 0.0375.

Table 2.
Empirical results

Variable	Estimation results		
	model 1	**model 2**	**model 3**
$Size_{t-1}$	-0.0033***	0.0047	0.0043
	(-3.35)	(1.17)	(1.51)
$Profitability_{t-1}$	0.0080	-	0.0162
	(1.06)	-	(0.879)
$Assets_efficiency_{t-1}$	-0.0016*	0.0010	0.0054*
	(-1.78)	(0.294)	(2.32)
$Equity_{t-1}$	-0.0153***	0.0342*	-
	(-3.24)	(1.94)	-
$Cash_{t-1}$	0.0153**	0.0422*	-0.0375**
	(2.52)	(1.96)	(-2.51)
$Fixed_assets_{t-1}$	0.0116**	-0.0200	0.0106
	(2.32)	(-0.936)	(0.727)
$Relationship_{t-1}$	0.0073**	-0.0029	0.0711***
	(2.50)	(-0.232)	(7.99)
Industry dummies	YES	YES	YES
Time dummies	YES	YES	YES
No. of observations	854	1,366	1,194
R^2	0.0542	0.0279	0.0731

The table reports the coefficient estimates from GLS random effects panel regressions. The analyses cover the period 2010-2015. The definitions of the variables are presented in Table 1. Constants are not shown. *t*-Values are in parentheses. ***, **, * denote statistical significance at the levels 1%, 5% and 10%, respectively.

Source: Author's calculations.

5. Conclusion

This paper analyses the potential impact of the use of relationship banking by small and medium-sized enterprises in Poland on their financial situation in the post-crisis recovery period. In a study conducted on a random sample of entities for the period 2010-2015,

the problem was addressed at three levels – the cost of credit for companies, their profitability and the impact on their debt level. The purpose of the article has been achieved, since the influence of relationship banking on Polish SMEs during the post-crisis recovery period was identified and measured. However, our findings did not allow us to positively verify the research hypotheses. In the case of profitability, the use of relationship banking did not have a statistically significant impact on this issue. In contrast, the results of the other estimations indicate that relationship banking not only does not have a positive influence on the cost of credit and the level of debt, but it leads to a deterioration of companies' financial situation. Firms in relationships were characterised by increasing level of debt and the terms on which they obtained credit worsened. This suggests that there was the hold-up problem during the period studied. Our findings may also be of relevance in the context of the recovery period caused by, among other things, the COVID-19 pandemic and the war in Ukraine.

There are several limitations to the study that may affect the evaluation of the research problem. First, the main limitation is the size of the sample. If a larger sample was used, the results would be more accurate. This problem is mainly caused by low response rate in the survey conducted among the SMEs in Poland. Second, there might be some other factors related to relationships which may affect the dependent variables. Including them in models can lead to obtaining additional results and more insightful interpretation. This indicates possible future directions of the research regarding relationship banking in the context of post-crisis recovery. For example, it would be advisable to analyse the problem how does scope or duration of the relationship influence the companies' financial situation in the post-crisis recovery period. Furthermore, some companies are engaged in more than one banking relationship, so it should be studied whether or how affected are such companies with regard to firms dedicated solely to one lender.

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CHALLENGES OF MANAGING PASSENGER TRANSPORT IN THE REGIONS ON THE EXAMPLE OF POMERANIAN VOIVODESHIP

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Purpose: The research objective of the study is to determine the conditions, threats and challenges of passenger transport integration in the regions using the example of the Pomeranian Voivodeship.
Design/methodology/approach: The study was conducted based on the assumptions of the concept of passenger transport integration in the Pomeranian Voivodeship (Poland). In the article were used qualitative research methods from the field of social sciences. It is based on scientific and practical own author's studies, in particular in the scope of economics and management.
Findings: The article shows that the scope and method of integrating passenger transport in the region must be determined by precisely formulated objectives; integrated passenger transport in the region must provide a transport offer competitive with other means of transport in the region, decision-makers should abandon the current political management of the offer of this transport services.
Research limitations/implications: The limitations result from the assumptions of the analysed document, which may change during work on the integration of public transport.
Practical implications: The article indicates the conditions for the effective implementation of the concept of public transport integration in the Pomeranian Voivodeship in Poland. Its significance and value for practice result from the identification of integration goals and potential threats to their achievement. The authors are scientists and practitioners in the field of passenger transport systems operation.
Originality/value: The study is the first critical assessment of the concept of public transport integration in the Pomeranian Voivodeship. It indicates its weaknesses and threats, taking into account the experiences of Poland and other countries.
Keywords: management, urban transport, integration.
Category of paper: research paper.

1. Introduction

The systemic approach to transport due to its structure (road network, transport hubs, means of transport and transport processes) has been subordinated in economic sciences to the need for integration. Transport integration has been recognized as one of the processes improving its functioning. Contemporary researchers in the field of economic sciences have enriched the requirements for all processes in urban transport and transport integration. Every activity for the benefit of the community should bring useful value to the customer (Pine, Joseph, 1998). And this useful value should be improved in order to introduce added value. Added value is a contemporary requirement for every activity (economic and social institutions) in improving services and processes. In the case of integration of passenger transport (as one of the transport subsystems), the aim is to introduce added value for the passenger by improving the quality of transport services, shortening the time of covering space or reducing costs. One of the creators of the process approach to management – M. Hamer states that: "value for the customer is created by processes" (Hammer, 1999), and these are the essence of transport operation.

In the practice of integrating passenger transport at the regional level, it is very difficult to meet the three above-mentioned criteria for assessing value simultaneously. In the case of a public transport service, the assessment is carried out by the customer (passenger). Its utility value is assessed in the context of the individual needs of household members for mobility and their household budget. The household budget covers the expenses for traveling by public and private transport.

Households that have a car will always use the travel mode they find useful depending on the nature of the need. Therefore, the integration of public transport in the region may not result in significant changes in the reduction of traveling by private car.

In the transport policy, the functioning of passenger transport in the last decade has been subordinated to the goals of sustainable mobility policy. Achieving these goals requires offering residents attractive and competitive public transport services in relation to journeys by passenger cars. The main challenges of managing public transport services in the Pomeranian Voivodeship are the integration of this transport in the agglomeration, which has a polycentric character, and the region, as well as stable financing of its services. So far, it has not been possible to integrate public transport in the Tri-City metropolis in a way that would significantly affect its attractiveness and competitiveness. Regional bus transport in the Pomeranian Voivodeship operates as a separate system, or more precisely as a number of separate subsystems. Rail transport is integrated internally in terms of tariffs and tickets, but it is not integrated with municipal transport in the Tri-City metropolis (and other cities in the province) and with district and regional bus transport.

The research objective of the study is to determine the conditions, threats and challenges of passenger transport integration in the regions using the example of the Pomeranian Voivodeship. The following research hypotheses were put forward in the article:

- the scope and way of integration of passenger transport in the region must be determined by its objectives,
- integrated passenger transport in the region must provide a transport offer that is competitive with other modes of transport in the region.

In the article were used qualitative research methods from the field of social sciences. It is based on scientific and practical studies, in particular in the scope of economics and management.

2. The essence of passenger transport integration

The aim of integration is to increase the share of public transport in modal split by removing barriers related to the use of public transport services and by exploiting synergies, although convincing evidence of their occurrence is lacking (May, Kelly, Shepherd, 2006).

According to K. Nosal and K. Solecka, the integration of public transport should include: infrastructure, organization, economic and financial issues, information and spatial development (Nosal, Solecka, 2014). According to S. Chowdhury and A. Ceder , integrated public transport systems should be characterized by the integration of: networks, fares, information, stops, timetables (Chowdhury, Ceder, 2013).

The biggest challenge of integrating passenger transport in the regions is the integration of fares and tickets. This integration facilitates transfers encouraging the use of public transport. (Shiftan, Sharaby, 2012). It may consist in introducing: a single fare covering all means of public transport or an additional fare which makes possible the use of all means of public transport. The most important feature of the integration of fares and tickets is that passengers do not incur additional costs of journeys with transfers and that only one ticket distribution system operates. In the objective approach, the integration of fares and tickets of public transport may cover selected or all services.

Analyses conducted in 69 cities in Italy showed that integrated fares increased the number of trips by 2% in the short term and 12% in the long term (Abrate, Piacenza, Vannoni, 2009). However, the increase in demand generated by relatively lower travel costs, in the situation of price inelastic demand for public transport[1], is not enough to compensate, especially in the short term, for the loss of revenues resulting from integration (White, 1981).

[1] For more on price elasticity of demand, see: (Litman, 2012; Webster, Bly, 1981).

The process of tariff and ticket integration is facilitated by technical progress in the field of ticket carriers. The currently commonly used electronic cards are being replaced by applications in mobile devices. From the point of view of ticket integration goals, the most important functions of electronic tickets are the ability to buy a single ticket or pay for a door-to-door journey by a single transaction. Electronic ticketing systems not only allow for transfers based on a single ticket, but also select the cheapest travel option for the passenger.

The development of integrated mobility platforms has been accompanied by the concept of Mobility as a Service (MaaS). MaaS encompasses transport services carried out in five stages: registration, travel planning, booking, payment and travel (Malasek, 2018), as well as providing a more flexible offer and more travel options (Mobility…, 2017).

3. Integration of passenger transport in regions - examples from the EU

In Germany, three forms of cooperation have been developed within the framework of public transport integration, which provide passengers with the possibility of using various public transport services. These are:

- tariff agreement,
- transport agreement,
- transport union.

The tariff agreement consists of providing common tickets and eliminating price competition that could lead to a deepening financial deficit in the service of some lines. The transport agreement includes tariffs and timetables. Transport association is a specialized entity managing the entire public transport offer in a given area. One of the tasks of the association, apart from the integration of public transport, is the division of revenues between individual operators, which reflects their share in the passenger travel. Transport association is indicated as an effective example of full integration of passenger transport in the region (Knieps, 2006). This form is frequently used in public transport integration in Germany.

In Sweden, regional transport authorities are usually jointly controlled by municipal and regional authorities and operate as commercial law companies (not municipal associations). The principle has been adopted because their deficit is covered half by the regions and half by the municipalities, in proportion to the operational work in their area. Half of the votes belong to the province, and the remaining half to the municipalities, in proportion to the number of inhabitants. In most tenders, the gross revenue model is used, in which the operator's revenues are independent of the number of carried passengers. The disadvantage of the model is the relatively low decision-making possibility and motivation of operators to acquire passengers, which requires extensive high competences of regional transport authorities, fully responsible for matching the offer to market needs (Wolański et al., 2016).

4. Experiences in passenger transport management in the Pomeranian Voivodeship

Public passenger transport in the Pomeranian Voivodeship consists of the following subsystems:

- municipal urban transport in the cities of the province, including the Tri-City metropolis,
- district and regional bus transport,
- urban and regional rail transport.

These subsystems are integrated only to a small extent of the service offer. Integration most often concerns the adjustment of city and regional bus timetables to train departures.

In the Tri-City metropolis, despite many plans, preparing of a dozen or so studies and several attempts to unify the offer of services, the integration of municipal urban transport with rail transport has not been achieved. In this respect, the possibilities and potential of the Metropolitan Transport Association of the Gulf of Gdańsk (MZKZG), established in 2007 by 14 towns and communes in the Tri-City metropolis, have not been used. The main reasons for the disintegration of urban transport in the metropolis are:

- particular political interests of local government authorities and the inability to reach compromise on key issues related to integration,
- maintaining and deepening the differences in entitlements to reduced fares and free travel in urban, district and regional bus and rail transport, resulting in the need to allocate significant financial resources from local government budgets for their unification in the case of integration, at the expense of a possible expansion of the range of services,
- non-participation of the state budget in financing metropolitan municipal transport by transferring funds for the refund of concessions to the budgets of local governments,
- formal and legal factors, manifested in the adoption of regulations and organizational solutions that reduce the efficiency of the functioning of organizers and passenger transport subsystems, including by making it difficult to employ private operators in favor of municipal ones (*in- house*).

The Bus Transport Development Fund has created the possibility of enriching the offer of this transport in rural communes, districts and the region. In the Pomeranian Voivodeship, in order to use the funds from the FRPA, district- commune associations were established, which launch new bus lines co-financed from this fund. They ensure integration in terms of tariffs and timetables. So far, no solutions have been implemented that would integrate bus transport within more than one county-municipal association.

Rail transport has been integrated internally in the Pomeranian Voivodeship. Passengers can travel on complementary rail lines and on substitute routes, e.g. in the metropolitan area, on the basis of a single ticket.

The three passenger transport subsystems mentioned in the province are not integrated. In the metropolitan area, MZKZG, as a supplement to the tariffs of individual organizers of municipal urban transport and rail transport, issues metropolitan tickets valid in the area of 14 cities and communes. This solution is not comprehensive and does not meet modern tariff and ticket standards.

The main problems of the current functioning of passenger transport in the region focus on the shortcomings of separate transport offers and the lack of interoperability of urban and regional transport systems (Adamkiewicz, 2024).

5. Assumptions for the functioning and integration of passenger transport in the Pomeranian Voivodeship

The integrated passenger transport system in the Pomeranian Voivodeship should be based primarily on the pursuit of meeting the transport needs and expectations of passengers as well as improving the quality of the services offered.

The concept prepared by the consulting company Marcin Gromadzki Public Transport Consulting (PTC, 2022) assumes the integration of passenger transport in the Pomeranian Voivodeship by creating:

- the metropolitan transport authority, established within the Tri-City metropolis, which is to operate on the basis of a metropolitan act that has not yet been adopted,
- district and regional transport authority, integrating the bus transport offer operating within the framework of district-commune associations,
- railway transport authority.

The metropolitan transport authority is to take over the tasks of the entities organising urban transport services (ZTM in Gdańsk, ZKM in Gdynia and UM in Wejherowo) and metropolitan rail transport (Marshal's Office) on the lines operated by PKP SKM in the Tri-City and by the Pomeranian Metropolitan Railway. A solution was recommended in which the area of operation of the integrated metropolitan passenger transport would correspond to the area of MZKZG (14 cities and communes) with the possible inclusion of the city of Tczew and two neighbouring communes. No solutions have been presented so far regarding the structure and organisational form of the metropolitan transport authority, the way of its financing and the employment of operators.

The Regional Transport Authority (ZTR) is to perform the function of integrator of district and regional bus transport in the province, assuming that the organizers of this transport will be exclusively district-commune associations. The task of ZTR will be to achieve tariff and ticket integration and coordination of bus timetables between district-commune associations.

A solution was recommended consisting in increasing the financing of bus lines from FRPA in a situation where district-municipal associations decide to integrate the offer through ZTR.

The Railway Transport Authority, in the event of integration of this transport offer already at this stage, is to play the role of the entity that will ensure integration of rail transport with metropolitan (as well as urban outside the metropolis) and district and regional bus transport.

The basis for the integration of the three passenger transport subsystems in the Pomeranian Voivodeship are to be tariff agreements. Within the framework of the agreements, integrated tickets of a given transport authority would be honored by the other two.

6. Opportunities and threats for effective management of passenger transport in the Pomeranian Voivodeship

Previous foreign and domestic experience, especially from the Pomeranian Voivodeship, in the scope of functioning and integration of passenger transport allows for the identification of opportunities and threats to the effective management of such transport services.

The course of passenger transport development management processes in the Pomeranian Voivodeship indicates their subordination to a large extent to political goals. This is obvious, in a situation where this transport is subsidized in 60-80% from local government budgets and the state budget. Also, implementing transport and social policy goals through public transport justifies the involvement of politicians in the issues of the functioning of this transport. However, this involvement should only concern strategic issues, leaving the tactical and operational level to experienced managers. Meanwhile, in recent years, Poland has seen an intensification of filling managerial positions and positions on supervisory boards of companies and official positions in public administration units with politicians without appropriate qualifications. Excessive politicization of public transport management also favors the implementation of ideological concepts that diverge from achieving the goals of sustainable mobility by rationalizing the functioning of passenger transport by increasing the quantity and improving the quality of public transport services.

Strong politicization of passenger transport management may constitute a barrier to its effectiveness, in a situation of divergence of interests in the development of public transport. The process of creating the Tri-City metropolis is accompanied by two different visions of using additional financial resources. The first one assumes using a significant part of these resources to cover the costs of the integration process in the metropolis, including in particular the refund of discounts in rail transport and the unification of tariffs, and transferring the released financial resources from the budget of the Marshal of the Pomeranian Voivodeship to the development of railways in the region. Supporters of the second one point to the need to use additional resources to develop the transport offer of metropolitan transport, including in particular rail

transport in Gdańsk. Achieving a political consensus on this issue will not mean an optimal choice, because it may turn out that the quality of services will not improve significantly in either the metropolis or the region, which is important from the point of view of achieving the goals of the sustainable mobility policy.

Regardless of the additional funds allocated for the functioning of metropolitan transport, local governments must take into account the need to increase the funding of public transport in the province as part of its integration. Integrated ticket prices must correspond to passengers' preferences and encourage changes in transport behaviour through a greater use of public transport, especially rail and regional bus. It should be assumed, taking into account the low price elasticity of demand in public transport, that discounts on trips made within the networks of more than one transport authority will not generate sufficient demand to cover the lost revenue. The same principle must be taken into account by metropolitan and regional transport authorities when integrating tariffs in metropolitan, district and regional bus transport.

A significant challenge that determines the effectiveness of the actions taken from the point of view of sustainable mobility goals is ensuring a stable system of financing public transport in the province. An example of how additional funds can significantly increase the offer of public transport services is the use of money from the FRPA in the Pomeranian province. This method of financing has one major drawback. Like other sources of funding from the budget, it is exposed to political recognition. A change in the political situation may be a sufficient premise for changing the rules of using or even liquidating this fund. Therefore, basing the goals of the sustainable mobility policy predominantly on budget funding may by its nature lead to difficulties in achieving them. Therefore, those financial solutions that are aimed at improving the quantity and quality of public transport services and its competitiveness in relation to trips made by passenger cars should be preferred. The factors of public transport competitiveness (including ticket prices) should be identified based on the results of marketing research. On the other hand, solutions should be introduced that favor effective spending of funds on the purchase of transport services based on open tender mechanisms. In this context, additional sources of financing for public transport in the voivodeship (financial resources for the Tri-City metropolis, FRPA, additional resources from local government budgets for integration) and increasing the scope of competition and privatisation of some municipal operators should be perceived as actions enabling the achievement of synergy effects.

A threat to the effective management of passenger transport in the province is a lack of a consistent long-term energy policy of the state. The actions taken so far in the field of electromobility in public transport have been ineffective.

7. Summary

The research conducted in this study allowed to achieve the goal of determining the conditions, threats and challenges of passenger transport integration in the regions, using the example of the Pomeranian Voivodeship. It also proved the hypotheses that:

- the scope and way of integration of passenger transport in the region must be determined by its objectives, taking into account the preferences of residents who decide on the modes of transport,
- integrated passenger transport in the region must provide a transport offer that is competitive with other modes of transport.

Political considerations did not allow even municipal transport in the Tri-City metropolis to be integrated in the early 1990s, despite the preparing of a mature concept in this area by a team of experts from the University of Gdańsk. As a result, three independent municipal urban transport systems were created: in Gdańsk, Gdynia and Wejherowo, which did not provide an integrated transport offer even to a small extent. After a dozen or so years, the Metropolitan Transport Association of the Gulf of Gdańsk began to operate, which was to implement the integration concept extended by including rail transport in the metropolitan system. Once again, political considerations determined the lack of the result expected by users. Only an additional offer of metropolitan tickets was provided, constituting the fourth tariff in the metropolis, operating in parallel with local ones in Gdańsk, Gdynia and Wejherowo. Its advantage was integrated tickets, not only municipal, but also municipal-railway, but all at unattractive prices.

Being aware of the small success, in the search for a solution for full integration, in Gdańsk, characteristically – outside the MZKZG structures, an integrated municipal-railway season ticket was introduced. On the other hand, in the area extending beyond the metropolis, the special unit called InnoBaltica began to implement a system of electronic tickets promoted as a modern, integrated system, potentially covering the entire Pomeranian Voivodeship, which could include separate tariffs of all organizers and operators of passenger transport. However, with the technological and electronic progress, this system turned out to be not very modern and created only an illusory impression of integration for passengers.

For local government authorities, the so-called lifeline has become the possible adoption of a law establishing the Tri-City metropolis, which is to provide additional funds from the state budget for integration, especially passenger transport. In this context, financial flow channels ensuring stable financing of public transport will be of great importance.

The metropolitan act will not, however, lead to full integration of passenger transport on a province-wide scale. As a result, a concept was created to establish three transport boards in its area: metropolitan, regional and railway, which are supposed to cooperate with each other. The basis for such a solution are the applicable legal and financial conditions, which do not support full integration of passenger transport in the province by one entity. The expected

conditions in this respect were not introduced by the act on public transport passed in 2010, in which integration issues were treated marginally. It did not eliminate various catalogues and levels of entitlements to concessionary travel applicable in municipal and regional transport, nor did it provide unified sources of their financing. In the meantime, mainly for populist reasons, the scope of these entitlements granted from their own funds by local governments has expanded. Some of them have even gone so far as to introduce free municipal transport.

Until the legal and financial barrier to integration is eliminated, solutions such as those proposed in the mentioned concept will be considered. As a result, integration will be neither complete nor effective. It will continue to deviate from the standards that determine the target solution with a single passenger transport authority in the province.

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NON-MATERIAL TOOLS FOR MOTIVATING LOW-PAID WORKERS IN THE CARE SERVICES SECTOR IN POLAND – A CASE STUDY

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Purpose: The aim of the article is to examine the effectiveness of non-material tools for motivating low-paid employees in the Polish care services sector and their influence on both motivation and demotivation. The study is based on a case of a car services company operating in four voivodeships: Łódź, Masovian, Lower Silesian, and Silesian.
Design/methodology/approach: In 2022, a quantitative study was conducted using a survey among 160 low-paid care workers. A Likert-scale questionnaire assessed the motivational potential of selected non-material tools, grouped into three categories: task-related, work environment, and development-related tools.
Findings: The study revealed that non-material motivational tools play a key role in shaping the engagement and satisfaction of low-paid employees in the care services sector. The most effective motivators included job stability, flexible working hours, and favorable working conditions. These factors notably boosted employee motivation and engagement. In contrast, a negative work atmosphere and lack of recognition from managers were identified as critical demotivating factors The study indicates that the effectiveness of motivational tools varies, and strategies must reflect employees' individual needs and working realities in this sector.
Research limitations/implications: The study is limited to one care services company, which may affect the generalizability of the findings. Future research should include additional organizations from other low-productivity sectors and examine long-term effects of non-material motivational tools.
Practical implications: The study's findings hold significant value for management practices in the care services sector. Non-material tools boost engagement, reduce turnover, and improve care quality. Higher motivation can enhance efficiency and lower recruitment and training costs. Introducing development programs and internal training strengthens skills, fosters belonging, and enhances organizational competitiveness and image.
Social implications: The study's results could improve the quality of life for employees in the care services sector by better aligning human resource management policies with their needs.
Originality/value: The article contributes new insights into the use of non-material motivational tools in the under-researched context of low-paid care workers in Poland, offering evidence-based recommendations for improving motivation in this vital yet often overlooked sector.
Keywords: non-material motivational tools, care services sector, low-paid employees, case study, Poland.
Category of the paper: Research paper.

1. Introduction

The care services sector plays an increasingly important role in aging societies, including Poland, where the demand for professional care for the elderly and dependent individuals is steadily growing. A key challenge for enterprises operating in this sector is ensuring an adequate level of motivation and engagement among employees, who are often low-paid earners.

A low-paid employee is defined as someone receiving the minimum salary set by the government for hired labor, regardless of their skill level or additional compensation components (Ustawa o zmianie ustawy o minimalnym wynagrodzeniu…, 2016). In the author's opinion, these individuals often lack access to better-paying jobs due to insufficient education, high regional unemployment, limited job opportunities, or personal challenges. This group also includes retirees and pensioners who treat employment as an additional source of income.

One of the largest and least compensated groups in the care services sector comprises caregivers of elderly individuals. The author selected this occupational group for analysis because their role in providing care for the elderly and dependent individuals is crucial to the health and well-being of their clients. Moreover, the significance of this profession is expected to grow as society continues to age.

In this specific professional group, non-material motivational tools play an especially important role. They can effectively support daily work, enhance job satisfaction, and reduce employee turnover. Given the challenges faced by the care services sector, effective management of the motivation of low-paid employees is essential to ensuring the quality of services provided and employment stability.

2. Literature Review

The author has categorized non-material motivational tools into three main groups: tools related to task performance, the work environment, and opportunities for development (Table 1). Tools related to task performance, such as autonomy in work, aligning job responsibilities with aspirations, work-life balance, and managerial recognition, support efficiency and job satisfaction. In the care services sector, where tasks demand high levels of commitment, these elements play a critical role in boosting employee morale. The second group of tools, related to the work environment, includes job stability, favorable working conditions, a positive atmosphere, occupational safety and hygiene, flexible working hours, and effective communication between managers and employees. These elements foster a sense of security, comfort, and collaboration, which translates into better efficiency and loyalty among

employees. The third group, concerning opportunities for development, encompasses internal training and personal growth. Providing employees with opportunities to enhance their qualifications and a clear career path strengthens their engagement and sense of belonging to the organization. This is essential for building long-term relationships within the workplace.

The selection of non-material motivational tools for studying low-paid employees in the care services sector was driven by the specific characteristics of this professional group and the nature of work in care services. Each of these categories plays a significant role in fostering employee engagement, efficiency, and loyalty. Modern approaches to motivation increasingly emphasize the importance of these tools as key factors influencing intrinsic motivation and job satisfaction.

Table 1.
Non-material motivational tools for employees

Non-material tools related to		
task performance	**work environment**	**opportunities for development**
• independence in performing tasks, • aligning responsibilities with aspirations, • work-life balance, • managerial recognition.	• job stability, • favorable working conditions, • workplace atmosphere, • workplace safety and hygiene, • flexible working hours, • effective communication between employees and managers.	• opportunities for personal growth, • enhancing skills through internal training/workshops.

Source: own study.

As noted by K. Darling, J. Arm, and R. Gatlin (1981, pp. 847-855), non-material motivational tools can serve both as a complement to material incentives and as autonomous factors influencing employees' intrinsic motivation. Non-material tools encompass a wide range of organizational, social, and psychological actions that trigger intrinsic motivation and support the realization of inherent values associated with the work performed. A. Broni (2012, pp. 1-5) highlights that the use of non-material motivational tools by managers not only facilitates the achievement of organizational goals but also enhances relationships among employees, boosting their engagement and employment stability. Similarly, Adamska (2018, pp. 7-19) emphasizes that non-material tools play a crucial role in enhancing employee engagement and motivation.

Among tools related to task performance, independence in performing tasks is a crucial factor, as defined by K. Blanchard (2006, p. 156), who considers it a key element of effective work. Managers should create conditions that allow employees to utilize their knowledge and experience without constant supervision. J. Schmidt (2016, p. 123) emphasizes that managerial-granted autonomy involves enabling an employee to perform a specific task, in a specific situation, within a specific timeframe, without external support. Another critical aspect is aligning responsibilities with employees' aspirations, which, according to L. Zbiegień-Maciąg (2005, p. 126), helps unlock an employee's potential and enhances their job satisfaction. Work-life balance also plays an essential role; H.J. Greenhaus (2003) defines it as an equal

commitment to both professional and family roles. Managerial recognition is another effective tool. According to G. Langelett (2014, p. 75), managerial praise strengthens an employee's self-esteem and motivation by acknowledging their achievements. A. Pietroń-Pyszczeak (2014) reinforces this view, highlighting the motivational boost derived from recognition.

In the category of tools associated with the work environment, job stability stands out as a key factor. It provides employees with a sense of security and confidence in their workplace. R. Mierzwiak (2016, p. 131) notes that favorable working conditions, including well-organized workspaces, access to modern technologies, and an ergonomic environment, are essential for effective management. Workplace atmosphere is another significant element. According to B. Tracy (2019, p. 134), the atmosphere depends on the individuals forming the work community, mutual respect, the ability to express opinions freely, and positive interpersonal relationships. A. Raziq and R. Maulabakhsh (2015, p. 720) argue that a good workplace atmosphere is influenced by kindness from both coworkers and managers. They suggest that employees should be able to count on mutual respect, assistance, equitable information sharing, fair task and position allocation, equal treatment regardless of gender, and the prompt resolution of conflicts. These factors collectively create an environment conducive to productivity and employee satisfaction.

A friendly workplace atmosphere fosters employee loyalty, engagement, and creativity, as highlighted by H. Grant and E.T. Higgins (2013). According to D. Ovidiu-Iliuty O.I. Dobre (2013, p. 8), values such as trust, friendship, mutual assistance, and loyalty shape organizational culture and support the achievement of better outcomes. A positive atmosphere, grounded in empathy and care, is essential for team efficiency and fostering strong relationships between employees and managers.

Workplace safety and hygiene, as described by A. Przewoźna-Krzemińska (2017), involve a set of principles aimed at preventing accidents and creating a hygienic work environment. These measures not only ensure physical safety but also contribute to employees' sense of well-being and their overall productivity. Similarly, Kowalski and Nowak (2019) emphasize that investments in occupational health and safety directly enhance employee efficiency and engagement, serving as a key factor in improving organizational effectiveness.

Flexible working hours, according to M. Latos-Miłkowska (2009), allow for the adaptation of schedules to meet the individual needs of both the employer and the employee, ensuring maximum benefit for both parties.

The final element in this category is effective communication between employees and managers, which facilitates the free flow of information and fosters trust. Communication between a manager and an employee is a key non-material motivational tool. A. Przewoźna-Krzemińska (2017) defines it as the exchange of information through various mediums, such as words, gestures, or texts. Effective communication requires clarity of message, ensuring that both the sender and the recipient can understand it properly, which in turn promotes trust-building and efficient collaboration.

As noted by R.E. Petty, J.T. Cacioppo, and R. Goldman (1981), establishing relationships based on partnership and managing employees' emotions can lead to a sustained increase in their engagement. As Kim Scott (2019) emphasizes, the key to building effective relationships at work is to "care personally while challenging directly", which fosters trust, openness, and long-term commitment within teams. Similarly, I. Bessel, B. Dics, A. Wysocki, and K. Kepner (2002) emphasize the importance of flexible working hours, managerial recognition, and opportunities for decision-making, which significantly impact job satisfaction.

Tools related to opportunities for development include personal growth and internal training/workshops, which H. Król and A. Ludwiczyński (2006) identify as key for building career paths. The authors emphasize that a clearly defined career path and opportunities for skill development are significant motivational factors. Similarly, M. Armstrong (2009, p. 48) highlights that respect and recognition can take the form of public praise, promotions, or the opportunity to participate in prestigious projects. Such actions enhance employees' sense of value and belonging to the organization. These tools enable employees to expand their competencies and strengthen their self-worth. Armstrong stresses that professional development and opportunities to work on high-profile projects not only boost employees' sense of belonging but also increase their efficiency.

These tools not only enhance employee satisfaction and engagement but also support their growth and creativity, ultimately leading to improved organizational outcomes. It is particularly important to emphasize the role of a friendly atmosphere, values such as trust and loyalty, and the delegation of responsibilities, which strengthen employees' sense of belonging to the organization.

A key challenge for managers remains tailoring these tools to the individual needs of employees. Doing so allows for the full utilization of their potential and the establishment of lasting relationships based on mutual respect and trust.

3. Research Methodology

The author conducted the research in Poland within a company providing care services in four voivodeships: Łódź, Masovian, Lower Silesia, and Silesian. The study involved 160 low-paid employees, including 139 women (86.9%) and 21 men (13.1%), all employed as caregivers in the examined enterprise.

The research methodology utilized a survey technique due to its quantitative nature and the availability of a large number of respondents. One of the methods used in the operationalization of variables was the Likert scale, where respondents rated statements (Czernek, 2015, p. 177). The questions focused on evaluating the non-material motivational tools used in the company, as well as identifying the tools that most motivated or demotivated employees.

The primary objective of the questions was to identify potentially motivating tools and to determine the strength of motivation for each factor. Respondents rated the motivational impact of each tool on a five-point Likert scale:

1 – Strongly disagree.

2 – Rather disagree.

3 – Neutral.

4 – Rather agree.

5 – Strongly agree.

The aim of the study was to examine the impact of specific non-material tools related to task performance, the work environment, and opportunities for development on motivating low-paid employees in the care services sector in Poland.

4. Research Results

This subsection presents the research findings regarding employees' opinions on the most motivating and demotivating non-material tools.

Figure 1 illustrates the frequency distribution of responses for the most motivating non-material tools (as perceived by employees). The tools are listed in order of frequency, from the most to the least commonly mentioned.

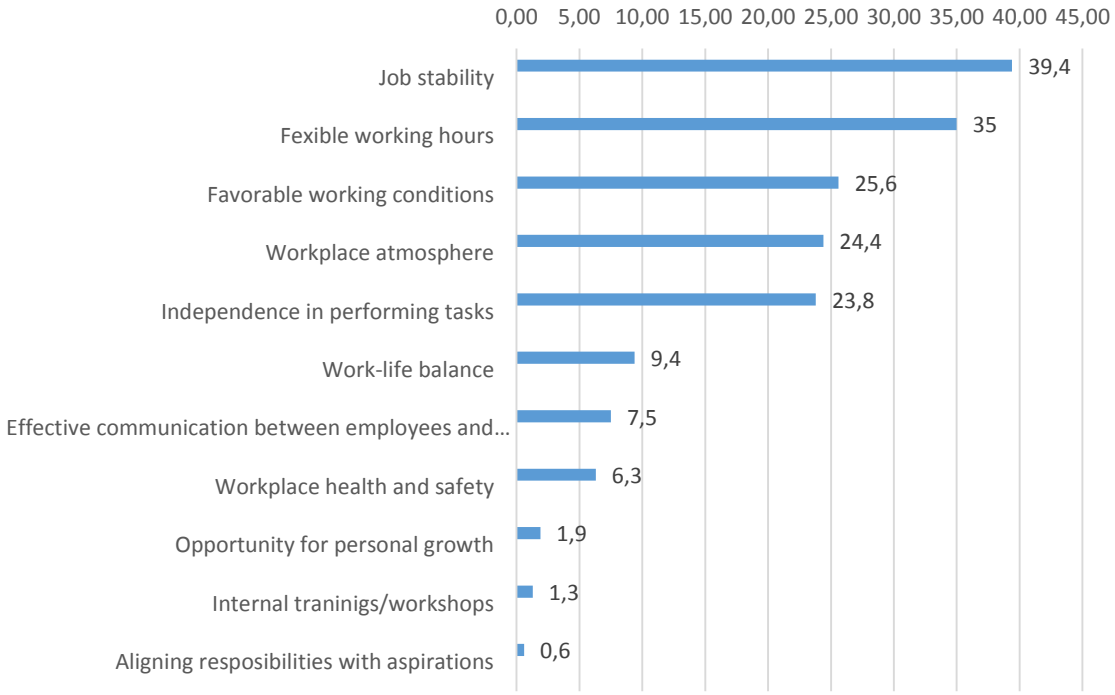


Figure 1. Most motivating non-material tools (in %).

Source: own study.

The data presented in Figure 1 indicates that the most frequently identified non-material motivational tools are job stability (39.4%) and flexible working hours (35.0%). The least frequently selected options were skill enhancement through internal training/workshops (1.3%) and task alignment with aspirations (0.6%). Other commonly mentioned tools included: favorable working conditions (25.6%), managerial recognition (25.0%), workplace atmosphere (24.4%), independence in performing tasks (23.8%).

Figure 2 presents the frequency distribution of responses for the most demotivating non-material tools, as indicated by employees participating in the study.

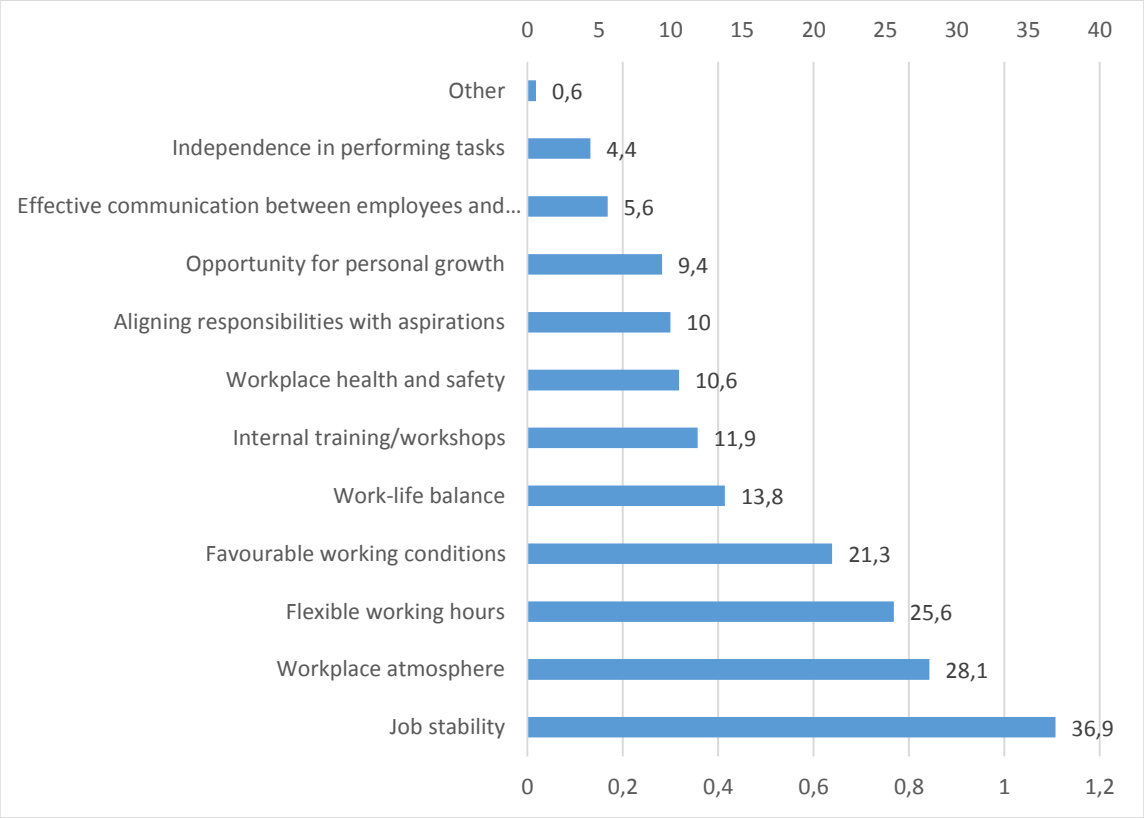


Figure 2. Most demotivating non-material tools (in %).

Source: own study.

The analysis of the data shown in Figure 2 allows us to conclude that respondents most frequently identified **job stability (36.9%)** as the most demotivating factor. Other commonly mentioned factors included **workplace atmosphere (28.1%), flexible working hours (25.6%), managerial recognition (21.9%),** and **favorable working conditions (21.3%).** The least frequently mentioned factors were **effective communication between employees and managers (5.6%)** and **independence in performing tasks (4.4%).**

Table 2 presents the extent to which non-material tools motivate employees. The responses to this question were expressed on a scale of 1–5, where: 1 = to a very small extent; 2 = to a small extent; 3 = neutral; 4 = to a large extent; 5 = to a very large extent.

Table 2.
The extent of employee motivation through non-material tools

Variable	Parameter		Overall (N = 128)
Extent of motivation through non-material tools	**Extent**	1	3.9% (*n* = 5)
		2	8.6% (*n* = 11)
		3	22.7% (*n* = 29)
		4	46,1% (*n* = 59)
		5	18.8% (*n* = 24)
	Mean scale value 3.7		

Note. **n** – number of responses; **%** – percentage of selected responses; **N** – total number of respondents who answered the question.

Source: own study.

The data in Table 2 reveals that the median rating for the extent of motivation through non-material tools (as perceived by employees), based on a five-point scale, was 4. This value also represented the mode of this variable, with 46.1% of respondents stating that non-material tools motivate employees to a large extent. Additionally, 18.8% of employees reported that these tools are highly motivating. On the other hand, 8.6% indicated that non-material tools motivate them to a small extent, while only 3.9% stated that their motivation stemming from non-material tools was very low.

The analysis of this subsection's data indicates that the most motivating non-material tools, according to employees, are as follows (in order of importance): job stability, flexible working hours, favorable working conditions, managerial recognition, workplace atmosphere. Conversely, the most demotivating tools identified by respondents were: workplace atmosphere, working hours, lack of managerial recognition, working conditions.

The study results demonstrate that non-material motivational tools are perceived by employees as effective in enhancing their engagement and job satisfaction. The majority of respondents positively evaluated these tools, emphasizing their significant impact on workplace motivation. Only a small percentage of participants considered them less effective, which underscores their overall high utility in personnel management.

These findings confirm that the use of non-material tools can be crucial in building motivation systems, especially within occupational groups with limited financial resources.

5. Discussion

The results of the research on non-material motivational tools for low-paid employees in the care services sector highlight their significant role in fostering employee engagement and work efficiency. These findings align with previous studies emphasizing the importance of non-material tools in motivating employees, particularly in the context of financial constraints across various industries.

F. Galia (2008, p. 56) highlighted the importance of independence and creativity as key motivating factors for employees, which is reflected in this study's results, where independence in performing tasks and work flexibility were rated as crucial motivational tools. K. Kovach underscored the value of recognizing employees' individual needs, which corresponds with the high ratings for managerial recognition and aligning tasks with employees' aspirations (Bessel, Dicks, Wysocki, Kepner, 2002).

Research by J.E. Sharon and K. Beverly (2007, p. 71) emphasized the importance of relationships with direct supervisors and teams. This is consistent with the findings of this analysis, where a positive workplace atmosphere and effective communication were among the most frequently identified motivational tools. Similarly, McKinsey studies have demonstrated that managerial recognition and opportunities to participate in special projects and tasks play a crucial role in employee motivation, often surpassing traditional financial incentives.

A. Wziątek-Staśko (2014, p. 693) emphasized the importance of work-life balance, a finding confirmed in this analysis. This underscores the growing need to incorporate flexible work arrangements and provide support for employees in managing their time. Similarly, Walentek (2019) points out that implementing work-life balance strategies leads to increased work efficiency and job satisfaction, especially when accompanied by organizational support and awareness of employees' individual needs. These insights are further supported by A. Kochmańska (2016), who identified non-material tools such as organizational culture, participation, and task delegation as having a significant impact on pro-organizational attitudes and engagement.

The findings of M. Pęcek and J. Walas-Trębacz (2018, pp. 21-22) also align with the author's research. Factors such as job stability, a positive workplace atmosphere, and clearly defined goals and tasks were rated as key determinants of employee motivation.

A comparison of the results from this study with existing literature unequivocally indicates that non-material motivational tools play a vital role in building employee engagement and work efficiency. Moreover, the study demonstrates that the effective use of these tools, particularly in the care services sector, can significantly enhance job quality and employee satisfaction. This is especially critical in addressing the challenges posed by an aging society.

6. Conclusions

The conducted research confirmed that non-material motivational tools play a crucial role in enhancing engagement and efficiency among low-paid employees in the care services sector. Job stability emerged as the most motivating tool, highlighting the fundamental importance of security and stability for employees in this group. Conversely, internal training proved to be

less effective as a motivator, likely due to its limited perception as a tool that delivers immediate benefits.

The most motivating tools were those related to task performance and the work environment**,** such as flexible working hours, a positive atmosphere, managerial recognition, and effective communication. These tools not only support current employee engagement but also foster long-term loyalty to the organization. On the other hand, tools related to opportunities for development**,** such as training or role rotation, were found to be less effective. This indicates the need for better alignment of these tools with employee expectations in this sector.

The study also indicates that negative experiences, such as a lack of recognition, an unfavorable workplace atmosphere, or limited communication opportunities, can act as demotivators, weakening employee engagement. In this context, it is essential to tailor motivational tools to the individual needs and expectations of employees to maximize their potential and mitigate demotivating factors.

In conclusion, the research highlights the importance of non-material motivational tools as an effective method of human resource management in the care services sector. Implementing job stability, work flexibility, a positive atmosphere, and managerial recognition can contribute to increased employee satisfaction, improved service quality, and enhanced organizational efficiency. Further research is recommended to examine the long-term impact of non-material tools on various employee groups and to analyze their effectiveness in other sectors of the economy.

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FAIR SALARY ACCORDING TO ARISTOTLE: LIMITATIONS AND OPPORTUNITIES

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Purpose: This text explores philosophical and economic debates on fair wages, drawing on the Aristotelian principle of distributive justice. The text examines the challenges inherent in applying this principle in practice and explores potential pathways to address and overcome these challenges effectively. The reason for choosing this topic is the practical significance of fair pay and the gap in the current scientific literature on distributive justice.
Design/methodology/approach: This investigation is a conceptual analysis of economic theories about fair salaries.
Findings: The study demonstrates that the Aristotelian principle of distributive justice is either explicitly or implicitly assumed in economics, including theories that expressly deny the doctrine of distributive justice.
Research limitations/implications: This research does not embrace empirical investigations and mathematical methods. Yet, it provides directions and methodologies for further theoretical and empirical research on quantitative perspectives on the impact of normative beliefs on economic and managerial decisions regarding salaries. Further studies can go into a detailed discussion of case studies to incorporate the study's findings into various situational factors.
Practical implications: The article demonstrates the potential application of the Aristotelian concept of distributive justice in setting salaries.
Social implications: The presented analyses may encourage both management theorists and practitioners to adopt a balanced perspective on remuneration issues—one that avoids extremes, from accommodating unfounded entitlement attitudes to ignoring fundamental employee rights. Such an approach should also contribute to a balanced shift in social perception.
Originality/value: The study presents a novel perspective on the Aristotelian principle of distributive justice, demonstrating its compatibility with diverse economic theories, including those that explicitly reject the principle. The text is addressed to theorists and decision-makers involved in matters of remuneration.
Keywords: distributive justice, paid work, salary, labour meta-ethics, meta-economics.
Category of the paper: General review or research paper.

1. Introduction

Today, a substantial body of economic literature is dedicated to the Aristotelian principle of corrective (or compensatory) justice (Gardiner, 2011; Kymlicka, 2002; Piketty, 2014; Rawls, 1971; Sen, 2009), but his principle of distributive (or proportional) justice (DJ) is underinvestigated. For example, David Miller (1999) highlights how theories of justice have evolved to prioritise social equality and corrective measures over DJ. Similarly, Thomas Piketty (2014) observes that public discourse on inequality increasingly prioritises immediate corrective measures, such as reparations or targeted interventions, while neglecting systemic distributive reforms essential for addressing structural inequalities. Furthermore, Elizabeth Anderson (2010) critiques the dominance of procedural frameworks, which focus on addressing grievances individually, as they frequently bypass discussions on broader patterns of structural inequality, relegating DJ to a secondary role. These remarks underscore the need to revisit DJ, particularly in economics and the economy, as the idea of justice is complex and can easily be oversimplified if one principle is isolated from the other.

Aristotle presents justice as an ethical virtue concerned with giving each their due. He distinguishes two aspects of justice: DJ (Gr. διανεμητική δικαιοσύνη) and corrective justice (1gr. ἐπανορθωτικὴ δικαιοσύνη). They are principles that guide just actions and solutions. For him, these principles are complementary and indispensable. However, they differ. In his view, DJ establishes fairness in the initial distribution of resources and opportunities based on individual merits. Corrective justice involves providing appropriate reparation or compensation to individuals who have been wronged or unfairly treated, thereby restoring them to their original position before the injustice. Corrective justice may involve restoring equal opportunities for individuals who are disadvantaged compared to others. (Chroust, Osborn, 1942; Eldred, 2011; Fleurbaey, 2016; Lamont, Favor, 2017; Rawls, 1971; Rosen, 1975; Sen, 2010).

Stagirite grounds his idea of justice in two principles: the principle of equality and the principle of reciprocity (Chroust, Osborn, 1942; Eldred, 2011; Fleurbaey, 2016; Lamont, Favor, 2017; Rawls, 1971; Rosen, 1975). According to the principle of **equality**, people should be treated the same in the same circumstances. For example:

- Two students submitted their assignments late. It would be unfair if one of them received a penalty for the delay while the other did not. They should be treated the same because they are in the same circumstances.

The principle of equality does not presume the sameness of all agents; therefore, it may require treating them differently, because of their differences, which make the situation unequal. Accordingly, DJ requires fair remuneration. For example:

- A student who was late to class for the first time received only a warning, while another student who was frequently late was given extra homework. Even though both were late, their past behavior differed, so the principle of equality requires treating them differently.

According to the principle of **reciprocity**, we should pay back what we receive from others. Consequently, justice requires that if someone contributes to the profit of others, they have the right to receive some part of this profit. Accordingly, the principle of corrective justice requires that people repair the harm they have caused to others.

While Aristotle primarily applies DJ to political offices and honors, this analysis extends it to financial profits, particularly fair remuneration for labor. Although the Stagirite does not explicitly discuss this dimension, his theory inherently encompasses it.

This study takes the point of departure from Aristotle's concept of DJ, emphasising the relationship between three factors: (A) remuneration for labour, (B) the final profit that labour generates and (C) the worker's contribution to this profit. The following formula and diagram depict this proportion:

$$A = B \times C$$

This formula is not a mathematical algorithm. A, B, and C, along with their proportion (marked by x), need to be specified by research to yield a conclusion about A. Justice requires prudence, for without it one cannot discern what is right in a given case; yet prudence alone is not enough to be just—it must be accompanied by a stable moral disposition and the will to do good to others. This formula outlines the directions of prudent decisions within the virtue of justice. (Chroust, Osborn, 1942; Eldred, 2011; Fleurbaey, 2016; Knoll, 2016; Lamont, Favor, 2017; Rawls, 1971; Rosen, 1975).

Critics of the Aristotelian idea of DJ argue that the formula does not apply to reality because there are obstacles in identifying and measuring the final profit (see section 3), the contributions of the worker to the final profit (see section 4), and the proportion between the income and the final profit (see section 5). This text discusses the main issues in setting B and C and their proportion (marked by the multiplication sign x).

This study argues that the above difficulties do not prove the DJ formula wrong. They only show how difficult it is to translate it into the language of economic action and to apply it in setting fair wages. In light of the growing need for a fair distribution of resources (Boushey, Steinbaum, 2022; Zucman, 2023), this study provides directions that enable the concept of DJ to be specified using quantitative methods.

The study is conceptual, and its method is analytical. It presents the concept of distributive justice within the context of specific economic theories to guide the setting of fair salaries. The research focuses on the logical connections between assumptions of the theories and their implications for fair wages. The study demonstrates that the Aristotelian principle of distributive justice is either explicitly or implicitly assumed in economics, including theories that expressly deny the doctrine of distributive justice. This text explores ways to develop

Aristotle's concept of distributive justice (DJ) to operationalise it and apply it to standards for setting fair wages.

2. Methods

In this text, terms such as *gratification, compensation*, and *remuneration* for labour designate a worker's financial or extra-financial benefits in exchange for performing work. Salaries (wages) represent the economic component of remuneration. Wages, understood in this sense, must be distinguished from compensations and allowances that, although related to employment, do not constitute direct payment for work performed and, therefore, do not qualify as wages.

In this paper, *labour* and *work* refer to purposeful acts that create or contribute to the development of services or products that benefit or are helpful to more persons than the agent who performs the labour. This definition embraces physical and mental labour. According to this definition, work may encompass, for example, designing an idea, organising and facilitating the labour process, creating a distribution network, or promoting products through advertising. This definitional approach is regulative. It deviates from those concepts of work that associate it with effort.[1] In this text, labour's effects are referred to as its *products*. This term embraces objects, services, and possibilities produced, including the profit that labour generates.

This study isolates DJ by examining an idealised scenario where all corrective justice requirements are perfectly met, leaving only DJ in question. Only financial rewards are considered, narrowing the focus to salaries, excluding non-financial benefits. Using this model for thought experiments, it formulates the question of a just wage under these conditions.

Future research may apply these findings to real-world situations where DJ must account for extra-financial benefits (e.g., privileges or authority) and corrective justice issues may arise. Insights from these thought experiments can later be enriched with empirical data from complex real-life scenarios.

[1] Some definitions of labour identify it with effort. For example: “Labor is the amount of physical, mental, and social effort used to produce goods and services in an economy. It supplies the expertise, manpower, and service needed to turn raw materials into finished products and services” (Amadeo, 2020).

3. The final profit

The final benefit (B) is the advantage that people outside the working entity (the one performing the work) gain from her labour. This benefit encompasses both financial and non-financial aspects, as well as quantitative and qualitative elements. While defining this benefit is challenging, it is not insurmountable, as I will attempt to demonstrate in this section by discussing obstacles in specifying B.

3.1. Limited perspectives of predictions

The difficulty in defining the final profit (B) of a work may lie in the fact that it has indirect and far-reaching consequences beyond its direct effects. These consequences extend infinitely and go beyond the limits of prediction. However, despite our limited knowledge about the future, we can estimate outcomes based on probabilities, allowing us to scale the benefits and losses that others may experience due to someone's work. Using probabilistic analysis, it is possible to estimate the likelihood of these outcomes and assign weights to them. For instance, the positive impacts on economic growth and accessibility are highly probable and significant, whereas the potential ecological disruption is less likely but still measurable. By quantifying these effects, stakeholders can gain a better understanding of the overall scale of benefits and losses, enabling informed decisions about the work's value and implications.

3.2. Various stakeholders of labour

Meta-theories of economics define divergent labour stakeholders—the individuals or groups whose benefits or losses are considered in assessing the final benefit—in various ways. Classical theories often focus on direct stakeholders, including employers and employees. At the same time, broader frameworks encompass indirect stakeholders, such as communities or future generations, who are affected by labour’s long-term outcomes. Sustainability-focused theories might also consider environmental stakeholders.

The diversity of work stakeholders presents a challenge in determining the final benefit B; however, this challenge is not insurmountable. Various economic theories recognise the diverse stakeholders involved in labour and wage determination. For example, Stakeholder Theory (Freeman, 1984) argues that businesses should consider the interests of employees, employers, consumers, and communities, rather than focusing solely on profit maximisation. Similarly, Institutional Economics (Commons, 1931) highlights the role of labour unions, government regulations, and corporate policies in shaping fair wages and working conditions. Efficiency Wage Theory (Shapiro, Stiglitz, 1984) acknowledges the interests of both employers and workers by suggesting that higher wages improve productivity and job commitment, benefiting both parties. Meanwhile, Rawlsian Justice Theory (Rawls, 1971) and Co-Determination Models in Germany and Scandinavia emphasise worker participation in corporate decision-making, ensuring that economic justice and fairness extend beyond traditional market forces.

3.3. The diversity of evaluation criteria

Theories of economics typically adopt the subjective approach to values. In this view, labour stakeholders may divergently evaluate B. Consequently, it may be challenging to establish B as an intersubjective value. However, even within a subjective concept of value, it is possible to establish an intersubjective value of labour (B) by recognising consistent economic patterns and shared evaluation mechanisms. Carl Menger (1871) and William Stanley Jevons (1871) argue that while individual preferences determine value, markets aggregate these preferences into a structured pricing system, providing an objective reference for labour valuation. Friedrich Hayek (1945) further emphasises that decentralised market interactions reconcile subjective valuations, allowing for a collective determination of economic worth. Additionally, Daniel Kahneman and Amos Tversky (1979) demonstrate that predictable biases and regularities in human decision-making contribute to stable valuation frameworks. Therefore, despite individual variations, labor's value B can be measured intersubjectively through empirical market data and common economic principles (Murray Rothbard, 1962; Israel Kirzner, 1973).

Within an objective theory of value, determining the intersubjective value of B becomes more straightforward, as value is anchored in measurable economic factors rather than subjective preferences. For example, Eugen von Böhm-Bawerk (1896) and John Stuart Mill (1848) emphasise that economic value arises from objective utility and capital investment, making it easier to define labour’s contribution to wealth creation. Unlike purely subjective approaches, objective theories provide quantifiable benchmarks—such as productivity, scarcity, or social necessity—that allow for a consistent and replicable valuation of work.

3.4. Potential disproportion between the final profit and available gain

The final profit B differs from the portion of that profit available for distribution among employees. Employees can significantly contribute to the benefits others derive from their work, yet not receive a proportional share of those benefits. In such cases, DJ requires society to compensate for this imbalance by "repaying" workers for the advantages they generate for others.

While market mechanisms can partially address this issue by aligning compensation with contribution, situations of distributive injustice may still arise. These injustices can either be accepted as unavoidable or addressed through mechanisms aimed at restoring fairness. Determining which approach is preferable is beyond the scope of this discussion. However, it is sufficient to note that benefit B can also be approximated and evaluated, albeit imprecisely, in situations of distributive injustice.

3.5. Reinvestments

Reinvestment may decrease the distributable share for employees. The need for reinvestment, however, should not be misused by any party. The principle of the golden mean applies: excessive reinvestment in non-essential ventures can limit fair profit distribution. At the same time, overconsumption of financial resources on wages may lead to stagnation and collapse. Balancing these competing priorities requires transparent financial planning and alignment of employer and employee goals (Palley, 2017; Mueller et al., 2017; Baker, 2019).

4. The contribution to the final profit

Suppose that the final profit B is known. One can still shake the idea of DJ by pointing to difficulties in identifying or measuring the worker's contribution (C) to B.

4.1. Teamwork

In collaborative work, outcomes are often the result of the combined efforts of workers, managers, and capital, making it challenging to isolate individual contributions to the final profit (B). For instance, in a software development team, the final product emerges from the interdependent contributions of developers, designers, testers, and managers. This interconnection complicates assigning value (A) to any single worker's input (Alchian, Demsetz, 1972). While collaborative work complicates isolating individual contributions, theories such as marginal productivity (Solow, 1957), human capital (Becker, 1964), and efficiency-based frameworks (Farrell, 1957; Pindyck, Rubinfeld, 2013) offer methods for identifying worker's contributions.

4.2. Extra-labour contributions

Factors external to labour can create situations of distributive injustice, where the benefit to the worker is disconnected from the value of B and C. Aristotle illustrates this with examples such as usury, where the borrower bears all the associated risk (Aristotle, *Politics*, 1258b). However, such instances are anomalies, not the norm.

Labour is here defined as any purposeful activity that enhances B, including not only production but also roles such as marketing, financial planning, and investment management. For instance, promoting a product or managing finances directly adds value. Even bearing financial risk, often overlooked, can be considered labour, as it involves deliberate effort to enable production and growth. Justice theories, such as those by Knight (1921) and Rawls (1971), recognise this risk-bearing as a valid contribution to B. Modern practices, like due

diligence in banking, align returns with risk and work, adhering to more ethical principles (Boatright, 2013).

According to the principle of DJ, available profits for workers should be divided proportionally among contributors based on their respective inputs. Non-labour factors, such as reinvestments, systemic conditions or external market forces, are acknowledged in the calculation of the profit available to be shared among workers. However, these factors are not immense obstacles to specifying C. For example, if fashion makes a product attractive, one can isolate the factor of fashion by specifying the contributions C that create this product. In this situation, a non-labour factor of fashion determines the profit to be shared among workers. However, within this profit, one can set A, which is proportional to C and the available profit for the workers to share.

4.3. Quantitative methods to calculate qualitative contributions

In specifying C, one should face qualitative contributions, which are hard to quantify and measure. Evaluating them has long challenged economic theories like marginal productivity, which struggle to measure non-quantifiable factors such as fostering innovation, enhancing workplace culture, or building a company's reputation. Tools like predictive modelling and econometric analyses can approximate these impacts. Metrics such as revenue growth, brand equity, or customer loyalty offer indirect measures of the financial effects of qualitative inputs. While imperfect, these methods bridge the gap between intangible contributions and quantitative evaluation (Johnson, Lewis, 2022).

5. The potential inhomogeneity in the proportion between the income, contribution and final profit

Some critics of DJ argue that different social goods should be distributed according to other principles, and that a single measure of distributive justice is insufficient (Nozick, 1974; Walzer, 1983). The authors demonstrate that there is a fundamental inhomogeneity between the various profits that work generates for divergent entities in different spheres and the worker's profit. For example, a worker's wages might reflect proportional effort, while the profits for business owners or investors stem from entirely different sources, such as risk or capital investment. Similarly, societal benefits, such as innovation or public welfare, often elude simple proportional calculation.

However, there are methods to find quantitative homogeneity between non-homogeneous qualities. For example, one approach utilises weighted metrics, assigning importance to factors such as effort, skill, capital investment, and societal impact. Another method is comparative value ratios, which build on Aristotle's concept of proportionality. For example, if labour

contributes 40% and capital 60% to the production value, wages and profits could be distributed accordingly, with adjustments for factors such as risk. Market-based mechanisms with adjustments, such as progressive profit-sharing or collective bargaining, may help address power imbalances and external benefits overlooked by market wages. (Smith, 2023). Consistently, ethical values – including justice – can be integrated into economic analysis and policy-making (Van Staveren, 2022). Statistical tools exist to incorporate social justice indicators into economic forecasts (Bachelet, Martinez, Zornoza, 2021).

6. Discussion and perspectives for further investigation

Traditionally discussed in moral and philosophical realms, the concept of DJ has often been challenging to operationalise in empirical studies. However, by translating DJ concepts into tangible indicators—such as inequality measures, resource allocation models, and welfare functions—the study bridges the gap between normative theory and practical policymaking. This research highlights the feasibility of employing economic and quantitative approaches to articulate and measure DJ.

This research presents the perspective of interdisciplinary collaboration. Economists, sociologists, and ethicists can collaborate to refine models that incorporate both normative claims and methodological rigor. Such collaboration is vital for shaping policies that not only appear just in theory but can also be validated quantitatively to demonstrate real-world efficacy.

Another key application is in identifying cases where workers who substantially enhance social welfare are under-compensated relative to their societal impact. The critical aspect is addressing situations where remuneration fails to correspond with DJ. This misalignment can occur when wages are determined by market distortions, employer bargaining power, or systemic inequalities rather than by a worker's actual contribution to production or societal well-being. By following the principle of DJ, policymakers and businesses can establish fairer compensation standards that more accurately reflect both individual impact and the broader economic and social value generated.

Moreover, the results highlight context sensitivity. While a robust methodological foundation is crucial, policymakers must interpret findings within the socio-cultural nuances of each region. This balance between universal quantitative tools and local specificities emerges as a central challenge, demanding ongoing refinement of the models and the data that inform them. Future studies could also investigate the interplay between distributive and corrective justice, incorporating reparations with salary structures to address historical injustices or systemic inequalities.

7. Summary and conclusions

This text presents the main obstacles to setting fair wages according to the Aristotelian principle of DJ. The analyses presented show that these difficulties do not constitute an insurmountable obstacle to setting wages by the DJ principle. Instead, these problems are challenges of the contemporary economy and the field of economics. The study proposes directions for applying this principle in practice to evaluate and correct imbalances in wage distribution, ensuring that compensation aligns with an individual's contribution to the common good.

The study offers a new perspective for future research that can apply the framework of DJ to real-life situations, incorporating workers' non-financial benefits and requirements of corrective justice.

The study outlines directions which make it possible to express the idea of DJ in economic terms and apply it using quantitative methods. This finding highlights the potential for integrating DJ into frameworks commonly used in economics and related disciplines.

The findings demonstrate how econometric indicators and statistical models can effectively capture dimensions of fairness and equity, providing policymakers with concrete data for designing and evaluating interventions. By moving beyond purely philosophical discussions, the study provides actionable insights into how DJ can be effectively integrated into everyday policy decisions. By doing so, it advocates an empirical, data-driven approach to advancing DJ in diverse real-life scenarios. The text does not provide ready-made solutions; it outlines a research agenda that poses a significant challenge to contemporary economics.

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MANAGER IN THE AGE OF ALGORITHMS: THE USE OF AI TOOLS IN DECISION-MAKING PROCESSES

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Purpose: The purpose of the article is to analyze the role of managers in the context of the growing use of artificial intelligence (AI) tools in decision-making processes. The author attempts to answer questions related to the competencies required for effective management in data-driven environments and identifies key challenges and under-researched areas concerning the adaptation of AI technologies within organizations.
Methodology: The study was conducted among 85 managers, business owners, and leaders representing various management levels and economic sectors. A questionnaire method and in-depth interviews were used. The sample was purposefully selected, taking into account the level of AI implementation, company size, and industry. The analysis focused on attitudes toward AI, the scope of tool usage, and the competencies required for their effective application.
Findings: Respondents most frequently used AI for data analysis, process automation, and customer relationship management. The key benefits identified were increased efficiency, more accurate decision-making, and cost reduction. The most important competencies included data analysis skills (86%), adaptability (74%), and critical thinking (73%). Smaller enterprises were less likely to implement AI due to financial constraints and a lack of technological competencies. Most managers recognized the need for further education in analytical tools and AI.
Research limitations: The main limitation is the purposive sampling method, which restricts the generalizability of the results. The article highlights the need for further research on the barriers to AI implementation, particularly in sectors with a low level of digitalization.
Practical implications: The research findings may influence training strategies within organizations and the development of competency programs for managers. The results suggest a need to invest in the development of digital and analytical skills among leaders.
Social implications: The use of AI in management also requires reflection on ethical considerations, algorithmic transparency, and social responsibility, especially in the context of decisions that impact people.
Originality/value: The article fills a research gap by combining theoretical and practical perspectives, providing a comprehensive view of managerial competencies in the age of AI. It is intended for scholars, management practitioners, and technology decision-makers.
Keywords: manager, management, algorithms, competencies, AI.
Category of the paper: research paper.

1. Introduction

The dynamic development of artificial intelligence (AI) is revolutionizing the way organizations operate, introducing new models of management, decision-making, and shaping relationships between humans and technology. This transformation presents managers with numerous challenges whose scale and complexity are unprecedented in the history of management (Krechowicz, 2021, pp. 393-404). Algorithms and tools offered by AI not only automate processes and optimize operational activities but also redefine the concept of leadership, requiring managers to acquire new competencies — from data analysis skills to the ability to lead teams in hybrid human-machine environments (Śledziewska, Włoch, 2020, pp. 45-55). The increasing integration of algorithms into everyday management compels decision-makers to address fundamental questions: which decisions should remain within human domain, and which can be entrusted to algorithms? How can one maintain an ethical approach to management in a data-driven world? What qualities should a future leader possess to effectively lead a company through digital transformation? The article presents both theoretical perspectives on the issue and practical implications for organizational leaders operating in a dynamically evolving technological environment. Despite growing interest in the use of algorithm-based tools in management, previous research has mainly focused on the technological or organizational aspects of their implementation. A research gap thus exists concerning the diversity of managerial attitudes toward AI tools, particularly in relation to industry sectors, levels of technological adoption, and organizational size. Moreover, in-depth analyses of the competencies required to effectively use these tools in decision-making processes — especially in low-digitization environments — are still lacking. This study aims to fill that gap. The purpose of this article is to reflect on the evolving role of managers in the era of artificial intelligence and to analyze the challenges associated with the adoption of algorithm-based tools in decision-making processes. The author attempts to combine both theoretical and practical perspectives, highlighting the key competencies required in AI-supported management. The text also seeks to identify underexplored areas and demonstrate how technological development is reshaping leadership competencies. It serves as an introduction to a broader discussion on the future of management in the context of rapidly advancing technologies and their impact on organizational leadership decision-making.

2. The Evolution of Management in the Context of AI

Management as a scientific discipline has undergone numerous stages of development and transformation, evolving from classical organizational theories to modern approaches based on digitalization and process automation. Artificial intelligence represents the next step in the evolution of management, transforming both decision-making models and the roles of managers within organizations. Initially, management was grounded in a scientific approach dominated by the principles of Taylorism and Fordism. Managers primarily performed a controlling function, and decision-making processes were hierarchical and based on rigid rules (Koźmiński, 2004, pp. 35-53).

The development of information technologies and ongoing globalization introduced new concepts, such as process management, while organizations themselves became increasingly focused on learning. Today, with the advancement of algorithms proposed as tools to support both management and decision-making, we can observe a shift toward data- and algorithm-driven organizations, where decisions may be supported or even fully taken over by artificial intelligence systems.

One of the key aspects of modern management relates to the role of algorithms in automating decision-making processes. The development of algorithm-based tools can assist managers in analyzing vast data sets, forecasting market trends, and optimizing business processes (Chen, Liu, Bai, Chen, 2019, p. 2131). Intelligent algorithms can not only recommend optimal strategies but also independently execute tasks that previously required human involvement. An example of this is AI-powered customer relationship management (CRM) systems, which automatically personalize communication with clients and optimize sales strategies.

Decisions based solely on acquired experience may no longer be sufficient in today's business environment. Intuition alone can be too risky, especially given the high volatility and complexity of contemporary markets. Modern approaches rely on data analytics and predictive models to support decision-making processes, which are becoming a natural part of organizational operations. The tools available to managers allow for faster and more accurate decisions, based on the simultaneous analysis of thousands of variables (Davenport, Ronanki, 2018, pp. 108-116). In practice, this means that managers increasingly depend on algorithms that provide recommendations based on historical data analysis and predictions of future outcomes.

As the role of algorithms grows, managers are no longer just decision-makers—they are also strategists and technology integrators. They must understand the potential of AI tools and continuously develop their ability to manage teams in which humans collaborate with intelligent systems. This shift introduces new challenges, such as the ethical implications of

AI usage, emerging legal regulations, managing hybrid teams, and building trust in the solutions provided by AI-based tools.

The development of decision-support tools not only transforms enterprises but also redefines the role of managers and the skills required. Traditional competencies, such as strategic planning, human resource management, or decision-making, must be complemented by the ability to operate in an environment driven by algorithms and data analysis. Today's managers, in order to function and lead effectively in this new reality, must continuously develop new skills that enable them to fully harness the potential of intelligent technologies in management.

One of the key aspects of management in the new reality is the ability to analyze and interpret data. Managers do not need to be experts in programming or statistics, but they should understand the basics of data analytics and market analysis in order to effectively utilize reports generated by available tools and make informed strategic decisions that contribute to maximizing the value of the enterprise (Davenport, 2018, pp. 39-65).

Modern organizations base their strategies on advanced predictive models, which is why the ability to read, interpret, draw conclusions from, and constructively respond to analytical results is becoming an essential element of managerial competencies (Sienkiewicz-Małyjurek, 2018, p. 47).

The tools currently available to managers do not replace people, but they change the way people work. Managers increasingly need to lead hybrid teams, in which intelligent systems support process automation alongside human employees. A key challenge is the effective use of the potential of both people and technology. This requires a new approach to work organization, task coordination, and employee motivation in the face of increasing automation — a task that is complex and demanding (Tegmark, 2019, pp. 111-115).

Tools based on algorithms are increasingly supporting decision-making processes by reducing subjectivity and human error. Managers must learn to interpret recommendations derived from algorithm-generated data and make decisions based on insights provided by these systems. However, a significant challenge lies in understanding the limitations of these tools and in the ability to assess the risks associated with automating decision-making processes.

The use of algorithm-based tools in management is also associated with ethical and social considerations. Managers must be capable not only of managing organizational efficiency but also of ensuring the ethical implementation of technology. This includes maintaining algorithmic transparency, avoiding bias in decision-making, and building trust in systems among employees and customers. These competencies require not only technological knowledge but also soft skills such as empathy and communication abilities (Bostrom, 2016, pp. 17-38).

The use of algorithms in decision-making processes does not eliminate the role of the manager; rather, it redefines it. Business leaders become moderators of analytical processes, capable of interpreting algorithmic recommendations and implementing them within a strategic

context. This means that the core competencies of managers are evolving — in addition to traditional skills like human resource management and business decision-making, they must now develop analytical and technical capabilities that enable them to work effectively with available tools.

Despite the numerous benefits, implementing AI tools in management also brings new, still unknown challenges. One of the most significant is trust in algorithms — managers are often reluctant to rely on AI-generated recommendations due to the lack of full transparency in decision-making models. Furthermore, algorithms may fail to account for the cultural and social context of decisions, potentially leading to unintended consequences (Brynjolfsson, Rock, Severson, 2017, pp. 33-35).

3. Methodology and Sample Selection

The aim of this study is to analyze managers' perceptions regarding the role of algorithm-based tools that support decision-making processes in their daily work. The research seeks to verify how management personnel use these tools, what benefits they perceive, and what challenges and risks they identify. A key aspect of the study is also the assessment of the competencies required by managers and their readiness to adapt new technologies in managerial practice. The study was conducted in September and October 2024. This period was chosen due to the availability of respondents and the stability of external conditions, which allowed for the collection of reliable and comparable data. The research was carried out among business owners, managers, and leaders from various industries, sectors, and management levels. This approach provided a broad perspective on the impact of artificial intelligence on management practices and the competencies required in the era of digital transformation. The sample was selected purposefully, taking into account sectoral diversity, organizational size, and the degree of use of decision-support tools within companies. Participants included business owners, managers, and mid- to senior-level leaders holding executive, managerial, or board positions. This group was selected because they are the primary decision-makers responsible for the strategic implementation of new technologies, including AI-based systems.

The respondents represented various sectors of the economy, which enabled the analysis of differences in approaches to AI tools depending on the specific characteristics of the enterprise. The study included individuals working in sectors such as IT and new technologies, finance and banking, industry, trade and e-commerce, services (e.g., HR, business consulting), healthcare, and public administration.

In terms of organizational size, the study involved managers, leaders, and business owners managing micro, small, medium, and large enterprises. This approach allowed for the examination of how attitudes toward AI tools vary based on company size. An additional

segmentation criterion was the level of AI tool implementation in decision-making processes within the organizations. Three groups were identified:

- Enterprises actively using AI in decision-making processes.
- Enterprises planning to implement AI tools in the future.
- Enterprises not using AI at all.

The total number of respondents was 85, including leaders, managers, directors, and business owners. The survey questionnaire was made available online and distributed through professional social networks such as LinkedIn, as well as via direct email outreach to businesses.

Additionally, to deepen the analysis, interviews were conducted with selected respondents, which made it possible to obtain more detailed information about their experiences with the implementation and use of AI tools in day-to-day management and decision-making processes. Although the sample was selected purposefully, its representativeness was ensured by taking into account key criteria such as industry sector, organization size, and the level of AI implementation in decision-making processes. Furthermore, elements of randomness were introduced within respondent subgroups to reduce selection bias and enhance the credibility of the results. This approach enabled a diversified analysis of managers' perceptions, representing various levels of management and different experiences with algorithm-based technologies, thus strengthening the validity of the findings. A limitation of the study is the purposive sampling, which, although representative in terms of selected criteria, does not allow for full generalization of the results to the entire population of managers in Poland. Given the dynamic development of AI-based technologies, it is necessary to conduct ongoing research that can capture changing attitudes and the level of AI adoption across different economic sectors. Future studies should further explore the barriers to AI implementation, particularly in low-digitization sectors, and incorporate the perspectives of operational staff and specialists who support decision-making processes.

Table 1.
Sample selection based on the management level criterion

Position level	**N – Sample size**
Lower management level	N = 17
Middle management level	N = 31
Senior management level	N = 18
Business owner	N = 19
Total	N = 85

Source: own elaboration.

Table 2.
Sample selection based on the industry sector criterion

Industry sector	**N – Sample size**
IT and new technologies	N = 15
Finance and banking	N = 12
Manufacturing and industry	N = 10

Cont. table 2.

Trade and e-commerce	N = 14
Services (HR, business consulting)	N = 13
Healthcare	N = 11
Public administration	N = 10
Total	N = 85

Source: own elaboration.

Table 3.
Sample selection based on the enterprise size criterion

Position level	**N – Sample size**
Micro enterprise (up to 9 employees)	N = 18
Small enterprise (10 to 49 employees)	N = 23
Medium enterprise (50 to 249 employees)	N = 27
Large enterprise (250 or more employees)	N = 17
Total	N = 85

Source: own elaboration.

Table 4.
Sample selection based on the level of implementation of algorithm-based AI tools supporting decision-making

Position level	**N – Sample size**
Enterprises actively using AI	N = 44
Enterprises planning to implement AI tools in decision-making	N = 23
Enterprises not using AI tools in decision-making	N = 18
Total	N = 85

Source: own elaboration.

Among the respondents who participated in the study, there were 18 managers, leaders, directors, and business owners representing enterprises that have not implemented AI tools in their decision-making processes and do not plan to do so in the near future. This group provides valuable insights into the barriers, limitations, and reasons for refraining from adopting artificial intelligence in management.

Respondents working in companies that do not use AI tools in decision-making processes represent various sectors of the economy, with a predominance of organizations operating in industries with lower levels of automation and more traditional business models. The sectoral breakdown is as follows: Manufacturing and industry – 4 enterprises, Trade and e-commerce – 3 enterprises, Services (HR, business consulting) – 3 enterprises, Public administration – 3 institutions, Finance and banking – 2 enterprises, IT and new technologies – 2 enterprises, Healthcare – 1 enterprise.

4. Managerial Competencies in the Age of AI: Findings from Empirical Research

AI tools are increasingly becoming an integral part of management, supporting managers in decision-making, business process optimization, and data analysis. Their application can significantly impact organizational efficiency; however, the level of adoption of this technology varies across industries and economic sectors. Questions still arise regarding the actual role of AI tools in management, the extent of their use, and the challenges and concerns associated with their implementation.

Considering the size of the enterprises managed by the respondents, those not using AI are mainly small and medium-sized businesses. This suggests that limitations in implementing new technologies may stem from financial and organizational barriers, as well as a lack of appropriate technological competencies. The size structure of these enterprises is as follows: micro-enterprises (up to 9 employees) – 6 enterprises, small enterprises (10 to 49 employees) – 5 enterprises, medium enterprises (50 to 249 employees) – 5 enterprises, large enterprises (over 250 employees) – 2 enterprises.

Figure 1 presents the main reasons for the lack of AI tool implementation in this group of enterprises.

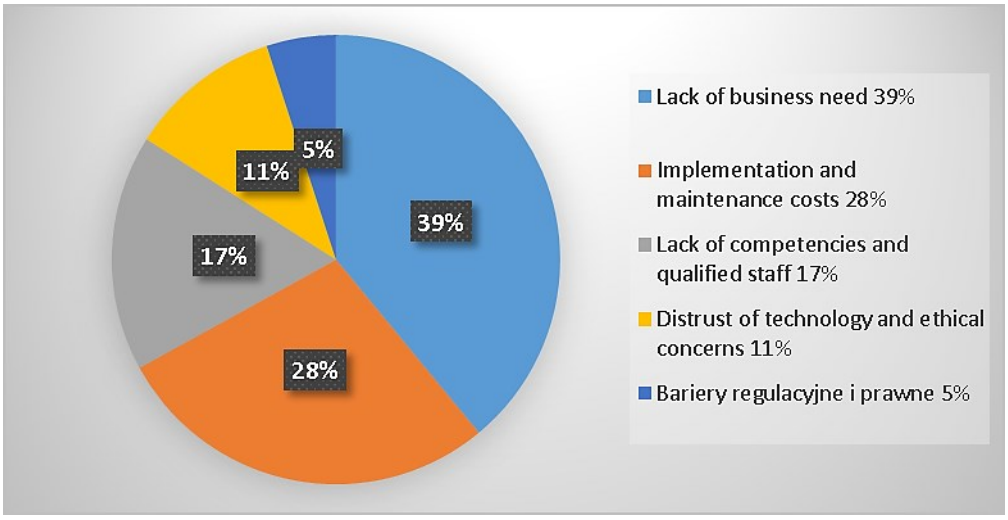


Figure 1. Reasons for the lack of AI tool implementation in decision-making processes among the surveyed sample.

Source: own elaboration.

Despite the current lack of AI tool implementation in decision-making processes, more than half (56%) of respondents in this group indicated that they may consider adopting artificial intelligence tools within the next 3-5 years.

After excluding the group of enterprises that have not implemented AI tools in decision-making, the further analysis focuses on 67 managers, business owners, directors, and leaders who actively use AI solutions in decision-making processes.

The analyzed group consists of representatives from various management levels. The position structure is as follows: business owners – 21%, directors (senior management) – 27%, and managers/leaders (lower and middle management) – 52%. This distribution indicates that the largest group consists of lower and middle-level managers who are responsible for day-to-day operational and strategic decisions, supported by algorithm-based tools.

The enterprises where managers have implemented AI tools in decision-making operate across various industries/sectors. The sectoral distribution is presented in Figure 2.

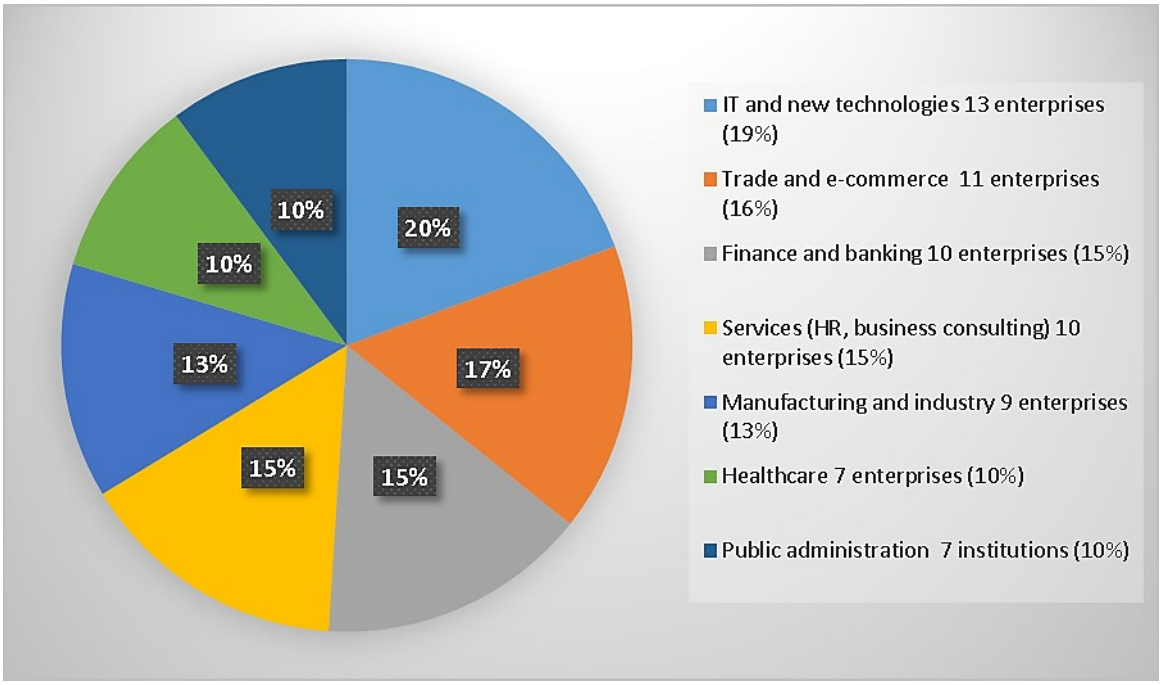


Figure 2. Distribution of the research sample using AI tools in the decision-making process (in %).
Source: own elaboration.

The largest share in the group is held by enterprises from the IT and new technologies, trade, and finance sectors, indicating that AI tools supporting decision-making are particularly popular in industries that require the processing of large volumes of data and the automation of decision-making processes.

Taking into account the size of enterprises that actively implement AI tools in decision-making processes, the data shows that among the respondents working in micro-enterprises, only 12 (18%) use AI in decision-making; in small enterprises, 16 respondents (24%); in medium-sized enterprises, 23 respondents (34%); and in large enterprises, 16 respondents (24%).

This data demonstrates that the use of AI tools in decision-making is not limited to large corporations—smaller enterprises also invest in algorithm-based artificial intelligence solutions, although the scale of implementation may vary depending on the organization's resources and capabilities.

Managers also indicated the decision-making areas in which AI tools play a key role. These are presented in Table 5.

Table 5.
Areas of AI Application in the Decision-Making Process

1	Data analysis and market trend forecasting	78% respondents
2	Automation of operational and production processes	65% respondents
3	Customer relationship management (CRM, chatbots, offer personalization)	59% respondents
4	Cost optimization and resource allocation	55% respondents
5	Recruitment	42% respondents
6	Support for strategic business decisions	39% respondents

Source: own elaboration.

Respondents also identified the key benefits of using AI tools in decision-making processes. These are presented in Table 6.

Table 6.
Key Benefits of Using AI Tools in the Decision-Making Process

1	Increased operational efficiency	82% respondents
2	Faster and more accurate decisions	76% respondents
3	Reduction of operational costs	61% respondents
4	Improved customer experience	58% respondents
5	Enhanced business competitiveness	52% respondents

Source: own elaboration.

Respondents were also asked about the competencies they consider essential for the effective use of AI tools in the decision-making process. The results are presented in Table 7.

Table 7.
Key Competencies for the Effective Use of AI Tools in the Decision-Making Process

Ability to analyze and interpret data	86% respondents
Flexibility and adaptability in a changing environment	74% respondents
Critical thinking	73% respondents
Understanding of automation processes and decision-making algorithms	59% respondents
Digital and technological competencies	52% respondents

Source: own elaboration.

The study indicates that among managers who actively use AI tools in decision-making processes, the ability to analyze data, adapt to new technologies, and think critically are of key importance. These tools are most frequently used for data analysis, which influences decision-making, process automation, and cost optimization. Managers, leaders, directors, and business owners clearly recognize the benefits of AI, such as increased efficiency and improved competitiveness.

At the same time, there are still significant barriers to the implementation of AI tools that support decision-making—particularly in terms of integration with existing systems, implementation costs, and the need to develop technological competencies among managers. In the face of these challenges, training and the development of analytical and digital skills are crucial to effectively harness the potential of available tools in management.

5. Summary

The research findings indicate that managerial competencies in the age of AI differ significantly from traditional leadership skills. While classical management relied on intuition, experience, and control of operational processes, today's managers need to develop analytical and digital competencies, as well as the ability to manage teams in which AI plays a key role.

The analysis shows that 85% of respondents identified the ability to analyze and interpret data as a crucial competency when using AI tools to support decision-making. This means that managers must not only understand reports and analyses generated by algorithms but also make decisions based on facts rather than intuition.

The importance of this skill is particularly evident in sectors where AI is used for market trend forecasting, customer behavior analysis, and operational process optimization. Managers in IT, finance, and e-commerce more frequently emphasized the need for analytical skills (with over 90% of responses), while in healthcare and public administration this figure was around 40%.

To manage effectively in a dynamic technological environment, managers must demonstrate a high degree of adaptability to tools. As many as 74% of respondents highlighted the ability to quickly adjust to a changing business environment as one of the most important success factors for managers using AI in decision-making. This means that AI cannot be treated as a static tool—technology is constantly evolving, and its effective use requires continuous skills development and openness to change. Furthermore, 59% of respondents stated that managers should have at least a basic understanding of automation processes and decision-making algorithms to use AI effectively in management.

This does not imply that leaders must possess programming skills—but it is essential to understand how AI works, its limitations, and the risks associated with implementing algorithms into decision-making processes.

The study shows that managerial competencies in the age of AI must include both hard skills—such as data analysis and technological know-how—and soft skills, such as adaptability, leadership, and an ethical approach to management. The findings suggest that the future of managerial competencies in the AI era will depend on the ability to integrate analytical expertise with human-centered leadership skills. Managers who succeed in combining these two dimensions will be better equipped to leverage AI in building their organization's competitive advantage.

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DEMOGRAPHIC CHANGES AS A CHALLENGE FOR MANAGERS

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Purpose: The first aim of the article is to demonstrate that demographic changes will force the need to employ older people, and the second is to indicate, based on the literature on the subject and own research, the benefits and risks of employing people of different ages, especially employing older people.
Design/methodology/approach: The research presented in this article was carried out based on an analysis of literature in the area of demography, the labor market, and human resources management.
Findings: In many countries, including Poland, for several decades now, there have been unfavourable demographic changes, consisting of a decrease in the birth rate. They result in changes in the population structure. In Poland, there are more and more people in the post-productive age, fewer and fewer in the productive and pre-productive age. This causes the need for changes in both the policy related to the labour market, but also poses a challenge for managers, who must modify the way of managing human resources, taking into account the employment and work of increasingly older people. This causes the need to modify the methods of recruitment, assessment, motivation, and development.
Research limitations/implications: In the future, research will be conducted directly in companies regarding expectations regarding the competences of older employees and their employment conditions.
Practical implications: There is a need for research on the possibilities and conditions of employment and work of older people, on modifying the elements of human resources management adapted to people of different ages.
Originality/value: presenting data on the size of the decline in labour supply, indicating the benefits of employing people of different ages.
Keywords: demography, labor market, human resources management.
Category of the paper: review and research paper.

1. Introduction

A very important issue for human resources management is the company's environment and the changes taking place in this environment. The most important areas of change, apart from the development of technology, techniques or artificial intelligence, include economic and legal

changes, and changes in the labor market (Pocztowski, 2018). An important part of the latter are demographic changes, resulting primarily from migration and changes in the birth rate (fertility), because they affect the structure of the population in general and the structure of employment.

Statistical data show that after Poland joined the European Union, a large number of people emigrated from Poland and the level of temporary migration reached over 2 million people (GUS, 2020), decreasing in the years 2019-2023 to about 1.6 million (GUSb, 2024). To put it slightly simply, the emigration of Poles was economic in nature and, on the one hand, it resulted from the lack of utilization of labor resources in Poland, and on the other, from the demand in other countries represented by companies, organizations and individuals for employees employed mainly in elementary jobs. However, for several years there has been a change in the phenomenon of migration in Poland. Since 2014, due to changes in immigration regulations, the number of immigrants, mainly from Ukraine, has started to increase, with a small decrease in the number of emigrants from Poland. At the end of 2021, about 1.5 million immigrants were working, mainly from Ukraine (Jarecki, 2023, pp. 36-43). The increase in migration from Ukraine increased significantly after Russia's attack on Ukraine in early 2022, but this was war migration, unrelated to taking up employment, although about half of the war migrants also took up paid employment. However, immigration from other countries, mainly Asian countries, has started to increase on the labor market.

The second element of demographic changes, i.e. fertility, is very important. It affects the creation of labor supply in the future. The size of the fertility rate in the coming years allows, among other things, to forecast how many people will enter the labor market in the future, in specific years. On the other hand, based on the age structure and the number of employees, it is possible to estimate how many people will retire and leave the labor market. This information is the basis for achieving the objectives of the article. The first is to demonstrate that demographic changes will force the need to employ older people, the second is to indicate the benefits and threats of employing people of different ages, including employing older people, and to indicate the specifics of managing them.

2. Demographic changes and their consequences for the labor market

To achieve the presented objectives, first the data on demographic changes were analyzed, indicating the loss of Poles from the labor market, then the results of research relating to the management of older and younger people and own research conducted among older people in the West Pomeranian Voivodeship, mainly members of universities of the third age. In addition, based on the analysis of the literature on the subject, guidelines for effective human resources management were presented, taking into account older people.

Demographic data show that fewer and fewer young people are entering the labor market in Poland. People at the top of the first post-war baby boom have reached (2024/2025) retirement age (they are 65-68 years old) and are mostly no longer working (GUSc, p. 141). The peak of the second boom is the current 40-42 year olds (GUSc, 2024, p. 141). Therefore, these are professionally mature people, still mobile, almost 40% of whom have higher education. From around 2030, the number of people over 60 will start to grow dynamically, and for the next 15 years, (and the number of people turning 60 will remain high for the next 10 years), and thus the number of retirees will increase significantly from around 2035. This therefore indicates a situation in which there are only a few years left to limit the negative effects of shortages on the labor market, e.g. by activating middle-aged and older people (aged 45 and over), but still working. Company managers can, and even should, take this phenomenon into account now, both in terms of the functioning of the company as a whole, its management, but also taking into account planning future personnel needs and developing tools for managing people, conventionally called older or age-diverse.

There is still some time, because changes in the age structure of employees on the labor market are not occurring rapidly, but this time is needed to create a specific employment structure in organizations that takes into account, among other things, current and forecasted demographic changes and to recognize the benefits and threats resulting from these changes. It is also important to search for and select appropriate tools for managing human resources, especially recruitment, motivation, development of acceptance of attitudes of other people, cooperation or sharing knowledge.

The problem of ageing of the society is not new in Europe. It appeared more clearly in the European Union in the 1980s, i.e. during its formation. Since 1964, there was a gradual decrease in the fertility rate in Germany (in other countries at a slightly higher level) to 1.4-1.5 and then the rate remained at this level. In 2005, after the enlargement of the European Union by 10 countries and the deepening problem of ageing of the society was noticed in these countries as well, the European Commission issued a document encouraging the implementation of a policy of keeping people of retirement age in work (Green Paper, 2005), and in 2010 it issued a resolution calling on the Member States, among others, to take actions to activate people over 50, also through incentives for enterprises (Demographic challenges, 2010). The document also proposed initiatives in the field of human resources management in order to employ older people. In the context of the proposed recommendations, it is therefore worth analysing in more detail the demographic situation in Poland (Table 1 and Table 2) and drawing conclusions regarding preparation for these changes in human resources management.

Table 1.
Changes in the demographic structure in selected age groups in Poland in the years 2010-2030

Year	**Total population** (thousand)	**19-24 years** (thousand)	**18-44 years** (thousand)	**45-59/64 years** (thousand)	**60-65 years and older** (thousand)
2010	38 093	3371	15 294	9277	6414
2011	38 082	3261	15 278	9185	6586
2012	38 069	3160	15 247	9070	6774
2013	38 056	3054	15 190	8948	6971
2014	38 037	2938	15 115	8828	7169
2015	38 016	2817	15 005	8713	7380
2016	37 988	2691	14 869	8607	7590
2017	37 957	2590	14 705	8521	7801
2018	37 920	2480	14 524	8458	8003
2019	37 876	2394	14 309	8430	8191
2020	37 830	2320	14 072	8431	8368
2021	37 773	2248	13 814	8471	8522
2022	37 706	2192	13 566	8519	8663
2023	37 627	2155	13 318	8583	8794
2024	37 538	2138	13 068	8678	8906
2025	37 438	2135	12 823	8802	8997
2026	37 328	2160	12 603	8933	9068
2027	37 208	2208	12 361	9101	9127
2028	37 078	2265	12 098	9264	9183
2029	36 941	2319	11 851	9474	9236
2030	36 796	2367	11 624	9630	9289
2031	36 645	2404	11 438	9742	9342
2032	36 488	2427	11 277	9818	9399
2033	36 326	2432	11 125	9872	9462
2034	36 161	2429	10 980	9900	9535
2035	35 993	2417	10 834	9905	9622

Source: Jarecki, 2015, pp. 13-22.

Table 2.
Population in Poland (31.12.2023) by selected age and the projected difference between the number of people retiring and entering the labor market

Estimated year of entry into and exit from the labor market (1)	**Age** (2)	**Population in relation to (2) (thousand)** (3)	**Age** (4)	**Population in relation to (4) (thousand)** (5)	**Potential difference (decrease) in labor supply (thousands) ((5)-(3))** (6)
2049	0	267	40	666	399
2048	1	304	41	645	341
2047	2	334	42	617	283
2046	3	350	43	628	278
2045	4	376	44	623	247
2044	5	394	45	604	210
2043	6	413	46	598	185
2042	7	397	47	598	201
2041	8	388	48	576	188
2040	9	381	49	553	162
2038	10	385	50	530	145
2037	11	404	51	508	104
2036	12	404	52	486	82
2035	13	427	53	469	42
2034	14	431	54	450	19

Cont. table 2.

2033	15	426	55	439	13
2032	16	397	56	433	36
2031	17	376	57	432	56
2030	18	362	58	435	73
2029	19	349	59	442	93
2028	20	342	60	448	106
2027	21	346	61	448	102
2026	22	358	62	460	102
2025	23	368	63	481	113
2024	24	371	64	507	136
-	-	-	-	-	deficiency 3716 thous.

Source: GUS, Rocznik Demograficzny 2024, 2024, pp. 141-142.

In Poland, the population has been decreasing since 2010 and, according to forecasts, this trend will continue until at least 2035 (Table 1). The population in Poland will decrease by about 2 million people during this period. Analyzing selected age groups, it can be seen that among people of the age of making decisions about their future life path, due to completing secondary school (19-24 years old), i.e. also of university age, there will be a decrease in the number of these people until 2025 (from 2.9 million in 2014 to 2.1 million in 2024) and then an increase until 2033 (to 2.4 million). From these data, it can be concluded that there will be a decrease in people entering the labor market and a related decrease in the number of university graduates. This is important because people after university are a key element in the development of enterprises and the economy.

The next group analyzed in Table 1 are people of the so-called mobile age (18-44 years old). This is the largest group of people and, as the name suggests, the most mobile. This group is in a particularly difficult situation. From 2014 to 2035, the number of these people in Poland will decrease by about 4.3 million. This will have a huge impact on the economy, the size and type of consumer demand, the supply of labor, the functioning of enterprises and employee management.

In the next age group (45-59/64 years), the number of people will decrease until 2019 (from 8.8 million to 8.4 million) and then increase to 9.9 million in 2035. Therefore, the supply of employees will probably be partially supplemented from this group. However, the most dynamic increase in the number of people will be in the age of 60/65 and over. In 2014, there were 7.2 million of them and in the years 2010-2014 there was an increase of about 750 thousand and by 2035 there will be an increase of another 2.5 million people. It can be assumed that this will be an extremely important group of potential employees. Of course, it may be difficult to expect people to be employed after the age of 70, but below that age it will become even advisable. It is worth adding that since 1990 there has been a systematic increase in the level of education of Poles, which affects the growth of competences and thus greater chances of employment of increasingly older people.

In turn, Table 2 presents data on the difference between the number of people leaving the labor market and entering it (the last row). A simplification was adopted, which may be implemented in the future, that both women and men retire at the age of 65. The second

assumption is that people enter the labor market at the age of 24. These simplifications do not significantly change the picture of changes in the labor market resulting from the decline in fertility and differences in the demographic structure of society. Therefore, the data contained in Table 2 show that in 2024, 507 thousand people will be unemployed. people retired (most women had already been retired for several years, but a similar number of sixty-year-olds are entering this age, so there are no large differences in numbers) and only 371 thousand people entered the labor market. Therefore, approximately 136 thousand people left the labor market. In the next 5 years, approximately 100 thousand people will also leave the labor market per year. Then this loss will decrease, after which, from around 2040, it will increase significantly and approximately 200 thousand people will leave the labor market per year and from 2045 approximately 300 thousand per year. Within 25 years, the surplus of people retiring in relation to those entering the labor market will amount to over 3.7 million people. If the retirement age for women were raised to 65, this number would decrease to 1.0-1.5 million. It should be added, which results from both Table 1 and Table 2, that the average age of employees on the market will increase. The data presented show that the country's managers, as well as companies, face the challenge of how to fill the gaps in the labor market. It should be added that the decline in population also means a decline in demand for goods and services, which has a negative impact on economic growth.

3. Demographic changes and human resources management

The analysis of demographic changes indicates that the average age of people on the labour market will increase. Of course, this can be partially compensated by the influx of immigrants, and as a rule, this occurs in large cities, where there are greater opportunities to find and change jobs. It should be assumed that staff shortages will affect smaller companies and those in smaller towns more. Large companies have a more developed system of recruitment and development of employees, they plan better long-term personnel issues, both in terms of quantity and quality, which helps to prepare better for demographic threats (Eckhardt et al., 2009), immigrants are more willing to come to large cities due to greater opportunities to find work, higher salaries and the ease of renting an apartment.

In business practice, but also in scientific publications in the field of human resources management, the issue of age management, including the management of older people in the context of demographic changes, has only begun to be addressed in the past few, maybe a dozen or so years. It is worth taking a look at the results of research in this area, especially showing the benefits of employing older people, but also the risks resulting from it. Studies show, first of all, relatively high work efficiency of older people (e.g. Filipp, Mayer, 1999, p. 179; Smentek, 2007, p. 16). This is mainly due to many years of broadly understood professional

experience, high quality of work performed, reliability, perseverance, loyalty, responsibility, conscientiousness, maturity, emotional stability and the ability to build relationships. Another significant benefit is their lower tendency to emigrate. However, it should be taken into account that there are very large differences in competences, including health, among older people. Hence the need for a more individualized approach to older employees. It is worth remembering, however, that medical progress, increased level of education, development of techniques and technology have caused the age of possible professional activity to be extended. Therefore, the phenomenon of the need to increase the employment of older people should be viewed optimistically, especially since the level of education of older workers in Poland and their skills will continue to increase, which also results from the educational boom that began in Poland at the turn of the eighties and nineties of the twentieth century, so 35 years ago, i.e. initiated by current 55-60 year-olds.

During changes in the employment structure in the company, great sensitivity and empathy of the people responsible for this process are important. Managers should be well acquainted with the issues of demographic changes, advantages and disadvantages of older people, the essence of discrimination and stereotypes related to older people, changes that progress with age and are related to needs, expectations, values, etc. Therefore, training of superiors and co-workers is useful. The disadvantages or threats may also include: poorer physical health, higher risk of illness, more frequent mistakes, lower flexibility, lower innovativeness, lower willingness to adapt to others, teamwork skills that decrease with age, lower willingness to learn (e.g. Barth, 2000, p. 85). Nevertheless, up to about the age of 50, employees learn in a similar way. Then, the approach to learning becomes different, which is manifested, among other things, by the fact that older people need better structured materials and what they are supposed to learn must be meaningful and useful (cf. Naegele, 2006, p. 111; Ilmarinen, Tempel, 2002, p. 223). In addition, research shows that younger people have better current memory and older people remember more because they adopt certain memorization strategies (e.g. grouping information) (Lehr, 2007, p. 96; Markson, 2003, p. 185; Semmer, Richter, 2004, p. 97). Therefore, learning and memorizing in older people does not have to be worse than in younger people, it is simply different.

In the context of the above analysis, it is worth presenting the challenges and recommendations for human resources managers. Firstly, it is important to generally recognize the importance of demographic changes and their impact on the possibilities of employing people of different ages. Secondly, it may be useful to define the positions that older people could occupy. Thirdly, it is beneficial to conduct training to make younger employees aware of the possible benefits, also for them, and the threats of employing older people, and to indicate how to strengthen the weaknesses of older employees. This also applies to the opposite situation - making older people aware of the advantages and disadvantages of younger employees (see: Zimbardo, Gerrig, 2008, p. 790; Dorsch, 2004, p. 488). Fourthly, we should try to

accustom older employees to the idea that they will continue their education and gain knowledge, because this is a key issue in the modern economy.

In the face of demographic changes, we can also indicate several recommendations for managers. A company that wants to employ older people can start building a company image that is favorable to older employees even earlier. Such an image will encourage an increase in the number of older people willing to take up employment in a given organization. When planning the employment of older employees, it is also important to take into account, as mentioned above, that they are less mobile, that discriminatory behaviors may occur on the part of younger people, consisting in treating them as less intelligent, not keeping up with technological changes, conservative, etc. and having outdated knowledge. It is also necessary to verify the tools of employee recruitment a bit, partially returning to more traditional ones.

On the other hand, an important problem is changing the mentality of potential, older employees. The point here is to persuade these people to take up work or at least to apply for it. Older people often do not believe that someone can hire them and are discouraged in their job search.

At the end of this point, it is worth mentioning the author's research conducted in 2018 among 521 members and supporters of universities of the third age, aged 55-69 (Jarecki, Kunasz, Skoczylas, 2018). The research concerned, among other things, diagnosing the conditions under which the surveyed people would take up employment and under what conditions companies would employ them. Among the most important results, it is worth pointing out that only about ¼ of people were willing to take up employment, and of these ¾ part-time or shorter. The remaining people were willing to work more than part-time. In turn, entrepreneurs would most often like to employ full-time (Jarecki, Kunasz, Skoczylas, 2018, pp. 113-115). The second major discrepancy was the hourly wage. Employees would like to earn about 50% more than the entrepreneurs offered. These differences in salaries probably resulted from the fact that employers would like to employ older people most often for elementary positions, and people willing to take up work, probably also because they most often had higher education, would like to work in specialist positions. This research may suggest that there is a large range in the employment conditions expected by both parties. This is also a challenge for further research and for managers, who may need to verify their ideas about older people who want to take up work, because these are people who are better qualified in their age group.

4. Conclusions

The presented analysis of data on the demographic situation allows us to conclude that there is a need for people involved in labor market policy and managing organizations to consider increasing employment among older people. However, in order to do this effectively, it is necessary to analyze the economic and social situation from a macroeconomic perspective, affecting the demand and supply of labor, and draw conclusions from the perspective of labor market policy. In addition, owners and managers should analyze not only the situation in the managed organization, but also the expectations and needs of potential employees, including older ones.

We can also indicate the challenges facing people involved in the scientific and practical management of older people. These include, for example:

- Studying the competences of older people, especially their knowledge, activity, involvement and the conditions of this involvement.
- Studying the possibilities and conditions of broadly understood cooperation between older and younger employees.
- Studying the obstacles on the part of the employer and older employee in the development of the latter and determining ways to eliminate these obstacles (e.g. reluctance to learn new technologies).
- Research on the possibilities of using different competences of older and younger people in the area of "psyche" (intelligence, information processing, memory, learning), body (vision, hearing, motor skills - strength, endurance, coordination, speed, agility), personality traits (especially motivation to work), emotional (satisfaction, joy, enthusiasm, fear, depression, etc.), social competences (e.g. trust, cooperation, isolation, bonds between employees) and health.

It is also worth adding that companies should learn to recognize the potential contained in older people. Some companies will be forced to learn to use methods of supporting motivation to work, efficiency, innovation, but also perhaps the health of their employees. There will also be a need to pay more attention to the flexibility of organization and working time, individualized training, creating vertical and horizontal career paths, and health care. Finally, there are actions to be taken to make managers in companies aware of the potential of older employees:

- clear communication about future plans at retirement age,
- promoting the benefits of extending activity,
- effective use of employee experience,
- solutions aimed at taking care of health.

There are probably more actions that could be mentioned, but it is worth starting to implement at least the ones mentioned.

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EXPENDITURE INDEPENDENCE OF COMMUNITIES IN THE EXECUTION OF EDUCATIONAL TASKS – A COMPARATIVE ANALYSIS

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Purpose: This study examines the extent of spending autonomy available to municipalities in relation to the fulfilment of their educational responsibilities. The construction of a measure to assess spending autonomy in the implementation of educational tasks permits the comparison of municipalities with one another.
Design/methodology/approach: A multivariate comparative analysis was conducted using the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method. A composite index was devised to evaluate the execution of the educational functions. A comparative ranking of municipalities was constructed for the years 2017 and 2022. Furthermore, an empirical analysis of municipal expenditure was conducted between 2008 and 2023.
Findings: The results demonstrated a notable correlation between income and expenditure on educational tasks, indicating that local authorities have discretion in allocating resources for these activities. This finding supports the idea of autonomous spending in this domain.
Research limitations/implications: A primary constraint of the present study is the unavailability of comprehensive and complete data, which is necessary to facilitate a more precise and thorough development of the measure
Practical implications: The present article provides an opportunity to assess the effectiveness of self-government intervention in the area of education spending.
Social implications: The evaluation of the spending autonomy of local governments in the field of education has the potential to influence public policy by optimising the allocation of resources and redressing regional inequalities in education.
Originality/value: This study examines the efficacy of spending on educational tasks and compares it with that of the local authorities with one another. By analyzing the performance of the local authorities at the upper end of the ranking, it is possible to identify a benchmark to which municipalities should aspire.
Keywords: municipality, public finance, educational tasks, spending autonomy, TOPSIS method.
Category of the paper: research paper.

1. Introduction

The main task of local government units (LGUs) is to satisfy the needs of the local community in the area of public goods, such as infrastructure, security, and state administration activities, and in the area of desirable goods, such as healthcare, education, culture, arts, and sports. The implementation of these tasks is determined by the laws that classify the task in question, define how it is to be financed, and set standards and limits for its performance. The laws determine which tasks are compulsory and which are not. For some tasks, local authorities can decide whether to perform them; for others, to what extent; and what resources to allocate to them.

The concept of self-government is founded on the principle of self-reliance, which can be further categorized into four distinct domains: political, organizational, economic, and financial. Among these, financial self-reliance exerts the most significant influence on task realization. This encompassed both revenue and expenditure autonomy. While income autonomy shapes the budgetary framework of the territorial self-government unit, expenditure autonomy empowers the decision-making process regarding the structure and hierarchy of expenditures and, consequently, the type and manner of tasks undertaken.

The financial obligations of territorial self-government units encompass expenditures related to the implementation of educational initiatives, social welfare programmes, municipal management, and the administration of self-government. The largest proportion of financial resources are allocated to the implementation of educational tasks. Self-government is permitted within legal limits set by law to determine the allocation of resources for this purpose. This study examines the degree of financial autonomy enjoyed by municipalities in relation to the fulfilment of their educational obligations. The development of a methodology for evaluating the extent of financial autonomy in the context of educational responsibilities enables the comparison of municipalities with one another and with rural municipalities, urban-rural municipalities, cities with district rights, and cities with district rights and district rights. The aim of the analysis is twofold: first, to identify an effective model for the implementation of educational tasks and second, to propose recommendations for the rationalization of the financing of educational tasks while maintaining appropriate standards.

2. Literature review

It is incumbent on local self-government units to guarantee the implementation of tasks that satisfy the needs of the population in areas of technical, social, order, and safety as well as spatial and ecological order. The type of task is contingent on the financing. The financial

resources at the disposal of territorial self-government units to fulfil their obligations are derived from two principal sources: revenues and subsidies from the central budget. The term "own revenues" encompasses a range of sources, including credits and loans, income derived from property, targeted European Union funds, tax revenues, including local taxes and fees, and participation in central taxes. Subsidies from the central budget, on the other hand, are divided into two categories: a general subsidy and targeted subsidies.

These tasks can be classified as obligatory, optional, statutory, or delegated tasks. The manner in which they are financed varies, with the legislation determining the specific financing method for each task.

Local government units are required to perform a range of tasks, which can be categorized as obligatory or discretionary. This distinction is derived from legislative and regulatory frameworks that govern the economic and social activities of local governments. The level of expenditure incurred by local governments is contingent on the scope of the tasks to be carried out and the decisions pertaining to their degree of implementation.

The financial independence of self-government, which is enshrined in legislation, affords territorial self-government units and latitude to select the manner in which tasks are undertaken and, in turn, how funds are allocated. Spending independence can be defined as the freedom to pursue fiscal policy and, above all, shape budget expenditure and balance (Kosek-Wojnar, Surówka, 2002). The extent of spending autonomy is influenced by a number of factors, including the type of tasks to be performed, legal regulations governing their execution, level of rigid expenditure, revenue generated by the entity in question, possibility of using balanced revenues, and access to loan markets. The capacity for self-reliance enables territorial self-government units to utilize budgetary deficits and local debt instruments to finance planned investment-oriented tasks. Constraints on spending autonomy are contingent on obligations imposed by the legislature. These include expenditure limits, methods of accounting for expenditures, the principles of transparency and savings, and priorities in debt coverage. It is presumed that expenditure independence signifies freedom in terms of the fiscal policy pursued, particularly regarding the formulation of budgetary expenditure and budget balance (Chojna-Duch, 2012).

The extent of spending autonomy is inextricably linked to the revenue and structure. The relationship between task expenditure and revenue restricts the degree of spending autonomy. The earmarked subsidies received by territorial self-government units were allocated for specific purposes. The high proportion of income allocated to these subsidies demonstrates the limited spending autonomy of the self-governing territorial units. While subsidies are distributed to finance specific tasks, the level of implementation is standardized. However, if these funds are not utilized, they may be redirected to implement other tasks. The objective allocation of subsidies increases the scope of spending autonomy of territorial self-government units (Jasińska, 2021).

It is incumbent upon the state to undertake activities pertaining to education, upbringing, and care of its citizens. The Polish educational system was designed to enhance the quality of education, create a more level playing field, and ensure universal access to education. Education is compulsory until the age of 18, with no tuition fees in public schools. Therefore, parents may choose alternative educational institutions for their child. Access to education is universal and equal, with systems of individual financial and organizational assistance in place to facilitate this LGUs are responsible for the implementation of educational policies.

The educational financing model in Poland is based on two principal sources of funding: the educational part of the general subsidy derived from the state budget, and a targeted subsidy. Furthermore, the model is augmented by self-government revenues in addition to funds derived from programs based on non-returnable foreign funds. The educational component of the general subvention, along with the distribution algorithm, is determined annually. Legal regulations stipulate the minimum amounts allocated to units. The subsidy considers a range of expenditures incurred by territorial self-government units, including salaries, teacher-in-service training, individual pupil tuition, severance pay for teachers, start-up benefits for teachers, the education of non-Polish pupils, oral matriculation examination examiners, and vocational counselling. Moreover, the financial circumstances of the local government units are considered.

Communes received supplementary financial assistance from the educational part of the General Subvention Reserve. However, the appropriate applications must be submitted. The reserve is at the disposal of the minister responsible for public finance, who, when allocating it, consults with the minister for education and upbringing, as well as representatives of local government units.

LGUs are eligible for grants supporting the implementation of educational activities. This represents a source of funding through which the state influences the functioning of units. It is the most potent instrument for state intervention in territorial self-government unit activities (Owsiak, 2017). Subsidies pertain particularly to tasks of an investment nature, as well as tasks related to the advancement of education in rural areas, tasks related to the implementation of educational reforms, and tasks aimed at equalizing educational opportunities and providing practical education. The subsidy may be granted to up to 50% of the planned expenditure of the territorial self-governing unit. The entity is required to allocate its own funds in the relevant budgetary period to implement the subsidized task in an amount equal to at least 50% of the planned expenditure. If the expenditure incurred by an entity's resources exceeds the number of grants received, the entity is required to return the difference to the grantor.

3. Materials and methods

This study was conducted on a sample of municipalities for the period of 2008-2023. The temporal scope was determined based on the availability of the data. This study uses data from the local data bank of the Central Statistical Office. A multidimensional comparative analysis was conducted using the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) method. A series of diagnostic variables was selected based on both substantive and formal criteria. The variables were verified by applying the classical coefficient of variation and those with low variation were rejected. The information potential of the variables was analyzed using the inverse correlation matrix method. In addition, the indicators were identified as stimulants or destimulants. Variables used in this study are presented in Table 1.

Table 1.
Indicators used to test the expenditure independence of communes in Poland

	Diagnostic variable
O_1	Share of educational subsidy in expenditure on educational tasks
O_2	Expenditure on education per capita
O_3	Share of expenditure on wages and salaries and their derivatives for educational tasks in total income
O_4	Share of capital expenditure on educational tasks in own income
O_5	Net enrolment rates (primary education)
O_6	Share of earmarked subsidies in total income
O_7	Share of own revenue in total expenditure
O_8	Investment expenditure per population
O_9	Share of income from local taxes and charges in expenditure

Source: own elaboration.

In the next stage of the research, the above characteristics were normalized using the method of unitization from zero according to the following formula:

For stimulants:
$$z_{ik} = \frac{O_{ik} - \min\limits_i\{O_{ik}\}}{\max\limits_i\{O_{ik}\} - \min\limits_i\{O_{ik}\}}, \max\limits_i\{O_{ik}\} \neq \min\limits_i\{O_{ik}\} \quad (1)$$

For destimulants:
$$z_{ik} = \frac{\max\limits_i\{O_{ik}\} - O_{ik}}{\max\limits_i\{O_{ik}\} - \min\limits_i\{O_{ik}\}}, \max\limits_i\{O_{ik}\} \neq \min\limits_i\{O_{ik}\} \quad (2)$$

Weights were assigned to each variable. The importance of these criteria was determined using the inter-criteria correlation method.

$$w_j = \frac{C_j}{\sum_{k=1}^{P} C_k} \text{ where } C_j = s_{j(z)} \sum_{k=1}^{P}(1 - r_{jk}), j = 1,2, \dots, P \quad (3)$$

C_j – measure of the information capacity of the j-th characteristic,

$s_{j(z)}$ – standard deviation calculated from the standardised values of the j-th characteristic,

r_{jk} – correlation coefficient between jth and kth characteristic,

P – number of diagnostic variables for N surveyed units.

The coordinates of the model units, benchmark (A+) and anti-benchmark (A−), were determined based on the normalized values of the characteristics, the weighting coefficients determined for the importance of these characteristics, and the coordinates of the model units, benchmark (A+), and anti-benchmark (A−).

$$A^{+} = \left(\max_{i}(z_{i1}),\ \max_{i}(z_{i2}), \dots, \max_{i}(z_{iK})\right) = (z_1^{+}, z_2^{+}, \dots, z_{1K}^{+}) \tag{4}$$

$$A^{-} = \left(\min_{i}(z_{i1}), \min_{i}(z_{i2}), \dots, \min_{i}(z_{iK})\right) = (z_1^{-}, z_2^{-}, \dots, z_{1K}^{-}) \tag{5}$$

For each unit, the Euclidean distances from the designated z+ pattern and z- antipatterns were calculated as follows:

$$d_i^{+} = \sqrt{\sum_{k=1}^{P}(z_{ik} - z_k^{+})^2};\ d_i^{-} = \sqrt{\sum_{k=1}^{P}(z_{ik} - z_k^{-})^2}, i = 1,2, \dots, N \tag{6}$$

and the values of the synthetic trait SWO were determined.

$$SWO_i = \frac{d_i^{-}}{d_i^{+} + d_i^{-}}, i = 1,2, \dots, N \tag{7}$$

The values of the synthetic SWO characteristics were determined for the groups of communes in 2017 and 2022.

4. Results

Among the expenditures of local governments, those related to education were among the highest. In the period 2008-2023, they accounted for 35%, 33%, 34%, and 29% of the expenditures of certain groups of rural, urban, urban-rural, and cities with poviat rights, respectively.

Municipal expenditure on education increased during this period. In 2023, compared to 2008, it increased by 145% in rural municipalities, 152% in urban municipalities, 171% in urban-rural municipalities, and 167% in cities with poviat rights.

The main source of funding for educational tasks of territorial self-government units is the educational part of the general subsidy from the state budget. The amount of this subsidy has increased in line with the increase in expenditure on these tasks. During the study period, the subsidy increased by 75% for groups of rural municipalities, 114% for urban municipalities, 113% for urban-rural municipalities, and 146% for cities with poviat rights. The changes in the amount of education in the general subsidy over the 16 years resulted from changes in the education policy and the distribution of educational tasks among territorial self-government units. Inflation and random factors such as the Covid-19 epidemic or war in Ukraine also affected the subsidy amount. The amount allocated to the education part of the general subsidy increased each year compared with the previous year. During the review period, there were

years in which the level was similar to that in the previous year. Figure 1 presents a comparison between the educational portion of the general subsidy and the expenditure on education from 2008 to 2023.

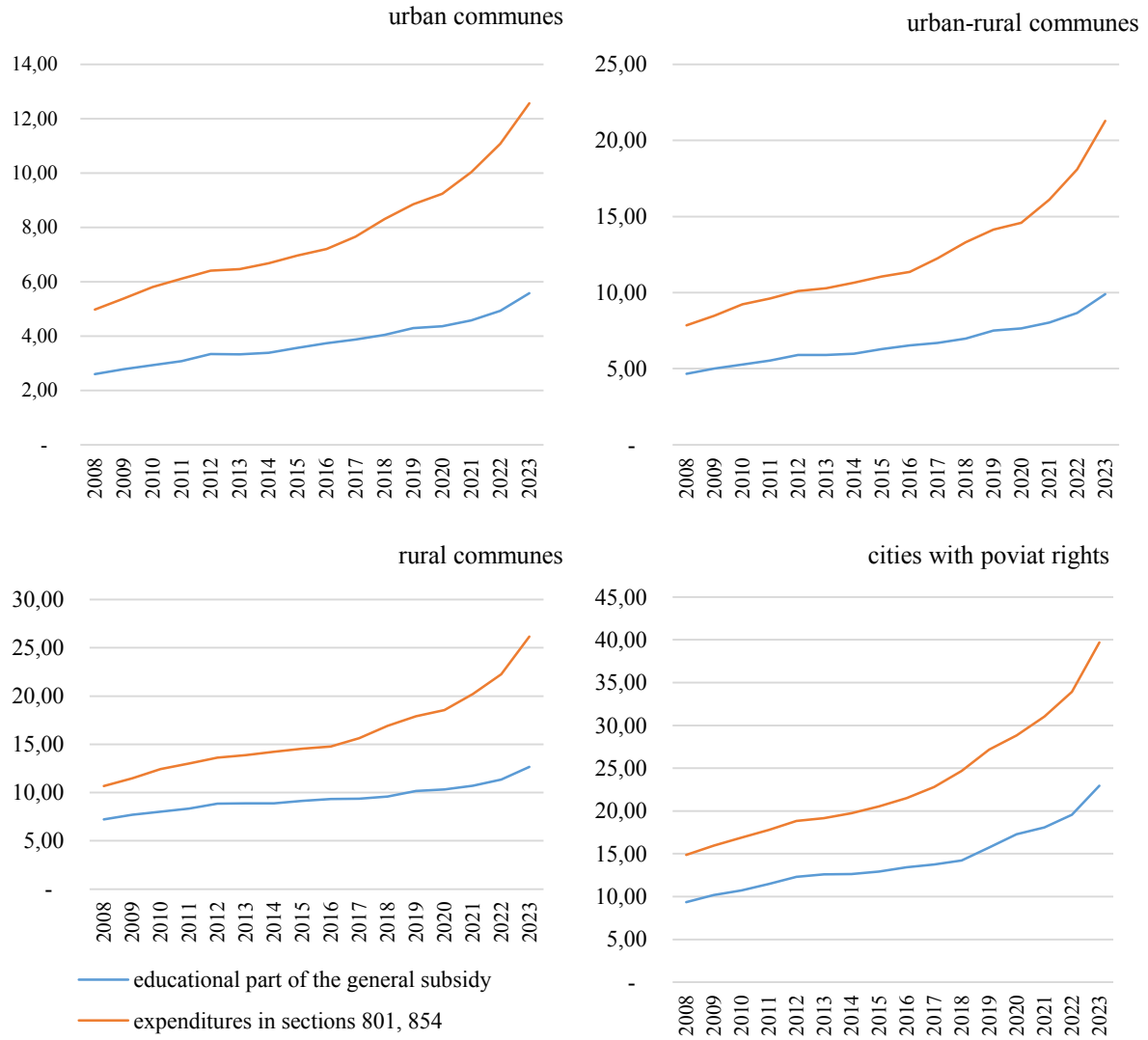


Figure 1. Comparison of the educational part of the general subsidy with expenditure on education from 2008 to 2023.

Source: own elaboration based on BDL GUS.

The increase in the education component of the general subsidy was not commensurate with the increase in expenditures on education. On average, it covers only 49% of LGUs' expenditures on education by 2023. The percentage share of education subsidies in expenditure in the selected years is shown in Figure 2.

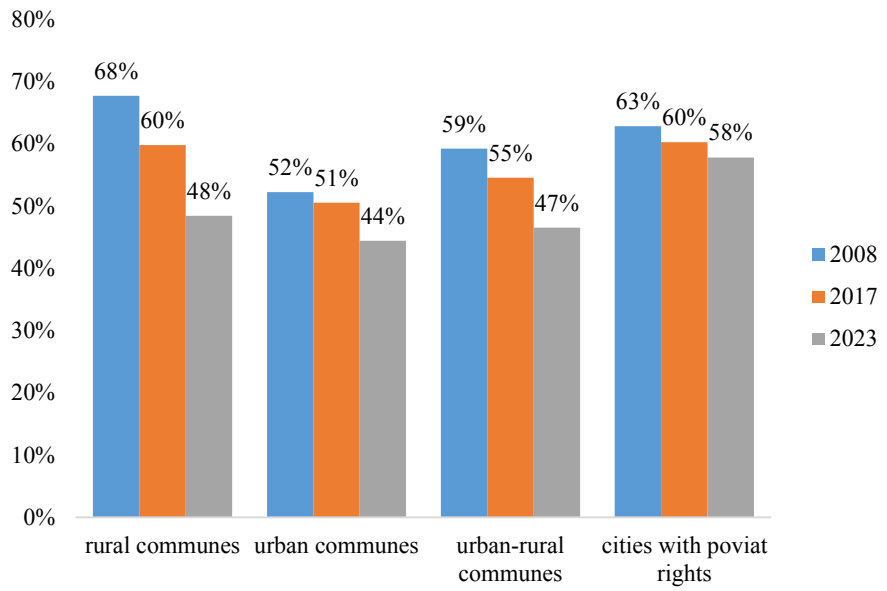


Figure 2. Coverage of expenditure on educational tasks by the educational part of the general subvention in %.

Source: own elaboration based on BDL GUS.

In Poland, legislation does not specify revenue from local self-government units that should be used to finance educational tasks. The decision-making body of the local self-government unit decides on the allocation of the subsidy. Despite this competence, authorities do not allocate funds from the education part of the general subsidy to tasks other than education because they are insufficient. In almost all units, this was less than expenditure on education. Only a few municipalities were located in the study area between the years 2008 and 2015. There were 8 rural communes and 1 urban commune.

In 2023, 57% of urban municipalities and 43% of urban-rural municipalities had sufficient funds from the education part of the general subsidy to cover 40-50% of education expenses, while 38% of rural municipalities and 52% of cities with poviat rights had sufficient funds to cover 50-60% of education expenses. The detailed distribution is shown in Figure 3.

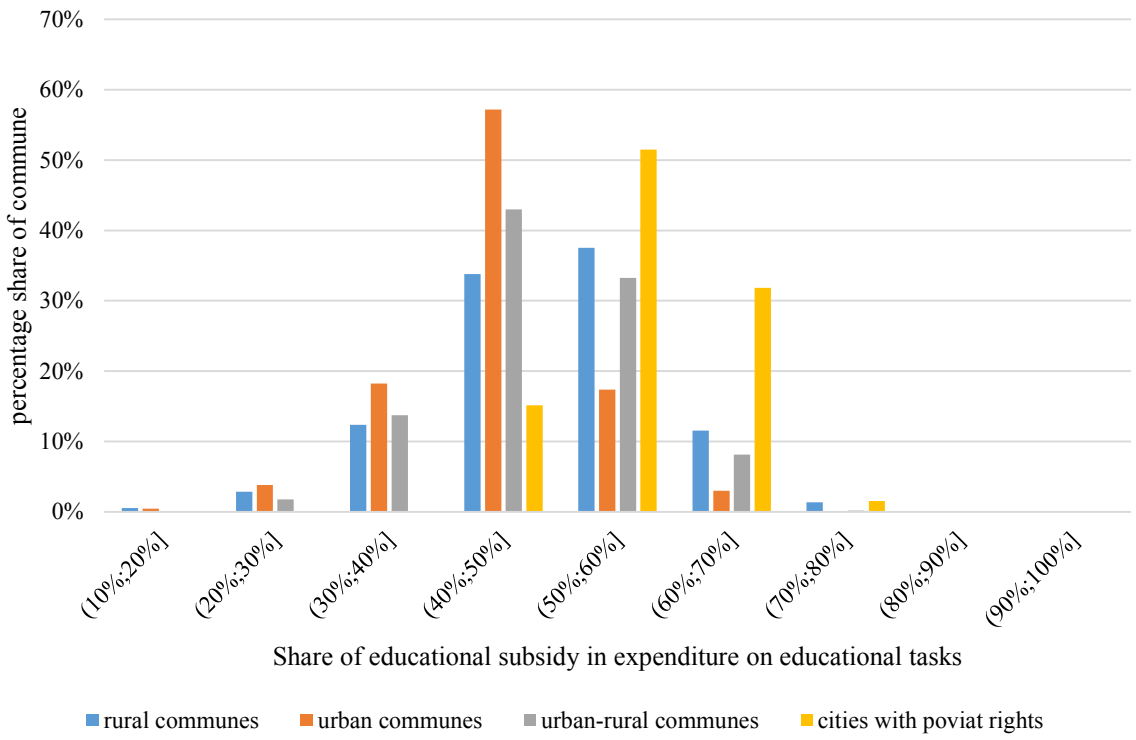


Figure 3. Share of educational subsidy in expenditure on educational tasks in 2023.

Source: own elaboration based on BDL GUS.

The average coverage of the expenditure in question by the education part of the general subsidy in 2023 was highest in cities with poviat rights (58%), followed by rural municipalities (48%), urban municipalities (44%), and urban-rural municipalities (46%). The greatest disparity in this indicator between municipalities is observed in the rural municipality group. The difference between the municipality with the highest level of financing of current expenditure by the education part of the grant and that with the lowest level is 75 pp. The difference was 57 pp for urban-rural municipalities and 49 pp for urban municipalities. The difference was smallest for poviat municipalities (32 pp), which proves the low differentiation of these units in terms of the indicator in question (this was also confirmed by the analysis of the coefficient of variation, 10.4%).

Finances related to the educational tasks carried out by the LGU are described in two sections of the budget classification: section 801 - Education and upbringing and section 854 - Educational upbringing and care. The majority of expenditures on financing educational functions are described in section 801. Section 801 includes capital and current expenditure. Most expenditures are current, including expenditures on salary and derivatives, current expenditures on the purchase of materials and services and subsidies. Table 2 shows the structure of the expenditures in Section 801.

Table 2.
Structure of the share of expenditure in expenditure in section 801 in 2023

	Urban communes	Rural communes	Urban-rural communes	Cities with poviat rights
current expenditure	88%	95%	92%	95%
current expenditure on wages and salaries and related expenditure	62%	65%	64%	63%
total capital expenditure	12%	5%	8%	5%

Source: own elaboration based on BDL GUS.

For each group of commune expenditures on salaries and salary derivatives, education staff accounted for the largest share of education expenditures. LGUs have little ability to make decisions on this expenditure. Through the regulations they adopt, they can decide the amount of certain allowances, such as motivational, functional, tutorial, amount of bonuses, the way in which teachers' overtime is accounted for, and the amount of subsidies for in-service training.

The commune's expenditure in Section 801 per capita ranged from PLN 816 in 2008 to PLN 3039 in 2023. Figure 4 shows the changes in expenditure levels during this period.

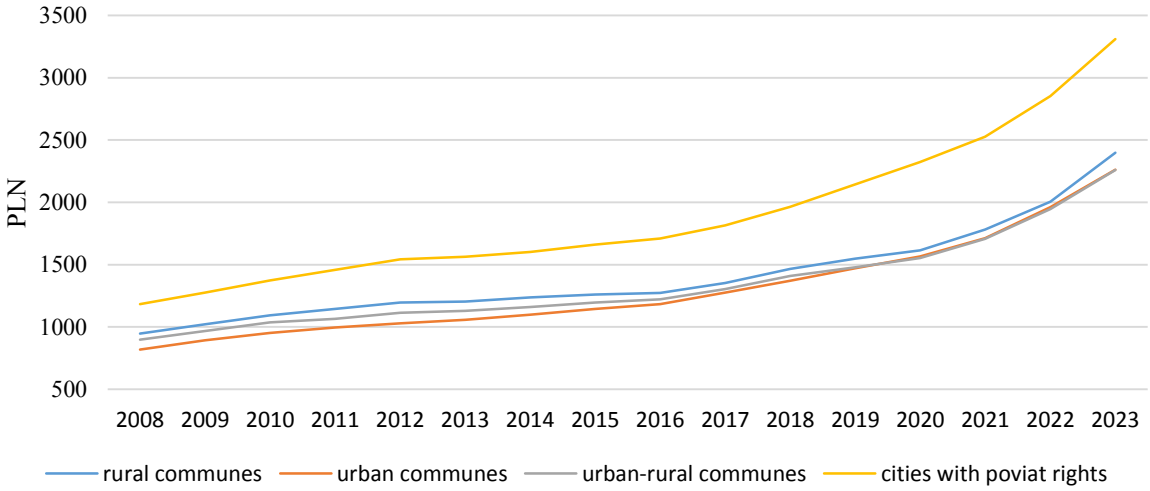


Figure 4. Average expenditure in section 801 per capita in PLN 2008-2023.
Source: own elaboration based on BDL GUS.

Per capita expenditure on education varied. Irrespective of municipality type, per capita expenditures varied between units in the same group of municipalities. This is evidenced by the value of the coefficient of variation, which averaged 22% over the study period for urban communes, 22% for rural communes, 17% for urban-rural communes, and 16% for cities with poviat rights.

There is a correlation between education expenditure and local government revenue. The correlation coefficient between per capita expenditure on education and per capita income has different values for the different groups of municipalities. This relationship is strongest for urban and rural communities. The average correlation coefficient for these communes for the period under consideration was 0.40. The correlation coefficient indicated a moderate correlation; however, the relationship was significant. The average correlation coefficient for

urban-rural communes is 0.27 and for cities with poviat rights it is 0.25. However, this correlation was low.

To complement this study, a measure SWO based on the proposed methodology is developed. As a result of the evaluation of the autonomy of expenditures on educational tasks, a ranking of municipalities was obtained. The municipalities under consideration within each group were divided into five classes. Class I to Class V successively include municipalities from the highest SWO value to the lowest SWO value. Comparing 2017 to 2022, we found that the level of spending autonomy increased slightly in the groups surveyed. Figure 5 shows the changes in the SWO evaluation among the commune groups. Among the groups of municipalities, urban-rural municipalities, cities with district rights, and the number of municipalities with a higher value of the SWO measure increased by 2022. The number of municipalities in classes IV and V increased compared to that in 2017. In the rural commune group, the number of communes decreased in favour of Class III. The yardstick has different values for communes, indicating independent spending on educational tasks.

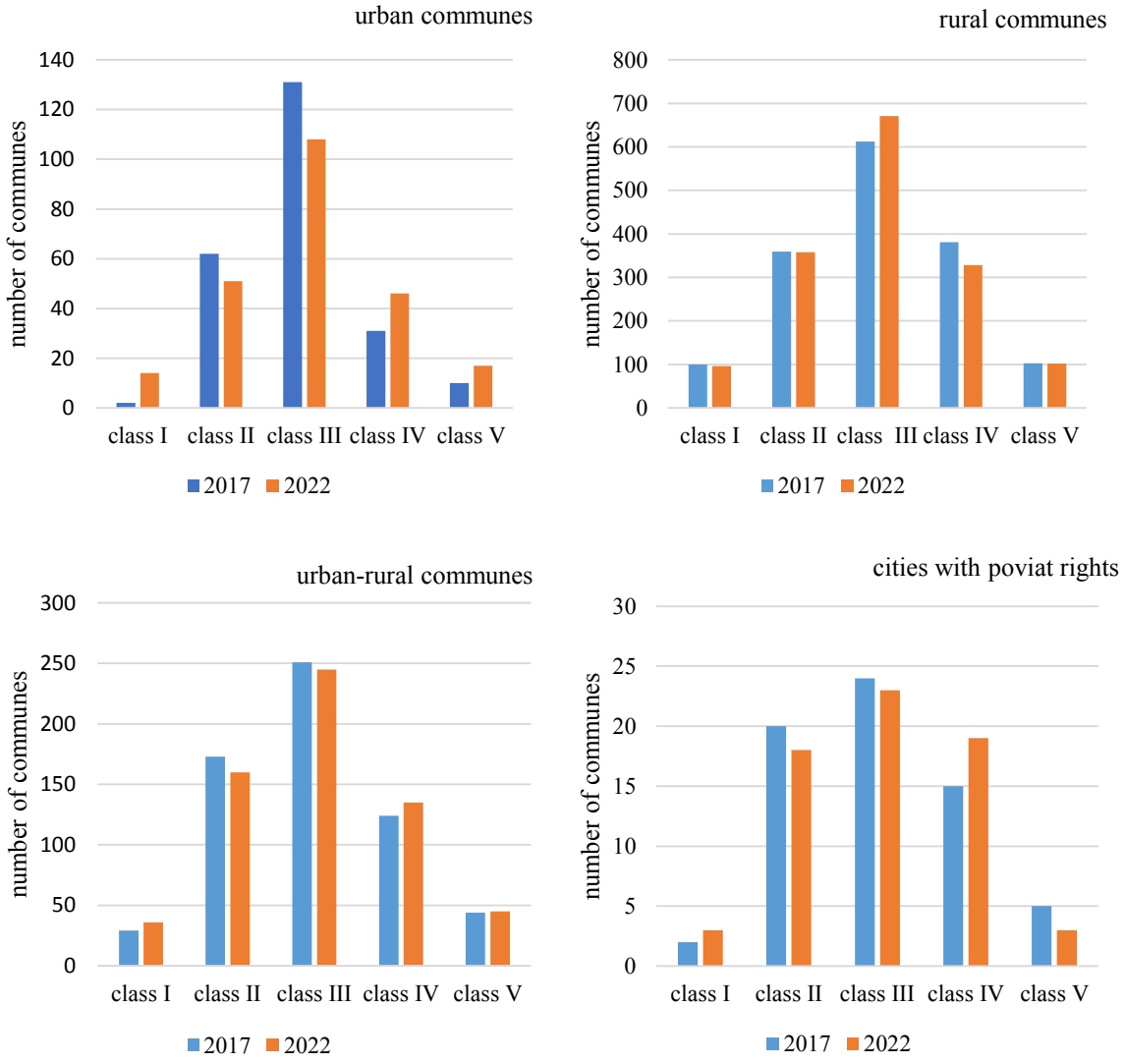


Figure 5. Number of municipalities in individual classes in 2017, 2022.

Source: own elaboration.

5. Conclusion

An analysis of the correlation coefficients between the variables related to the amount of income received and expenditure on educational tasks confirmed that self-government makes different decisions regarding their implementation. This indicates that TSUs have a certain degree of independence when deciding how to implement them. This is also evidenced by the values of SWO, the constructed measure of spending autonomy in the implementation of educational tasks, which assumes different values for the surveyed units. The allocated education subsidy is insufficient to cover expenses and the missing funds are supplemented by their own income. This is due to the chosen financing education model. This model is stable, but does not guarantee the same level of educational task implementation. Municipalities with greater spending autonomy in the implementation of educational tasks, that is, those assigned to Class IV and Class V, are characterized by high per capita expenditure on education and high expenditure on the implementation of educational investments covered by their own revenues, particularly taxes and local fees. These municipalities have favorable geographical locations, are economically active, and invest. The municipality with the lowest degree of self-government often has an unfavorable geographical location and does not have sufficient funds for investments that affect its further development. Transfers from the state budget were only used for the current task.

Existing legislation regulates the functioning of the education system, particularly how it is financed, organized, and operated. However, legislation does not specify how individual tasks should be performed. Not all have specific performance standards. This is the case, for example, with the didactic base, the organization of extra classes as part of the process of developing pupils' interests and talents, or as part of psychological and pedagogical support. The legislator delegates power to the LGU, without defining a uniform standard. The financial value of certain allowances is determined by municipal regulations, which vary from one municipality to another and depend on local government decisions. This is because of the degree of spending autonomy afforded by local governments.

The level of expenditure at the commune level varies according to the implementation of supplementary services that enhance the appeal of the educational provision or the personnel policies pursued. The absence of a standardized measure to ascertain the requisite funding for a given task at a specified level results in communes incurring disparate expenditure on its implementation. The financial outlay associated with the implementation of educational tasks in comparable units, in terms of the number of pupils and schools, can vary. This is contingent on the commune’s educational policy and financial condition. There is a close relationship between financial health and spending autonomy, particularly with regard to education expenditure.

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ORGANIZATION AND MANAGEMENT SERIES NO. 226

JOB CONTROL AS A PREDICTOR OF WORK-RELATED BEHAVIOURS AND FEELINGS AMONG MANAGERS – RESEARCH STUDY

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Purpose: The purpose of this study was to examine the relationship between job control and aggressive, passive-avoidant and proactive behaviours among executive managers as a professional group.
Design/methodology/approach: A total of 212 executive managers participated in the study. The study used three questionnaires: a self-designed scale to measure workplace control; a scale to identify three types of work-related behaviour (WORAB), namely aggressive, passive-avoidant and proactive behaviours; and an abbreviated version of a scale that measures feelings of work-related happiness (WORAF).
Findings: All the three hypotheses formulated in the study were fully confirmed. Job control was found to be a moderate predictor of all the behaviours studied, and a relatively strong predictor of work-related feelings. The study also confirmed that positive feelings have a mediating effect in the relationship between control and the studied behaviours.
Research limitations/implications: The self-reporting method adopted in this study is not an objective method, as it is based on the subjective feelings of respondents. In addition, the cross-sectional nature of the study does not allow firm conclusions to be drawn about the cause-and-effect relationship. Furthermore, since the respondents were recruited from a group of students at a single university, it cannot be said that they constitute a representative sample of managers.
Practical implications: The results of the study indicate that extending the scope of control at work is a way to reduce undesirable behaviour on the part of executive managers on the one hand and away to strengthen their proactivity on the other.
Originality/value: The relationship between job control and work-related feelings and behaviours has not been widely studied to date, especially among managers.
Keywords: job control, work-related behaviours, work-related feelings of happiness, executive managers.
Category of the paper: research paper.

1. Introduction

Job control at work seems to be one of the most frequently studied variables in the field of occupational and management psychology. Numerous studies indicate the positive role that control at work plays for both the employee and the organisation.

In psychology, a sense of control is equated with a sense of a person's influence over their environment and themselves, particularly in terms of their ability to regulate their emotions (Averill, 1973; Kobasa, Maddi, Kahn, 1982). Control can also be considered more as a cognitive construct, which is exemplified by the popular concept of internal vs. external locus of control, developed by Rotter (1966). Control at work, also in psychological terms, concerns the freedom of a person to perform their duties and is considered within the framework of working conditions. The former captures control as a disposition, the latter as an external, situational factor.

The importance and significant role of control in the field of work are reflected in numerous theories and concepts of which control is an essential component. One of the first models to consider control at work is the Hackman and Oldham Job Characteristics model (1976). In this model, control is conceptualised as an employee's autonomy in the organisation and involves experiencing responsibility for their job performance. It is associated with motivation, the quality of performance, job satisfaction, low absenteeism, and employee turnover. Another quite popular model is Karasek's (1979) Job Demand Control Model, which explains organisational stress. The author's large-scale study showed that a high degree of control in the hands of employees was positively correlated with their physical and mental health. At the same time, Karasek put forward the assumption that a high level of control with a high workload promotes employee motivation and development. Control was also included in a model by Maslach and Leiter (1997), which explains the development of the burnout syndrome as a consequence of organisational stress. Although the authors conclude that absolute control at work is not possible, due to, *inter alia*, a number of unpredictable circumstances, the total lack of control leads to exhaustion, cynicism, and a decrease in employee engagement and effectiveness (p. 66). The Job Demands-Resources (JD-R) model (Demerouti et al., 2001) also incorporates control. As in the case of the Hackman and Oldham Job Characteristics model, Demerouti et al understand control as a sense of autonomy, which, along with other resources (supervisor's support, feedback, rewards, participation, and job security), increases employee motivation, which translates into employee performance.

The above concepts have, in relation to control itself, largely been positively validated by numerous studies sometimes conducted in as meta-analyses, many of which included samples of thousands of subjects. One of the first such studies, by Spector (1986), showed a positive correlation of control at work with high levels of satisfaction, engagement and motivation, as well as low levels of physical symptoms, absenteeism and employee turnover. In contrast,

a study by Park et al showed that control reduces depersonalisation and enhances feelings of personal achievement (Park et al., 2014), which are among the dimensions of occupational burnout. Aronsson et al (2017) showed a positive role of control in reducing emotional exhaustion. The freedom to act also correlated with job satisfaction, which was confirmed by a meta-analysis conducted by Asif et al. (2018).

Despite a number of studies that confirm the positive effects of control at work on the employee, it is the author's knowledge that few analyses have been conducted to investigate the relationship between control and work-related behaviours as ways of coping with difficult situations. One such analysis is a study by Sonnentag and Spychal (2012), which found that control at work directly and positively correlates with proactive behaviours. However, academics are far less interested in studying behaviours, such as aggressive or passive-avoidant behaviours, which can be considered counterproductive, particularly in relation to executive managers. And yet representatives of this profession, due to the complexity of the tasks they perform and the significance of their responsibilities on their shoulders, constitute the most important part of human capital in an organization. It is therefore important to study the psychological aspects of their functioning in order to further develop their competencies, as well as to introduce changes to organisational environments with a few to making the best possible use of the potential of executive managers. This study, therefore, aims to address the gap in research into the relationship between control at work and work-related behaviours and work-related feelings of happiness among executive managers as a professional group.

Behaviours can be an important element of an operating style, which, in the case of executive managers, can be considered as management style or a leadership style. Among the many classifications and categories of management styles, one can distinguish between passive leadership, which is close to the laissez-faire style, and aggressive leadership, both referred to as bad or destructive leadership styles (Einarsen et al., 2007; Kelloway et al., 2005). Proactive actions, on the other hand, will be a determinant of desirable behaviours within the organisation and an element of leadership that leads to positive consequences at both the employee level and the organization-wide level. In this study, therefore, the focus is on three types of work-related behaviours: proactive, aggressive and passive-avoidant work-related behaviours. In addition, feelings of work-related happiness as a mediator of the control-behaviour relationship are included in the verified models. The author's analysis of the tested correlations is shown in Figure 1.

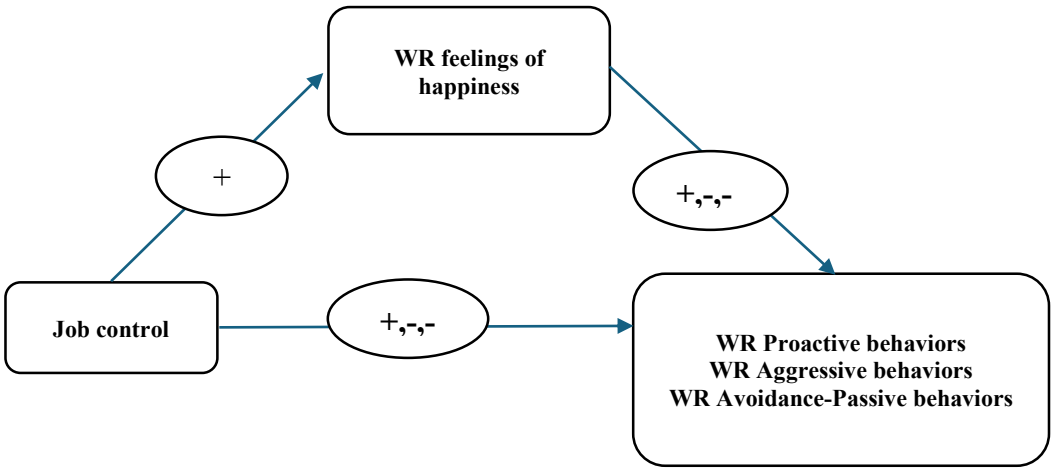


Figure 1. Theoretical model.

Source: own elaboration.

The following three hypotheses were formulated in this study:

H1: Proactive behaviour positively correlate with work-related feelings of happiness.

H2: Aggressive and passive-avoidant behaviours negative correlate with control at work.

H3: Work-related feelings of happiness have a mediating effect between control at work and employee behaviours.

2. Methods

2.1. The survey

The survey in the study was questionnaire-based and was conducted online using the MS Forms platform. It involved working students studying for a second-cycle degree in management on an extramural basis. Each respondent was assured of the anonymous nature of the survey. It was explained that any of them was free to withdraw from the study at any time.

2.2. Description of the sample

The analysis of the results included 212 respondents claiming to hold managerial positions, of which about 59% were men. Almost half of the respondents (48.1%) were aged between 31 and 40 years, 22.2% (41 to 50), approx. 19.3% (20 to 30), 6.1% (51 to 60), and 4.2% were aged over 60 years. The largest number of respondents, 31.6%, had been worked in their current positions for 3 to 5 years, 25.5% between 1 and 2 years, 19.8% from 6 to 10 years, 7.1% from 11 to 15 years, 5.7% (not more than six months), 5.2% from 7 to 11 months, and 10% for more than 16 years. The average number of years in a managerial position for the entire sample was 16.08 years (SD = 9.81).

2.3. Research methods and the research procedure

The following three scales were used in the study:

- Work-Related Behaviour Scale, developed by Jaworek, Karwowski and Marek (2021), which is divided into three independent subscales for measuring passive-avoidant, aggressive and proactive behaviours. The analysis of the results used abbreviated, 3-item versions of the WORAB subscales, for which items were selected based on the highest factor loadings (cf. Jaworek, Karwowski, Marek, 2021). The response scale ranges from 1 (almost never) to 4 (almost always). Examples of items include: *I pretend to be busy with something in order not to take on other tasks* (passive-avoidant behaviour); *I shout at my subordinates and colleagues* (aggressive behaviour); *When I am solving some issues, I act efficiently and quickly* (proactive behaviour).
- An abbreviated scale that measures work-related happiness, based on the Work-Related Feelings Scale (Jaworek, Marek and Karwowski, 2020), which comprises three items. The response scale ranges from 1 (almost never) to 4 (almost always). An example of an item is: *I get a lot of fun from what I do at work*.
- The *Control-at-Work Scale*, designed by the author, comprising three items. The response scale ranges from 1 (definitely not) to 5 (definitely yes). An example of an item is: *I can control the way I do my work.*

All the statistical analyses were conducted using the PS Imago Pro 10 statistical data analysis package and the Amos 29 module.

3. Results

In order to verify the relationship between control at work and the three types of behaviour: proactive, aggressive and passive-avoidant, three equations were designed using the structural equation modelling (SEM) method. Feelings of work-related happiness were included in each model as a mediator of the control-behaviour relationship. Descriptive statistics were also calculated for each scale measuring the variables under analysis, along with the correlations between them (see Table 1 for details).

Table 1.
Descriptive statistics and correlations for study variables

Variable	M	SD	1	2	3	4	5
1. Job control	3.69	.82	-				
2. WR feelings of happiness	2.81	.77	.336**	-			
3. WR Avoidance-Passive Behaviors	1.35	.49	-.237**	-.331**	-		
4. WR Proactive Behaviors	3.28	.53	.337**	.356**	-.387**	-	
5. WR Aggressive Behaviors	1.41	.58	-.288**	-.362**	.498**	-.197*	-

Note: *$p < 0.01$; **$p < 0.001$.

Source: own elaboration.

Very good goodness-of-fit measures were obtained for all the models (Table 2), meeting the recommended criteria (Hooper et al., 2008). Details are provided in Table 2.

Table 2.
SEM model fit

Model	Chi²/df	NFI	RFI	IFI	TLI	CFI	RMSEA
Model 1	1,380 (p=.102)	.953	.913	.987	.974	.986	.042
Model 2	1,385 (p=.099)	.955	.915	.987	.975	.987	.043
Model 3	1,047 (p=.399)	.968	.939	.998	.997	.998	.015

Model 1 (WR Avoidance-Passive Behaviors), Model 2 (WR Proactive Behaviors), Model 3 (WR Aggressive Behaviors).

Source: own elaboration.

The analyses showed that control at work is, as was expected, a significant predictor of all the work-related behaviours under analysis. More specifically, control at work lowers the level of aggressive behaviours (β = -.26) and, slightly, the level of- passive-avoidant behaviours (β = -.15), while it increases the level of proactive actions (β = .20). Control also proved to be a relatively strong predictor of work-related feelings of happiness (β = .40). A mediating effect of work-related happiness between control and behaviours was observed. Positive feelings turned out to be an even stronger predictor of the behaviours than control alone. The regression coefficients (β) were the same for passive-avoidant and aggressive behaviours (-.33), and .39 for proactive behaviours. Details are provided in Table 3.

Table 3.
Direct effects results

	Standardized beta coefficient (β)		R^2
	Job control	WR_Happiness	
Model 1			
WR_Happiness	.42**		.17*
WR Avoidance-Passive Behaviors	-.15*	-.33**	.17*
Model 2			
WR_Happiness	.42**		.17*
WR Proactive Behaviors	.20*	.39**	.26**
Model 3			
WR_Happiness	.40**		.17*
WR Aggressive Behaviors	-.26*	-.33**	.25**

Note: *p < 0.01; **p < 0,001.

Source: own elaboration.

4. Discussion of the results

Executive managers are the backbone of any organisation, which is why it is so important to study them in terms of the psychological mechanisms that determine their performance. A number of studies indicate that one of the factors with a positive impact on employees is job

control, which is usually defined as the freedom to act. This study, too, confirmed this relationship. All three the hypotheses were confirmed. A sense of control counteracts aggressive and passive-avoidant behaviour and increases the level of proactive behaviour among the executive managers included in the study. It is also associated with positive work-related feelings of happiness.

The present results are quite relevant to statistics on experiencing aggression in the workplace. According to a report by the Gallup Institute and the Lloyd's Register Foundation, 23% of employees have experienced workplace aggression at least once, including 18% who experienced psychological violence and harassment (Crabtree, 2022). Some researchers point to the key role of supervisors in their subordinates experiencing feelings of anger (Leslie et al., 2021), which is associated with aggression. Aggression at work can lead to a decrease in job satisfaction, the development of symptoms of burnout, and overall health deterioration (Merecz, Drabek, Moscicka, 2009). On the other hand, work-related passive-avoidant behaviours involve employees reducing their activity and not undertaking activities that are customarily their work responsibilities. In consequence, such behaviours will lead to a decrease in the employee's productivity and efficiency, which, in the case of executive managers, can have a negative impact on the organisation. Few studies that deal with the consequences of passive leadership indicate the dysfunctional nature of such leadership (Frischer, Larsson, 2000).

It follows from the results that work-related feelings of happiness also play an important role in the control-behaviour relationship, being a predictor of all the behaviours under analysis. Job control is one of the factors that positive affect the employee's well-being, although it is not the only one. Employee satisfaction can also be increased by, for example, developing appropriate skills, assigning tasks which the employee can identify with and which are relevant to the employee, or providing feedback on the employee's job performance (see Hackman, Oldham, 1976). An individual's well-being will promote desirable performance-related behaviours and dampen the tendency to respond in dysfunctional ways, such as aggression or escape.

In summary, the results of the study indicate that extending the scope of control at work is a way to reduce undesirable behaviour on the part of executive managers on the one hand and away to strengthen their proactivity on the other. The freedom in act, autonomy and the related sense of effectiveness positively affect the broadly-defined well-being of the individual, increasing their motivation to act and giving meaning to the activities they engage in. The positive impact of control at work on the employee is in line with the job crafting model (Wrzesniewski, Dutton, 2001). It involves making changes to the work environment so that work is tailored to the needs, preferences and abilities of the individual, with the goal of increasing the meaning of work, satisfaction, as well as the productivity and efficiency of the employee.

Increasing control at work in terms of greater employee freedom and autonomy, however, can be a difficult and sometimes even risky step. It requires managers to demonstrate courage and confidence in dealing with their subordinates and, above all, a good assessment of their capabilities. However, the risks taken may result not only in increased efficiency and productivity of the employee, but also in solutions that could be implemented across the organisation as way to improve its operation.

It should be mentioned that this study has some limitations. The self-reporting method adopted in this study is not an objective method, as it is based on the subjective feelings of respondents and narrows the analysis of the reality to their perspective of respondents. In addition, the cross-sectional nature of the study does not allow firm conclusions to be drawn about the cause-and-effect relationship. Furthermore, since the respondents were recruited from a group of students at a single university, it cannot be said that they constitute a representative sample of executive managers. Therefore, further research is recommended with the aim of determining the relationship between control and psychological aspects of how executive managers function within organisations. This should make use of measures and tools than questionnaire-based ones and a more reliable sampling method in a longitudinal study rather than a cross-sectional one.

5. Summary

The results of the study, which included a group of executive managers and which deals with the relationship between job control and aggressive, passive-avoidant and proactive behaviour, confirmed all the three hypotheses. Greater control at work counteracts undesirable behaviours and enhances task-oriented activity attitudes. The analyses also showed a mediating effect of work-related feelings of happiness in the control-behaviour relationship. The results encourage further research into the impact of job control on the functioning of executive managers functioning, although such further research should be conducted with greater methodological rigour.

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SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 226

THE FLEXIBLE SYSTEM SUPPORTING INDUSTRIAL ANALYTICS

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Purpose: The aim of this article is to analyze and assess the possibilities of building and implementing flexible Business Intelligence systems for modern industrial analytics.
Design/methodology/approach: The article presents a project of a system supporting multi-criteria analysis of production processes. The project included analytical work, the development of a prototype (data warehouse, OLAP server application, user interface), and its verification. The conclusions provide an assessment of selected technical solutions implemented in the prototype, as well as an evaluation of the expected software flexibility.
Findings: The flexibility of the system prototype was validated through pilot studies conducted in a large furniture manufacturing company. The experiment confirmed the feasibility of creating new analytical objects within a spreadsheet environment equipped with active connections to the OLAP server. The implementation process included software installation and configuration, training sessions for industrial analysts and development work carried out in the form of workshops. The development work was carried out by industrial analysts without the involvement of IT specialists.
Research limitations/implications: Due to the experimental nature of the project, the selection of appropriate techniques for industrial data visualization was deliberately omitted during the prototype implementation process. Future research will focus on evaluating the functionality, ergonomics and flexibility of the data visualization system.
Practical implications: The results of the experiment can be practically used for the designing and implementation of BI systems in the industrial sector. The flexibility of BI software will enable a reduction in costs associated with its maintenance and development, which will contribute to the popularization of this technology in the market economy.
Social implications: Data analysis using BI technologies can be a significant element in the process of implementing new research programs in the area of human-centric production management, in line with the Industry 5.0 perspective.
Originality/value: The article addresses the issues related to the design, implementation and development of specialized systems supporting industrial data analysis. It is intended for analysts, architects, and designers of Business Intelligence class systems.
Keywords: industrial analytics, software flexibility, Business Intelligence.
Category of the paper: Research paper.

1. Introduction

Business Intelligence systems are a collection of tools, technologies and software components used to integrate heterogeneous data sets, analyze them and publish insights to support economic decision-making processes (Wixom, Watson, 2010, p. 14). These systems are applied in various areas of economic, institutional and social activities. They have found numerous applications, including in healthcare (Basile, 2023), pharmaceuticals (Belghith, 2024), banking (Mohammed, 2024), industry (Wolniak, 2023), logistics (Seddigh, 2023), energy (Wang, 2024) and education (Hmoud, 2023).

In manufacturing enterprises, Business Intelligence systems can be effectively used to analyze production profitability. This includes direct costs (e.g., materials, infrastructure, labor, transportation, subcontracting) as well as indirect costs (e.g., administration, machine maintenance, factory hall renovations). In line with the principles of Industry 5.0, these analyses should also take into account factors related to workplace conditions and space, occupational safety, machine operation, environmental impact, and sustainable manufacturing (Adel, 2022; Bordeleau, 2020; Grabowska, 2022; Sever, 2024).

The aim of this article is to analyze and assess the possibilities of building and implementing flexible Business Intelligence systems for modern industrial analytics.

Flexibility is understood as the ability to create new multidimensional analytical objects (controlling models, reports, indicators) without the need to modify data structures or source code. These analyses will be conducted in real time based on current technological and manufacturing data.

The research process begins with a synthetic literature review covering selected topics in Business Intelligence software design. Next, the experiment is discussed, which involved developing a system prototype. The mission of this system is the multi-criteria analysis and evaluation of production processes. The project resulted in the development of a software prototype and its verification in a manufacturing company in the furniture industry.

2. Characteristics of Business Intelligence Systems

The core components of Business Intelligence systems include a data warehouse, OLAP (Online Analytical Processing) tools for processing multidimensional data structures and software that supports data visualization (Figure 1).

In the classical approach, designing a data warehouse structure involves specifying data tables, attributes, and reference connections. A data warehouse consists of two main elements: fact tables and dimension tables. Fact tables store quantitative data related to the enterprise's

activities, while dimension tables serve as reference entities defining the context for future analyses and simulation studies. For example, a fact table may contain historical sales data for product batches, whereas dimension tables would store analytical attributes such as product structure, sales region, customer profile, distribution network and time period. The data warehouse model is designed based on the star schema principle. At the center of the star schema is the fact table, which holds individual business transactions. Dimension tables extend radially from the fact table and contain descriptive data related to the analysis subject. Advanced variations of the star schema include the snowflake schema and the fact constellation schema. The snowflake schema allows for the representation of hierarchical dimensions.

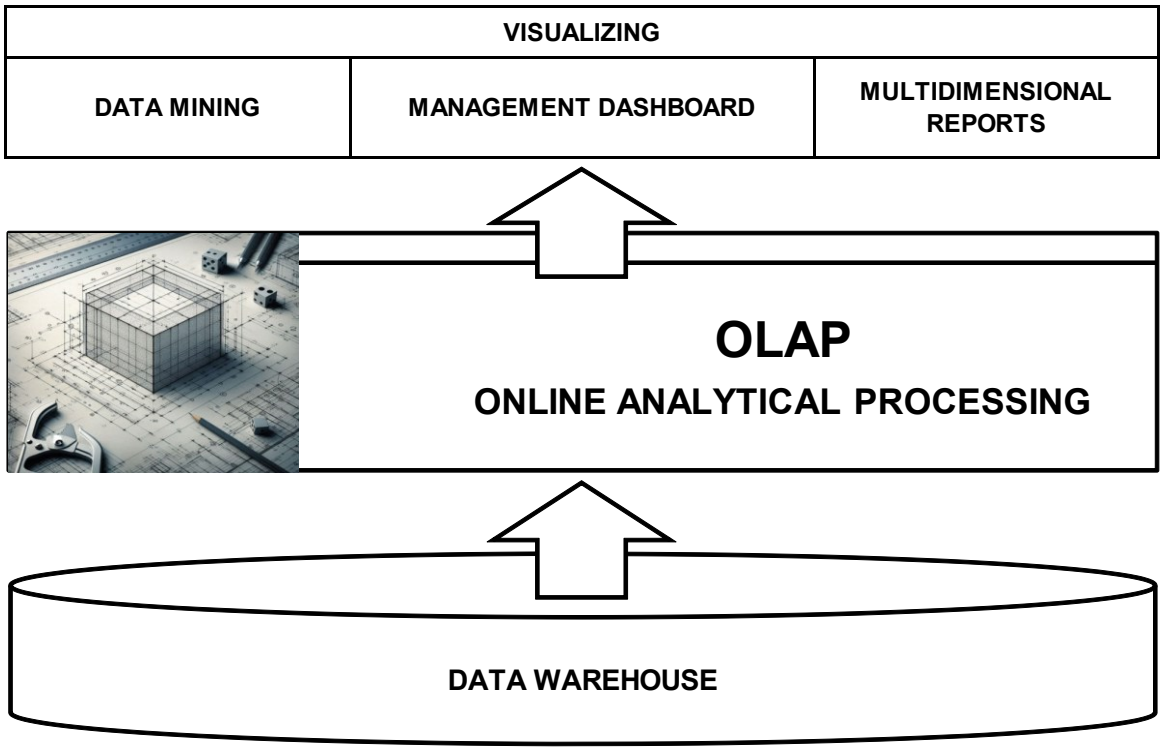


Figure 1. Architecture of a Business Analytics Support System.

Source: Author.

OLAP technology is used to implement multidimensional data structures and optimize the processing of large analytical datasets. A key element of OLAP technology is the data cube, which enables efficient multidimensional analysis.

The design of the user interface in analytical systems differs significantly from that of transactional systems. In transactional systems, the graphical user interface (GUI) is structured functionally, thematically and hierarchically, allowing access to forms through a central application menu.

In Business Intelligence systems, the choice of data presentation method depends on the needs of individual user groups.

For example, management dashboards can be effectively used to present summarized information on cost structures, including areas such as production, logistics, payroll and the maintenance of machinery and industrial facilities. These tools feature a consistent, clear interface with an intuitive navigation and control system.

Industrial analysts should be provided with tools that support the design of interactive summaries and reports, as well as spreadsheets enhanced with pivot table functionality.

Meanwhile, statisticians and econometricians will require Data Mining tools to support simulation studies, the construction of optimization models and the development of machine learning algorithms.

3. Experiment description

The project aimed to conduct analytical work in a large manufacturing company in the furniture industry, implement a prototype and assess the system's flexibility through a pilot deployment.

3.1. Research assumptions

A key assumption was that a system supporting multi-criteria analysis of industrial data should be flexible, meaning it should allow for the reconfiguration of reports, dashboards and other visual elements. The process of introducing changes should be driven by the continuous redefinition of functional requirements, the declaration of new reporting needs and the evolution of methods, techniques and tools for measuring key financial, production and social indicators.

Therefore, all development work should be carried out using predefined administrative consoles, eliminating the need for modifications to data structures or the reconstruction of software objects.

3.2. Research questions

Reconfiguring the visual elements of the user interface is a relatively simple task that does not require the involvement of specialists in databases, data warehousing or software engineering.

However, some fundamental issues remain to be resolved:

Will the reconstruction of analytical objects necessitate changes to the data warehouse or modifications to OLAP multidimensional data processing technology?

What functional, architectural and application assumptions should be adopted to ensure that inevitable requirement changes do not lead to weeks of costly development work?

Should the concept of flexibility in Business Intelligence tools be considered exclusively in relation to GUI applications?

Answering these questions requires an in-depth analysis of the methods, techniques and tools used in analytical system implementations, as well as the execution of a scientific experiment.

3.3. Experiment organization

The experiment involved developing a prototype and evaluating the feasibility of flexible modifications to multidimensional analytical reports without the need for time-consuming and costly programming work. It included analytical work in a large furniture manufacturing company, prototype development and an assessment of the validity of new functional requirements. These new requirements were identified over six months following the system's implementation (Figure 2).

At the outset, the functional requirements and data source specifications were identified. These requirements included:

- users' informational needs regarding the creation of multidimensional reports,
- expectations for improving strategic decision-making using a set of technical, economic and social indicators,
- preferences for the presentation and visualization of historical data.

The requirement specification was developed based on interviews with specialists in production, quality, safety and workplace environment, as well as an analysis of job documentation.

In Business Intelligence systems, an essential part of analytical work is defining data sources. Operational data may be stored in relational, hierarchical and object databases, as well as in text, binary, graphical (bitmaps, vector graphics) and multimedia files. Therefore, the experiment analyzed data from existing ERP (SAP-ERP), MES (Wonderware MES 4.0) and HRM (Oracle) systems, as well as semi-structured files from specialized safety management software.

The analytical data architecture design included: logical design of the data warehouse (data schema, fact tables, dimension tables, reference connections), implementation of a central data warehouse, designing the data migration process.

In detail, the data migration project involved: analyzing the data schema in source systems, examining table structures, files and data attributes, constructing transformation rules to support data conversion, developing monitoring mechanisms for data flow processes, implementing quality control procedures to ensure data integrity. The data migration process is undoubtedly a broader and more complex task compared to the relatively simple operation of data import. In practice, data import consists of sequential operations of loading data from previously prepared flat files (e.g. MS Excel spreadsheets) into the table structures of the information system.

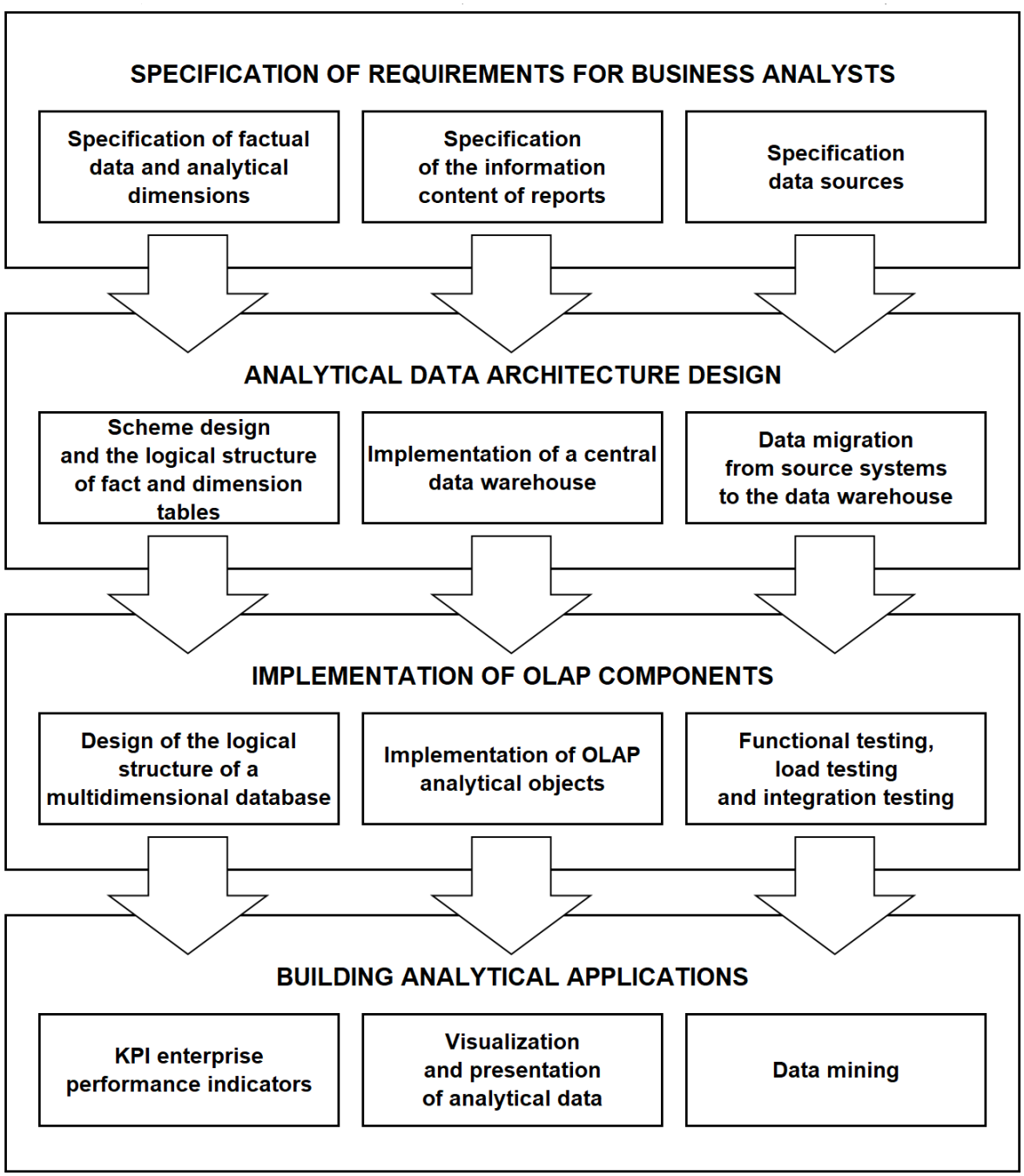


Figure 2. Experiment scheme.

Source: Author.

In the designed industrial analytics support system, the data migration process was the most time-consuming and costly phase of the project. This was not merely due to the data transfer time between heterogeneous sources and the central data warehouse, but rather the complexity of analyzing database structures in source systems. A major challenge was addressing issues arising from the use of inconsistent column names to represent analogous attributes of business objects, as well as differing data formats and types. Another significant problem was the non-uniform length of character strings in equivalent data fields.

The tasks related to the implementation of OLAP components included the design of the logical structure of the multidimensional database, the creation of new analytical objects (including informational dimensions, algorithms and calculation formulas), as well as the construction of KPI indicators. It should be noted that multidimensional databases include both source data and aggregated data. Therefore, the data migration process from the data warehouse to the multidimensional data cubes involved replicating operational data and calculating aggregates, statistics and other elements relevant to the computational efficiency of the analytical system.

The final stage of prototype development involved designing the graphical user interface (GUI) framework.

The prototype underwent a series of functional, performance and acceptance tests. Over the next six months, consultation sessions were conducted with users to evaluate: information content, quality and usability of analytical reports and KPIs. Based on this feedback, new requirements for the structure of reports and dashboards were formulated. Additionally, an assessment was conducted to determine whether these requirements could be implemented without modifying connection pools or reconstructing program objects.

4. Discussion of experiment results

4.1. Evaluation of the software prototype

The experiment involved the construction of a prototype system supporting industrial analytics. The software prototype was developed using a three-tier architecture (data warehouse, OLAP, user interface).

For the implementation of the data warehouse, a snowflake schema was applied. This solution enables the creation of dimension hierarchies. For example, a dimension hierarchy can illustrate the process of technical product assembly (hierarchical structure: product → subassembly → component → part). It is important to note that the dimension tables contain normalized data, including reference attributes. During the design process of the data warehouse, various groups of factual data can be described using the same informational dimensions. These dimensions are shared across different fact tables.

In turn, OLAP technology was applied to implement multidimensional data structures and optimize the processing of large analytical data sets.

According to the author, a key research problem in analytical data management is the division of operations between the data warehouse subsystem and the separate subsystem for processing multidimensional data cubes.

As previously mentioned, the design of the data warehouse structure may include a defined set of relatively autonomous fact tables and a set of shared dimension tables. This approach is characterized by flexibility – new fact tables and dimension tables can be created as the company's informational needs evolve. Conducting multiple experimental simulations and economic analyses typically leads to the formulation of new research questions. This, in turn, requires verifying initial assumptions and requirements, redefining the structure of multidimensional reports and modifying diagnostic indicators. Naturally, these changes may require the introduction of appropriate modifications to the structure of data sources, fact tables and dimension tables.

Considering the implementation of a multidimensional OLAP database as a solution closely tied to a previously developed and deployed central data warehouse, one may ask:

Is the need to build new analytical objects in the multidimensional database layer a result of potential oversights (errors) made during the creation of the central data warehouse?

Let us examine this issue using the example of the "time" dimension. In a data warehouse, fact tables contain timestamps for individual business transactions (e.g., invoice issue date, payment transaction date, production order completion date, etc.). Typically, the central data warehouse does not store a separate table structure representing the hierarchy of the "time" dimension. Considering data normalization principles, this approach can be deemed correct. In a two-dimensional tabular system, it is also difficult to identify practical use cases for such a redundant structure. The use of standard SQL queries allows for the construction of clauses that filter records based on a specified time range, e.g. "2024-06-01 – 2024-09-20". The query can be formulated using a typical "date" field in the fact table. Thus, from the perspective of working within a two-dimensional relational data model, a redundant table structure illustrating the "time" dimension is unnecessary.

In the context of implementing a multidimensional model, this issue must be considered differently. The hierarchical "time" dimension (e.g., structure: year, quarter, month) is one of the fundamental dimensions used in business analytics. Its construction should be carried out during the development of the multidimensional database. The structure of the new dimension and the processed analytical data will be managed on the server side of the OLAP analytical application. Metadata defining the logical schema of the analytical cube, the structure of informational dimensions and reference relationships will be stored as XML scripts in the data repository.

Of course, during the construction of the multidimensional OLAP database, it is also possible to extend the central data warehouse with elements related to handling the "time" dimension. In detail, this process requires creating appropriate data tables and T-SQL scripts. These scripts will be responsible for periodically updating the content of dimension tables based on new fact data. This solution introduces elements of transactional processing into the data warehouse architecture, which is fundamentally at odds with the concept of a data warehouse as a repository for historical data archiving.

Based on the conducted experiment, it can be concluded that achieving high flexibility in designing and reconfiguring data cubes requires the prior implementation of a central data warehouse. The recommended approach is to use the snowflake schema model. Furthermore, a critical success factor is the proper handling of periodic data loading from source systems into the central data warehouse.

As a supplementary remark, if the data warehouse layer is omitted in the development of a Business Intelligence system, the need for manually creating analytical structures in the multidimensional database layer will arise. Source data will be inserted directly into analytical structures, increasing the risk of errors and reducing system efficiency. These data will be duplicated across multiple data cubes, reducing model clarity and increasing redundancy. In general, this solution will be characterized by high failure rates resulting from inevitable changes in the system configuration and changes in the structure of data resources. For example, system reconfiguration will involve: changes in the pool of connections to external data sources, changes in protocol configurations, network address modifications and changes in the system of accounts, roles, and permissions. These changes are a logical consequence of the updates and development of source systems, which serve as the 'data providers' for the industrial analytics system.

4.2. Evaluation of the pilot implementation

As part of the pilot implementation, it was verified whether the set of multidimensional analytical reports developed within the project met the actual needs of the users. In particular, it was examined whether these reports required increased data granularity, the introduction of new analytical dimensions, as well as modifications to data structures and processing logic within the OLAP layer.

Based on the results of the analytical work, the system prototype was implemented with twenty-four reports evaluating production profitability. The profitability analysis covered direct costs related to manufacturing, industrial technologies, quality, machinery, infrastructure (buildings, factory halls), maintenance, production personnel, workplace safety, shipping and transportation. In the pilot study, indirect costs such as administration, marketing and research & development were deliberately omitted. It was assumed that these costs would be included in subsequent versions of the system prototype.

The process of creating analytical reports utilized the pivot table mechanism, which is typically an integral component of spreadsheet applications. Architecturally, pivot tables serve as an interface for presenting data retrieved from the OLAP analytical server and for further analysis, including charts, macro definitions, and the construction of technical, economic and social indicators.

The pilot study involved workshops with industrial analysts and managerial staff. Using pivot tables and active connections to the OLAP server, the process of redefining analytical reports included: transposing rows and columns, filtering data, rotating row and column labels,

hiding data subsets, grouping and applying standard statistical, logical, database functions. The modified reports were saved as spreadsheet files with active connections to the OLAP server.

Workshops were held 2-3 times per week, during which dozens of new analytical reports were developed based on existing report templates. This approach proved to be highly flexible, as creating new analytical reports from previously developed templates did not require modifications to the OLAP structures. Industrial analysts acquired the necessary skills after completing a three-hour training session on pivot table usage.

5. Summary

The pilot study revealed that it is not possible to develop a complete and comprehensive specification of functional requirements at the initial stage of the project. Working with a predefined set of multidimensional reports serves as an inspiration for creating additional analyses, summaries and indicators. This leads to the conclusion that a Business Intelligence system should be characterized by flexibility – the ability to modify and expand analytical objects without requiring changes to data structures or source code.

The development of an analytical system using a three-tier architecture enables the creation of scalable solutions for modern industry. The key advantage of this approach is flexibility – the ability to generate new multidimensional reports without modifying data structures or software objects. The flexibility of the system prototype was validated through pilot studies conducted in a large furniture manufacturing company. The experiment confirmed that new analytical objects could be created within a spreadsheet environment equipped with active connections to an OLAP server. These development tasks were carried out by industrial analysts without the involvement of IT specialists.

Based on the conducted experiment, it can be boldly concluded that achieving the intended flexibility of a system supporting industrial analytics requires prior analytical and technical work. A key element is the construction of a central data warehouse. The execution of these tasks is undoubtedly a complex and time-consuming endeavor, which may be perceived as a potential limitation of the proposed solution.

It is also worth noting that the use of pivot tables allowed for a swift and efficient verification of the prototype's core functionality, as well as further development efforts. Naturally, the final version of the industrial analytics support system should be equipped with an advanced data visualization system. In this regard, the implementation of management dashboards should be considered. Future research will focus on evaluating the functionality, usability and flexibility of industrial data visualization systems.

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NET POSITIVE ENTERPRISES IN THE LOCAL ECONOMY

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Purpose: The aim of the study is to draw attention to the contribution of local businesses to the protection of the most valuable common good - the human living environment. Based on the author's own research, it has been demonstrated that the sector of microenterprises and small, and medium-sized enterprises that are rooted locally operate in accordance with values defined as net-positive enterprises.
Methodology: A qualitative research method based on in-depth qualitative interviews with entrepreneurs. The selection criteria for the study group included businesses that have been operating for at least twenty years and belong to the micro, small, and medium-sized enterprise sector.
Findings: The research findings indicate that local businesses have focused their activities on minimizing their negative impact on the local environment. This is undoubtedly a consequence of the emotional bond between the entrepreneur and the space in which they grew up, were educated, and run their business. Being a net-positive enterprise is a commitment of the entrepreneur to this environment.
Research limitations: The issue requires further research to determine the impact of informal institutions (such as local culture and traditions) on the activities of locally rooted entrepreneurs.
Originality: The study reveals the relationship between the identity of an entrepreneur originating from a specific local environment and their responsibility for the quality of the natural environment, as well as the informal ties with the business surroundings in which they operate.
Keywords: net positive enterprises, local economy, in-depth qualitative interviews, locally rooted enterprises, protection of local resources.
Category of the paper: research paper.

1. Introduction. Historical perspective

The hope for developing an economic structure in Poland like that of Western European countries emerged with the adoption of the *Act on Economic Activity* by the Seym of the People's Republic of Poland on December 23, 1988 (Dz.U. 1988, nr 41, poz. 324). This aspiration was realized by the government of Tadeusz Mazowiecki, which, on January 1, 1990, implemented a package of reforms encapsulated in the succinct term *Balcerowicz Plan*

(Bałtowski, Miszewski, 2006). The foundational privatization, along with the restructuring and privatization of state-owned enterprises—enabled by the *Act on Privatization of State-Owned Enterprises* of July 13, 1990 (Dz.U. 1990, nr 51, poz. 298), paved the way for an economy based on free competition.

The *Act on Economic Activity* of December 23, 1988, was the first since World War II to define economic activity and to ensure equal rights and obligations for business entities, regardless of ownership type—whether state-owned, cooperative, or private. This legislative change initiated what became known as the *entrepreneurs' dignity revolution* (McCloskey, 2017). After years of verbal humiliation in communist-controlled media, where entrepreneurs were derogatorily labelled as profiteers, speculators, or "badylarze" (pejorative term for private horticultural farmers), they returned to the economic stage as a group eager for economic success and self-fulfilment through business ventures. Entrepreneurs played a crucial role in rebuilding the labour market by generating demand for workers, thereby mitigating the negative effects of the rising unemployment rate in Poland. They also facilitated the satisfaction of the long-suppressed consumer demand of Polish citizens (Kamosiński, 2023).

The constitutional guarantee of the right to own property and freely manage it, encouraged entrepreneurs to invest and implement long-term development strategies for their businesses. Many entrepreneurs who began their business activities after 1988 reached retirement age in the 2020s. Consequently, they faced the challenge of transferring their businesses to their children or grandchildren. This generational transition became one of the most significant challenges they had encountered since founding their companies. A substantial portion of them aspired to establish family businesses. The successor—by assuming the competencies of the business owner—is expected to inject new energy into the company's growth and lead it in a way that prevents the so-called *Buddenbrook syndrome* from becoming a self-fulfilling prophecy (Kamosiński, 2023).

The post-1988 shift in the ownership structure of enterprises in Poland dismantled the atypical size structure of businesses. Large socialist state-owned enterprises gave way to a thriving sector of micro, small, and medium-sized enterprises (SMEs). These organizations became the driving force behind local economic dynamics and embedded themselves within their communities. Typically, an entrepreneur established a business in a familiar environment—the place where they were born, raised, and resided. For many entrepreneurs, local rootedness holds intrinsic value, ultimately influencing how they utilize the local resources available to them.

2. Net positive enterprises

Locally rooted businesses, often unconsciously yet effectively, align with the values embodied by net-positive enterprises (Polman, Winston, 2021). The concept was introduced into scholarly discourse by Paul Polman and Andrew Winston and describes companies that derive their profits from addressing global challenges rather than exacerbating anthropogenic pressures. These enterprises adhere to a philosophy of giving back to the world more than they extract, prioritizing environmental sustainability and resource conservation as fundamental aspects of their mission. These enterprises adhere to a philosophy of giving back to the world more than they extract, prioritizing environmental sustainability and resource conservation as fundamental aspects of their mission. A distinguishing characteristic of net-positive enterprises is their approach to human capital. Rather than perceiving employees as mere resources, these businesses recognize them as integral co-creators of the organization. Consequently, they invest in both the professional and personal development of their workforce, fostering a strong emotional bond between employees and the company. Moreover, net-positive entrepreneurs voluntarily engage in collaborative relationships with their stakeholders, including suppliers and customers, but most notably with the local community (Polman, Winston, 2021).

From a broader perspective, net-positive enterprises function under the assumption that their operations mitigate the detrimental effects of anthropogenic activity and, as Kate Raworth posits, contribute to restoring planetary resilience. Raworth emphasizes that humans, as stewards of Earth's resources, can most effectively achieve this objective through small, agile organizations operating within localized markets. She asserts that *revitalizing the roots of the economy in the form of small, fairly managed enterprises is today the best way to reclaim resilience* (Raworth, 2021). A complementary viewpoint is provided by William Nordhaus, who underscores the principle of *the trade-off between the costs of emission reduction incurred today and the social value of mitigating climate-related losses in the future* (Nordhaus, 2021).

3. Thesis and research assumptions

The aforementioned observations substantiate the thesis that locally rooted enterprises, particularly those within the micro, small, and medium-sized business sectors, constitute net-positive economic organizations that, through their daily operations, contribute to the restoration of the Earth's resilience. These businesses exhibit territorial solidarity with all stakeholders within their respective local spaces. The interactions occurring between local space users—including entrepreneurs and residents—are direct (face-to-face) and stem from

cohabitation and professional activity within the same geographic area, as well as from a shared set of local values and collective developmental objectives. This embeddedness fosters a heightened sense of responsibility among entrepreneurs for the consequences of their business decisions.

The following key observations emerge from this dynamic:

- Entrepreneurs demonstrate a prominent level of responsibility for managing the resources available within their local environment.
- They assume direct responsibility for their employees and, indirectly, for their employees' families.
- The shared geographic space naturally promotes cooperation between business entities operating within it.
- Entrepreneurs bear an indirect responsibility for the quality of life within their local communities.
- They express a strong expectation for the stabilization of economic regulations, which would, in turn, encourage bolder investment decisions.

4. Research methodology

The empirical validation of the research assumptions was conducted through a qualitative research approach, specifically utilizing in-depth qualitative interviews with entrepreneurs. This methodological choice is justified by the inherent uniqueness of each enterprise—no two businesses are identical. Recognizing this premise, qualitative interviews provide an opportunity to capture the entrepreneur’s subjective perception of business operations, allowing for the identification of broader tendencies and insights. The selection criteria for participating entrepreneurs were as follows: each business had been in operation for at least twenty years and all entrepreneurs represented the micro, small, and medium-sized business sector. The study covered the period 2017-2023. A total of 34 in-depth qualitative interviews were conducted, with each session averaging 120 minutes. In twelve cases, the businesses met the criteria for being classified as family enterprises. It is important to note that this study is not statistically representative, as its objective is to explore qualitative insights rather than generalizable quantitative conclusions. The interview technique involved personal meetings with entrepreneurs, with all interviews being recorded and subsequently transcribed for further analysis.

5. Research findings

The qualitative interviews conducted with entrepreneurs—owners of micro, small, and medium-sized enterprises—reinforce the conviction that these organizations operate as net-positive enterprises. In their statements, entrepreneurs emphasized that responsibility is their core value, primarily understood as responsibility for their employees and, indirectly, for their employees' families. Due to their longstanding presence in the local environment, these businesses often provide employment for entire families, with two generations sometimes working within the same organization. As a result, the employer's responsibility is significantly magnified. A key observation is that employees in these enterprises are not anonymous figures. Employers generally have personal knowledge of their employees, their living conditions, and, in many cases, their life challenges. When necessary, entrepreneurs actively engage in supporting employees through difficult situations.

One female entrepreneur highlighted the duality of entrepreneurial consciousness, stating: *In a sense, it is freedom, but also an enormous responsibility. Because if you mismanage your business, your employees will end up on the street. So, you have to think not only about your own livelihood but also about the livelihood of your employees* (Kamosiński, 2024, p. 205). Another entrepreneur, reflecting on the concept of freedom in business, remarked: *[...] it is the privilege of shaping reality, of influencing it, of being a freer person than others—but it is also a great responsibility. We, as entrepreneurs, should feel responsible for our employees just as parents do. For a massive portion of a given employee's daily life, we are responsible for their behaviour, engagement, efficiency, and even their moral attitudes. We must set an example. I cannot expect my employees to refrain from using profane language in my company if I myself greet them with an expletive. Incidentally, I enforce this rule strictly to maintain a high standard of language culture* (Kamosiński, 2024, p. 132). The development of mutual trust between employees and employers is a natural consequence of the long-term stability of an economic organization. Over time, this fosters emotional bonds between workers and business owners, which, in turn, shape an ownership mindset among employees. Entrepreneurs participating in the study defined this phenomenon through statements they have heard from employees, such as: *Boss, let's improve this in our company,* or *Boss, someone has been criticizing our company.* According to the interviewed business owners, hearing an employee use the phrase *our company* is the greatest compliment and the highest form of recognition they can receive.

One entrepreneur emphasized this sentiment, stating: *An entrepreneur should create a team of employees who treat the company as a second home and willingly contribute their ideas. The foundation of the employer-employee relationship should be honesty and integrity* (Kamosiński, 2024, p. 90).

Locally rooted firms voluntarily engage in collaboration with their surrounding environment. The term "competitive strategy" takes on a different meaning in the local context, where competition is often replaced by cooperation among entrepreneurs within the same sector. Exchange of knowledge, advisory support, and even assistance in fulfilling orders are commonly observed practices. One businesswoman described this cooperative culture as follows: *We have a family-like network of upholsterers here—we don't see each other as competitors. We share experiences, and if one of us runs out of something, the other will lend or provide what's needed. We have a circle of acquaintances, and to this day, we support and help each other* (Kamosiński, 2024, p. 55).

The origin of this cooperative spirit can be traced back to the entrepreneurs who started their businesses together following the enactment of the 1988 *Act on Economic Activity*. These business owners, having utilized the new legal framework to establish their enterprises, share a common history, which fosters a deep sense of solidarity. One entrepreneur encapsulated this sentiment by stating: *We have known each other well because we all started our businesses at the same time* (Kamosiński, 2024, p. 56). This shared history has cultivated a strong support system among locally rooted entrepreneurs. In moments of crisis, assistance is readily offered, as illustrated by a businesswoman who faced external pressures forcing her to consider closing her company. Unexpectedly, she received guidance and encouragement from another entrepreneur: *I will help you but wait—don't shut down your business just yet. Take your time, think things through. First, you need to leave the location you're in; they're forcing you out anyway. You need to find a place in the city centre so that you're visible. Think about what you're good at and who you need for your team.* At that moment, she realized: *What do you mean, what am I good at? I do everything!* (Kamosiński, 2024, p. 63).

The local rootedness of businesses instils in them a powerful sense of responsibility for rational resource management. Entrepreneurs are overly sensitive to waste and the degradation of their immediate environment. They view their companies not merely as personal assets but as integral components of the local community. One entrepreneur articulated this perspective, stating: *We cannot treat our businesses as our exclusive property in every sense of the term. As entrepreneurs, we must recognize that we are part of the local community in which our company operates. [...] We must be mindful of the environment. We must give back what is rightfully due to nature, or at the very least, strive to coexist with it harmoniously* (Kamosiński, 2024, p. 134).

For locally embedded entrepreneurs, resource management is not merely an operational concern but a guiding principle in production strategy. Rather than pursuing overproduction, they deliberately maintain a controlled scarcity of products, ensuring that quality prevails over quantity. This strategic approach reflects a broader commitment to sustainability and waste reduction. One entrepreneur articulated this philosophy as follows: *Why produce more of something that is of lower quality and will eventually end up as waste? [...] The point is to make a product that is genuinely good. We used to make blueberry pastries with wild forest berries,*

and now we've introduced pastries made with cultivated blueberries. [...] We focus on regional ingredients and high-quality production. Let it be slightly more expensive, but also good, tasty, and healthy. [...] In a family business, it's not about endlessly increasing production numbers, efficiency, and revenue. That's not the point (Kamosiński, 2024, p. 172). This perspective aligns with the concept of the economy of moderation, which respects consumer sovereignty while encouraging sustainable consumption patterns (Koźmiński, 2016). Entrepreneurs who adopt this philosophy frequently receive strong customer endorsement for their business strategies, reinforcing their market position.

A second entrepreneur highlighted how reputation and quality craftsmanship have contributed to the long-term sustainability of their business: *People started recognizing us, and it turned out that we were well known in the local market—our company has been around for over twenty, almost thirty years. People know our name, and they always recommended us, telling others to come to us because we make solid furniture. Above all, we focused on quality—that was always our priority. No customer ever received something of dubious quality. [...] When I sewed, every seam had to be exactly two centimetres, and the threads had to be specific—not just any kind* (Kamosiński, 2024, pp. 68-69).

This commitment to durability and artisanry challenges prevailing market trends that prioritize fast production cycles and disposability. By ensuring long product lifespans, these entrepreneurs fulfil their responsibility to customers—particularly in terms of financial sustainability—while also contributing to environmental conservation by reducing unnecessary waste and preserving natural resources for future generations.

Entrepreneurs actively seek to minimize production waste by repurposing materials, assigning them both economic and symbolic value. One businesswoman described her approach to utilizing fabric scraps: *I started sewing pillows and other small items, including pet beds for dogs and cats. I donated them to the animal shelter. When I saw fabric scraps, I always saw potential—I couldn't bring myself to throw them away. Every piece of fabric could be turned into something useful because they were so beautiful that I had to repurpose, adapt, and bring my ideas to life. Whenever I had a free moment, I worked on small projects* (Kamosiński, 2024, p. 55).

Some of the company's post-production waste goes to care institutions that provide occupational therapy for people with disabilities. It should be emphasized that, for many such economic organizations, the production of additional items using post-production waste is not a commercial process. It is carried out of a desire to serve the local community, from a voluntarily expressed willingness to do good and support those in need.

This is a positive effect of the company's local rootedness, as well as that of its owner. He/she collaborates with the local community, respects the local resources available to him, and does not use these efforts for marketing purposes. He/she operates quietly, as it stems from a voluntarily expressed need to get involved in solving problems that he/she observes in the company's surroundings. Such attitudes toward resources available to local entrepreneurs are

likely not isolated. This activity offers hope for restoring our planet's resilience, which Kathe Routh advocates for.

Food processing enterprises recognize the urgent issue of declining biodiversity in agricultural production. According to entrepreneurs who participated in qualitative interviews, this trend represents the first step toward diminishing Earth's resilience. Locally embedded entrepreneurs argue that food production has been increasingly subjected to standardization, primarily to enhance efficiency in response to a growing global population. While this shift may be an inevitable economic necessity, local food processors find it difficult to accept. A restaurant owner reflected on the transformation of food supply chains: *[...] We realized that the products we have been purchasing for our restaurants over the past ten years have changed. We can no longer buy meat from local farms—we must source it from wholesalers. Sure, it may have a better certificate, a clearer invoice, and improved transportation conditions. It certainly meets all the required criteria—but it is not tastier. It contains more water. [...] [...] Something prompted us to investigate the origins of our supplies. Due to the scale of our business, we had to rely on large wholesalers. And we were horrified to find that we had become part of a globalized supply chain—large-scale, industrialized. We had lost access to what we had always known. [...] Everything had become so standardized that we could no longer enjoy different varieties of vegetables or meats. We had inadvertently become part of a global trading system—something we had only associated with highly developed economies. We came to the realization that we were no longer the same people who used to make our own preserves for the winter, who had real control over what went into a jar or a pot. We had become mere cogs in the vast machinery of global food production and raw material distribution* (Kamosiński, 2024, p. 216). The advocacy by locally rooted entrepreneurs for biodiversity in agriculture arises from a rejection of a uniform world devoid of diverse offerings. For this reason, maintaining biological diversity in these spaces is valued for preserving local uniqueness. It also presents an opportunity for local communities to distinguish themselves in an environment dominated by standardized products. Locally embedded businesses experience significant discomfort due to legislative inflation—the excessive and frequent changes in legal regulations, particularly in tax law. This instability discourages entrepreneurs from investing and pursuing new business initiatives, as they feel increasingly uncertain in an environment characterized by constant legal flux. The excessive complexity and lack of transparency in legal regulations ultimately lead to the waste of a crucial economic resource: entrepreneurial potential. It is difficult to quantify the exact magnitude of lost economic opportunities, but it is evident that many business ideas, expansion plans, and innovative projects are abandoned due to the unpredictable regulatory landscape. A businessperson articulated this frustration: *I don't invest, even though I could, because my husband and I have some capital. I could reinvest here, but I don't do it because the law is what it is. Everything is unstable. I try to earn enough from what I sell to cover current expenses, not to invest in extra things [...]. The instability of the law is terrible, and I still don't know what to do... I'm not even investing*

in additional furniture because right now, I don't know if in a month or two I might have to shut everything down (Kamosiński, 2024, p. 67). Another entrepreneur said: *[...] I feel that every change made for so many years almost always turns out to be a deterioration for us. And we must learn anew, invent something new, somehow defend ourselves against it, and so on* (Kamosiński, 2024, p. 31). To complete the picture, we present another statement: *An entrepreneur cannot operate peacefully because we never know what will change tomorrow* (Kamosiński, 2024, p. 97). It must be emphasized that entrepreneurs do not oppose legal regulations; they merely wish for the rules to be implemented without undue haste, which would enhance their quality. In this context, one must agree with the conclusion reached by James K. Galbraith, who observed that a modern economy should be based on trust -the trust built through legal regulations. According to him, law *is not a burden for the markets, but a necessary condition for their existence* (Galbraith, 2016, p. 68).

6. Recommendations and Discussion

According to Daron Acemoglu and James A. Robinson, net-positive enterprises can only flourish when state institutions are inclusive, thereby ensuring that entrepreneurs trust the rule of law upheld by these institutions (Acemoglu, Robinson, 2014). Giovanni Sartori further asserts that the full realization of inclusivity involves *personal participation, active and willing engagement* (Sartori, 1998, p. 148). This principle is a fundamental prerequisite for fostering an environment where entrepreneurial attitudes can freely develop, allowing individuals to pursue their ambitions as business owners. Their voluntary engagement in the life of the local self-governing community demonstrates that they are not merely capital donors or investors for the local community (Hausner, 2019). The arguments presented authorize the conclusion that, more than thirty years after the commencement of institutional change in Poland (Morawski, 1998), inclusive institutions are encouraging entrepreneurs who have stabilized the positions of their own companies, achieving so-called optimal development, to undertake another transformation. Its origin is rooted in the local anchoring of the company and presents entrepreneurs with the opportunity to voluntarily participate in the co-creation of local values aimed at strengthening territorial self-governing communities. Their involvement in mobilizing local resources (Hausner, 2019) to foster a circular economy, which enables the environment to continuously regenerate resources, has become a timely necessity. This cycle should not be disrupted, as it could lead to a deterioration in the living conditions of the residents. Locally rooted companies today bear both tangible and intangible costs to protect the resources around them, aiming for a future profit in the form of the common good – the preservation of life on Earth.

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PERCEPTION OF FEEDBACK AMONG ACCOUNTING OFFICE EMPLOYEES – EMPLOYEE EXPERIENCE MANAGEMENT (EEM) PERSPECTIVE

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Purpose: The purpose of this analysis is to understand how accounting office employees perceive feedback and which aspects of this process have the greatest impact on their engagement and effectiveness.
Design/methodology/approach: The article presents the results of a diagnostic study.
Findings: The findings indicate that the perception of feedback is most strongly influenced by attention to linguistic aesthetics and politeness, fostering a friendly work atmosphere, and receiving support from a supervisor or colleagues.
Research limitations/implications: A survey according to a questionnaire developed by the author. Due to the unrepresentative nature of the sample, the survey is treated as a pilot study.
Practical implications: The results have important implications for the practice of human resource management. First of all, they indicate the need to consciously build a culture of feedback in the organization, in which its form and interpersonal and organizational context are as important as the content of the feedback.
Social implications: Fostering a feedback culture based on respect, clear communication and shared goals can foster more empathetic and responsible attitudes in the workplace.
Originality/value: The research issues addressed concern the perception of feedback in relation to EEM among accounting office employees.
Keywords: feedback, Employee Experience Management, accounting offices, experience economy.
Category of the paper: Research paper.

1. Introduction

Employees are the key resource of any organisation. Currently, there is a shift away from the classical approach in which an employee is treated merely as a resource possessing a set of competencies. This approach has evolved alongside technological advancements, changes in organisational structures, and shifting employee expectations. Modern approaches to human resource management are more comprehensive and oriented towards the holistic development

of employees, as well as their satisfaction and engagement (Wilczyński et al., 2023). Companies that successfully implement these approaches are able to attract top talent, increase efficiency, improve the workplace atmosphere, and achieve their strategic goals. Employees who feel valued and supported are, in turn, more likely to be engaged and loyal to the organisation. Closely related to human resource management in an organisation is the concept of the "employee life cycle". This term is defined in the literature as the interaction between the employee and the employer (Gladka, Fedorova, Dohadailo, 2022) Plaskoff (2017) points out that this does not necessarily begin on the first day of work but from the very first thought about an organisation as a potential workplace. The employee life cycle refers to various stages of an individual's career within an organisation, from recruitment and professional development to the termination of employment. Feedback plays a crucial role at each of these stages.

The cognitive aim of this study is to identify how accounting office employees perceive feedback within the framework of Employee Experience Management. For the purposes of this study, the following research questions were formulated: Do accounting offices promote a culture of openness to feedback? How frequently do accounting office employees receive feedback? Which elements of Employee Experience Management are significant for feedback recipients?

To achieve the above goal and answer the research questions, a critical analysis of the subject literature was conducted, along with a diagnostic survey method using a questionnaire technique. The study was carried out among employees of accounting offices.

2. The Concept of Feedback and Its Types

Communication processes within an organisation are essential for the emergence and development of any human interaction, organisation, or culture (Winkler, 2008). It is emphasised that communication is not only a tool for exchanging information but also a means through which employees can learn and develop (Padlowska, 2021). One of the key elements of effective communication is feedback.

Feedback is information provided in response to an action, which can be given in various contexts, such as interpersonal communication, professional work, education, or personal development processes. The aim of feedback is to provide opinions or comments regarding behaviours, actions, or results of an individual or group to support their development, improve efficiency, or increase awareness of performed activities (Baker, 2010). Literature describes feedback as a process spread over time, contributing to employee development (London, Smither, 2002), which involves frequent and not necessarily formal communication about work quality or task execution. The purpose of feedback is to guide, motivate, and reinforce desired behaviours while reducing undesirable ones (Steelman, Williams, 2019). Properly delivered

feedback not only helps employees improve their performance but also serves as a source of knowledge, skills, and builds a culture of open communication in an organisation. This allows employees to feel valued and motivated, leading to higher engagement and work efficiency (Harvey, Green, 2022). The purpose of communication in an organisation is to provide information and receive feedback. Communication among employees is primarily based on conversations (Padlowska, 2021). Feedback is frequently used during employee discussions, particularly in performance reviews, where it focuses on evaluating employees (Budworth, Chummar, 2017). In such cases, feedback plays an informative role, where a supervisor provides their observations regarding an employee's performance, behaviour, and achievements at work. However, it is crucial that feedback is not limited to evaluation but also has a constructive and supportive nature for development. Feedback is an essential element of proper communication (Alam, Singh, 2021). It is vital in both professional and personal contexts. Effective feedback is one that is understood and accepted by the employee. Its impact is more evident when communication between a supervisor and employee is efficient (Cywińska, 2020).

Feedback in organisations plays a role not only in employee management processes but also in fostering a culture of open communication, effective collaboration, and continuous improvement (Lipka, 2024). One challenge for companies regarding feedback is their approach to its concept. The literature defines this as feedback sensitivity, which includes areas such as the perceived usefulness of feedback, the sense of responsibility to act on received feedback, social awareness, and self-perception of one's ability to receive feedback. Individuals with a positive orientation towards feedback are often open to constructive criticism, seeing it as an opportunity for improvement, whereas those with a more negative orientation may feel defensive or discouraged upon receiving feedback. This may depend on factors such as personality, life experiences, or the context in which feedback is given (Patel, Silva, Dahling, 2019).

Properly delivered feedback should have a positive intent, provide timely information, meaning it should be given immediately after the relevant event—and should not address too many issues simultaneously. To provide constructive feedback, it is necessary to convey information as precisely and specifically as possible. Well-delivered feedback not only supports employee development but also strengthens their relationship with supervisors and enhances overall organisational efficiency (Kamińska, Szczęsna, Wielgus, Żak, 2021). According to R. and F. Bee, there are two types of feedback—positive and negative. The purpose of positive feedback is to reinforce desirable behaviours and motivate their repetition. Positive feedback acknowledges effort and achievements, enhances self-worth and confidence. It emphasises what has been done well and should be continued. It plays a significant role in motivation by confirming that actions taken are appropriate, thus encouraging further engagement. Negative feedback, on the other hand, identifies mistakes and areas for improvement. It focuses on errors and shortcomings, often involving difficult emotions, but its aim is to improve efficiency and

prevent the recurrence of mistakes. It is crucial for negative feedback to be constructive, offering specific corrective actions rather than mere criticism.

3. Feedback on Employee Experience Management Models

Feedback in the context of Employee Experience Management (EEM) is a key element in creating a positive organisational culture and managing employee experiences. Employee Experience (EX) refers to the overall experiences employees have within an organisation, encompassing not only working conditions but also interactions with supervisors, organisational culture, development opportunities, feedback, and many other aspects (Plaskoff, 2017). Employee Experience Management (EEM) is a comprehensive approach aimed at optimising employee experience at every stage of their journey within an organisation, from recruitment to the end of their employment. The objective of EEM is to enhance engagement, satisfaction, and overall employee well-being. The main objective is to create a positive and productive working environment that improves morale, retention, and employee performance. Thoughtfully designed and executed feedback mechanisms contribute to employee commitment, satisfaction, and loyalty while supporting their professional growth. Thanks to modern tools and openness-based approaches, organizations can effectively collect feedback and implement changes that will have a positive impact on the entire company.

The employee experience management model developed by Yidiz, Temur, Beskesego and Bozbur (2020) encourages a structured and holistic approach to managing employee experiences in organisations. This model integrates various aspects of employee experience, from organisational culture and work environment to HR processes, motivation, and engagement. This approach aims not only to improve the employee experience but also to contribute to the organization's success by increasing employee productivity and loyalty.

Feedback is an integral element of the model developed by Yidiz, Temur, Beskese, and Bozbury, particularly in the context of interpersonal relationships, motivation, and employee engagement.

The model developed by Morgan also incorporates feedback as a tool for building a positive employee experience. This model focuses on four key pillars: the work environment, tasks, interpersonal relationships, and organisational processes. Morgan emphasises that it is crucial for organisations to create a coherent, transparent, and flexible experience that is tailored to individual employee needs and supports their engagement. In this model, the author also highlights the importance of feedback, which plays a significant role, particularly in the context of relationships and interactions, as well as in organisational processes. Employees who receive regular feedback feel more appreciated, while supervisors who can provide feedback in a supportive and developmental manner foster an atmosphere of trust that promotes better team

relationships. Morgan stresses that feedback should be broad, accurate, and tailored to the individual needs of employees. Each employee may have different expectations regarding the form and frequency of feedback. Therefore, it is crucial for managers to be flexible in adapting their approach to feedback. This enables employees to consciously work on their skills (Morgan, 2017).

The experience management model through feedback, published by Maylett and Wride, is also based on the belief that feedback, both positive and constructive, is essential for building employee engagement and creating a positive experience in the organisation. Maylett and Wride point out that employee experience has a significant impact on their motivation, productivity, and loyalty to the company. The model assumes that feedback should flow in both directions – not only from the top down but also from the bottom up. Employees should have space to express their opinions and suggestions, which strengthens their commitment and gives them a sense of influence over the organisation. Maylett and Wride emphasise that experience management is not only about results but also about how employees feel in their role and within the organisation. Feedback should be part of a broader strategy for improving employee experience, influencing their engagement and long-term motivation (Maylett, Wride, 2017). The model by Maylett and Wride aims to enhance employee engagement and create a more positive and engaging work environment for them.

The importance of feedback can also be found in the models developed by Bersin, Flynn, Mazor and Melian, each of these authors bringing unique perspectives on employee experience management. However, all these models place great emphasis on the continuous collection and utilisation of feedback as a component of improving employee experience. Organisations that effectively integrate feedback into talent management processes and organisational culture are more flexible and better adapted to the changing expectations of employees (Bersin, Flynn, Mazor, Melian, 2017).

In summary, the significance of feedback in various EEM models is a key tool for continuous improvement. Its regular collection and analysis allow organisations to better tailor their strategies to employee expectations, enhancing their engagement, satisfaction, and loyalty. Feedback is not merely treated as an evaluation moment but as a foundation for building long-term relationships with employees and better managing their experience within the organisation.

4. Methods

The primary objective of the study was to diagnose the perception of feedback among employees of accounting offices. Due to the non-representative nature of the sample, the study is considered to be a pilot. The research was conducted from 2nd January 2025 to 20th January 2025 using the diagnostic survey method. The survey technique was employed, with a questionnaire serving as the research tool. The questionnaire included questions regarding the reception and impact of feedback on employees in accounting offices.

The sample selection was purposive-random. The questionnaire was directed at accounting offices. Randomisation was achieved by applying a dependent random sampling procedure without replacement. The study utilised an online database of companies and decision-makers, namely BNF (bnf.pl, accessed on 15th December 2024). Entities registered under the category "Accounting and Tax Advisory Offices" were searched in the database. As of 15th December 2024, there were 20,354 such entities. A sample of 10% (i.e., 2 036) of registered entities was randomly selected for the study.

The following analysis pertains to the responses provided by 153 respondents. The majority of respondents were women (78.43%), with the overrepresentation of women resulting from the feminisation of the accounting profession. The largest group of respondents were individuals aged 25-34, while the smallest proportion of respondents were those aged 18-24 and 45-54 (1.96%). The study included individuals holding various positions in accounting departments. The largest number of respondents held the position of accountant (26.14%) and senior accountant (23.53%), while the smallest group comprised team managers (11.76%). In terms of tenure, most respondents (52.94%) had worked in their current workplace for between 1 and 5 years, whereas the smallest group had a tenure of less than 1 year (7.84%).

5. Results

In the first part of the study, respondents were asked whether they believed that the company they worked for promoted a culture of openness to feedback. The results are presented in Figure 1.

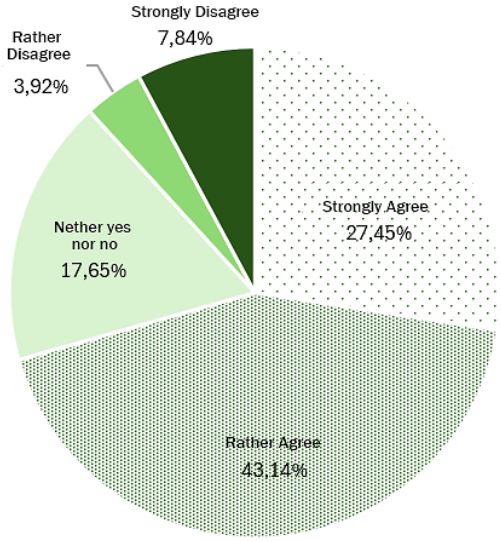


Figure 1. Culture of openness to feedback in accounting offices.

Source: Own study.

More than half of the respondents answered affirmatively, indicating that companies are effectively creating an environment for open expression of opinions and suggestions. This result suggests that companies value feedback and actively involve employees in decision-making processes. Figure 2 presents the frequency of feedback given to employees in accounting offices. Open feedback contributes to increased engagement, innovation, and faster problem solving. The study results indicate that for 25.49% of respondents, feedback is provided at least once a week. Meanwhile, 31.37% of respondents receive feedback several times a month. Approximately 25.49% receive feedback less than once a month. The frequency of feedback is crucial for effective employee experience management. Too much infrequent feedback may lead to a sense of neglect, while too frequent feedback may create a feeling of being overwhelmed.

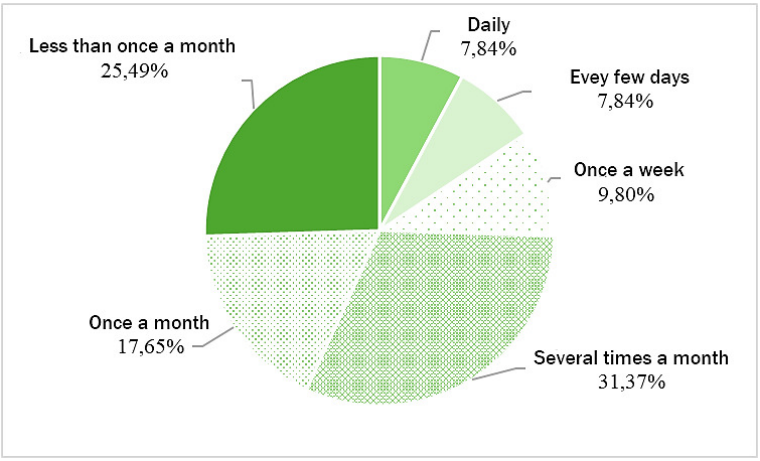


Figure 2. Frequency of feedback provision.

Source: Own study.

In the next part of the study, respondents provided answers regarding the reception of feedback. The results are presented in Table 1.

Table 1.
Perception of feedback by accounting department employees

	Strongly Agree	Rather Agree	Neither yes nor no	Rather Disagree	Strongly Disagree
Do you think feedback is provided in a way that is understandable to you?	29.41%	52.94%	5.88%	9.80%	1.96%
Does your supervisor adapt feedback delivery to your preferences or individual needs?	9.80%	56.86%	21.57%	7.84%	3.92%
Does the feedback you receive help you develop your skills and achieve career goals?	23.53%	49.02%	15.69%	9.80%	1.96%
Does feedback usually motivate you to continue working?	35.29%	49.02%	11.76%	1.96%	1.96%
Do you have the opportunity to share your comments regarding processes, work environment, or organisational activities?	19.61%	49.02%	13.73%	11.76%	5.88%

Source: Own study.

The data indicates that more than half of the respondents (52.94%) believe that the feedback they receive at work is communicated clearly and understandably. Additionally, 56.86% of respondents state that their supervisors adapt feedback delivery to their needs. More than 49% find workplace feedback as part of their skills development and motivation to continue working. This result indicates that organisations have a strong understanding of their employees' diversity and can tailor feedback delivery to individual preferences, work styles, and career goals, thus ensuring a positive employee experience. More than 49% of respondents indicated that they had the opportunity to share their comments regarding the functioning of the company. This result may indicate a positive organisational culture that supports the exchange of information and encourages employee involvement in decision-making processes. Employees feel that their voices matter, which translates into greater engagement, motivation, and overall positive employee experiences.

In Table 2, the results regarding the impact of selected EEM elements on the perception of feedback in the workplace are presented.

Table 2.
The impact of selected EEM elements on the perception of feedback

	Impact on feedback		
EEM Element	+	+/-	-
Various virtual communication tools are used in the communication process with employees	64.71%	17.65%	17.65%
The company ensures linguistic aesthetics and politeness in conversations with employees	88.24%	5.88%	5.88%
A friendly working atmosphere is fostered in the company	82.35%	9.80%	7.84%
Working conditions allow employees to balance professional and private life	76.47%	15.69%	7.84%
Employees' development aspirations are supported	70.59%	9.80%	19.61%
The company organises integration meetings	80.39%	5.88%	13.73%
Conditions for teamwork are created within the company	80.39%	13.73%	5.88%

Cont. table 2.

Employees receive support from supervisors or colleagues	82.35%	13.73%	3.92%
Team and individual goals are clearly defined	80.39%	15.69%	3.92%
Communication rules are clearly defined	70.59%	21.57%	7.84%

Source: Own study.

The study assumed that if the percentage of ratings exceeded 50%, it indicated a significant impact on the perception of feedback. The findings highlight that the most significant factors influencing feedback perception include: "ensuring linguistic aesthetics and politeness" (88.24%), "fostering a friendly working atmosphere" and "providing support from supervisors or colleagues" (82.35%), "organising integration meetings", "creating conditions for teamwork", and "clearly defining team and individual goals" (80.39%). According to respondents, the least impactful factor was "the use of various communication tools in the communication process" (64.71%).

6. Discussion and Summary

The interpretation of the results indicates that the key to positive feedback perception lies not only in the specific content delivered but also in the manner in which it is communicated and the overall team atmosphere. The findings are comparable to research conducted by Walker K. (2024), which demonstrated that clear communication of expectations and goal setting are essential for effective feedback. Linguistic aesthetics and politeness are fundamental to effective communication, as they help maintain respect and professionalism. Support from supervisors and colleagues fosters a sense of security, allowing employees to become more receptive to feedback. Additionally, teamwork conditions and clearly defined goals contribute to a sense of shared responsibility for achieving success, which facilitates the constructive and motivating exchange of feedback.

A key takeaway for organisations should be to invest in developing a strong feedback culture, ensuring not only the content of feedback is relevant but also ensuring the communication approach, workplace atmosphere, and clearly defined objectives. These elements collectively influence how employees perceive feedback and their willingness to engage in developmental actions based on it.

In the context of the results obtained, it is worth considering further research on the impact of the form of work (remote vs. desktop) on the reception and effectiveness of feedback. Changes in the organization of work, associated with the spread of remote and hybrid models, can significantly affect the quality of communication, especially in the area of feedback, which requires not only linguistic precision, but also an appropriate emotional sense.

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RETAIL INVESTMENT STRATEGY AND INCENTIVES AND ADVICE REGULATION IN THE INSURANCE DISTRIBUTION DIRECTIVE – CHALLENGES FOR THE FINANCIAL MARKET

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Purpose: The purpose of this article is to analyze the solutions proposed in the RIS amending the provisions of the Insurance Distribution Directive, hereinafter: "IDD" in the field of insurance distribution with an investment element regarding incentives and advice, and to assess their impact on the functioning of the Polish insurance market (OJ EU L 26/19, 2016).
Design/methodology/approach: The article uses the dogmatic-legal method. The article deals with the impact of the Retail Investment Strategy (RIS) on the Insurance Distribution Directive (IDD) regulations. The article defines the concept of incentives and presents the solutions for incentives in the IDD in the current legal state, and then presents the changes proposed in the RIS regarding the IDD. The possible effects of the implementation of the RIS in its current form into the Polish legal system are also identified. The article was written using the dogmatic-legal method.
Findings: The paper indicates the possible effects of implementing RIS in its current form into the Polish legal system. In addition, several legislative proposals for the implementation of RIS into the Polish legal system are presented.
Originality/value: The author is one of the first to present incentive and advisory solutions in IDD and RIS, and then compare them. The article is aimed at researchers, students and practitioners in the financial industry.
Keywords: insurance distribution, inducements.
Category of the paper: Research paper.

1. Introduction

On May 24, 2023, the European Commission published the Retail Investment Strategy (hereinafter "RIS") (2023/0167 (COD)). RIS amends regulations relating to the distribution of investment products in 5 different areas, i.e. the provision of investment services, the provision of insurance or reinsurance distribution services to third parties, the taking up and pursuit of insurance activities, undertakings for collective investment in transferable securities, and alternative investment fund managers (2023/0167 (COD), p. 5).

According to data published by the European Commission, the EU retail investment market is characterized by a low level of participation by retail investors, with EU citizens largely confined to savings products that generate low returns (2023/0167 (COD), p. 3). In the case of Poland, according to data from the Polish Development Fund on the structure of household financial assets in Q2 2024, the largest item in household financial assets was current settlement deposits (28.3% of assets) (PFR, 2024). In second place were other deposits (12.5%), while cash came in third (11.8%) (PFR, 2024). Together, these three items accounted for 52.6% of household financial assets.

According to the European Commission, RIS aims to change the investment culture, but this is only possible if retail investors gain confidence in the capital markets. In order to increase the confidence of retail investors in the capital markets, RIS implies facilitating access to relevant, comparable and understandable information about an investment product, minimizing the risk of undue influence of unrealistic marketing information, reducing shortcomings in the way products are created and distributed, related to conflicts of interest, and offering value-for-money products to retail investors (2023/0167 (COD), p. 2).

The purpose of this article is to analyze the solutions proposed in the RIS amending the provisions of the Insurance Distribution Directive, hereinafter: "IDD" in the field of insurance distribution with an investment element regarding incentives and advice, and to assess their impact on the functioning of the Polish insurance market (OJ EU L 26/19, 2016). The article uses the dogmatic-legal method.

2. Regulation of incentives in the IDD

In the current state of the law, the concept of incentives appears in Article 2(1)(9) of the IDD, as one of the types of remuneration. The aforementioned article defines remuneration as "any commission, fee, charge or other payment, including an economic benefit of any kind or any other financial or non-financial benefit or incentive, offered or given in connection with insurance distribution activities.[1] Analyzing the provisions of the IDD, it can be seen that the legislator introduces several mechanisms at the same time to increase customer protection in the insurance market and ensure greater transparency and fairness in the process of selling insurance products.

First, the IDD regulates how insurance distributors themselves are remunerated by other entities such as brokerage houses, as well as how insurance distributors' employees are remunerated and evaluated for their performance. It was pointed out that remuneration and performance appraisal must not be carried out in a way that contradicts the obligation to act in

[1] The current legal status as of 31.01.2025.

accordance with the best interests of their customers. It was stressed that this primarily applies to situations in which an insurance distributor or its employee could have offered a customer a different insurance product that better suited the customer's needs, while it did not do so because the way it was compensated, its sales goals or other issues gave it an incentive to recommend a particular insurance product.

The concept of the best interests of the customer is an example of a general clause, and therefore, in terms of interpretation, refers to a system of extra-legal judgments, i.e. moral, ethical, etc. For this reason, the doctrine points out that it is important to interpret the "best interests" in a specific context, that is, the way the distributor is remunerated - to the prohibition of misselling (sales inadequate to the needs of the customer) (Maśniak, 2020, pp. 104-105).

Depending on the role played in the insurance distribution process, care for the best interests of the customer will be manifested in a different way and should be evaluated through the prism of due diligence required of entrepreneurs, which all insurance distributors are (Maśniak, 2020, pp. 107-108). At the same time, it can be assumed that the introduction of the duty of care for the best interests of the customer equalizes the substantive advantage between the customer and the insurance distributor (Malinowska, 2017, p. 121).

To make it easier to determine which benefits in practice can be considered incentives, the legislature issued a delegated regulation supplementing the IDD with regard to information requirements and business rules applicable to the distribution of insurance investment products.

Article 8 of the delegated regulation indicates the criteria for evaluating incentives, as well as incentive schemes, i.e. the rules under which incentives are paid, such as bonus regulations for insurance agents. Two main criteria for evaluating incentives can be distinguished. First, it is verified whether the incentive may have a detrimental effect on the quality of the relevant service provided to the customer. Second, it is verified whether the said incentive may provide an incentive to act inconsistently with the obligation to act honestly, fairly and professionally in accordance with the best interests of the customer.

In addition to the main criteria mentioned above, there are also specific criteria listed in the delegated regulation. It is worth noting at this point that this is an open catalog, so individual insurance distributors can tighten the criteria for examining incentives or even abandon them altogether. These detailed criteria can be divided into positive criteria, which ensure the return of the incentive paid and refer to qualitative criteria, and negative criteria, which are examples of circumstances in which any form of remuneration or benefit can be considered to have a detrimental effect on the quality of the service provided to the customer (Tarasiuk, 2017, pp. 127-129).

Analyzing the aforementioned specific criteria, it can be concluded that, first of all, insurance distributors should avoid formulating sales targets based only on quantitative criteria, as there is a risk that insurance companies or insurance intermediaries will propose insurance products that are inadequate to meet customer needs in order to achieve an adequate sales volume. The doctrine points out that the mere formulation of sales targets, excess commissions

is not prohibited, but in order not to have a detrimental effect on the interests of the customer, remuneration arrangements for the achievement of certain "sales" targets can be balanced by mechanisms for reducing remuneration in the event of poor quality "sales" (Pokrzywniak, 2018). Another solution currently often used in practice is the combination of quantitative and qualitative criteria, which make the payment of remuneration conditional not only on the achievement of certain quantitative indicators, but also on the maintenance of a low number of customer complaints, a low rate of the percentage of customer cancellations from concluded contracts, due fulfillment of pre-contractual obligations to the customer, etc. (Pokrzywniak, 2018).

Secondly, the legislator introduces the obligation to inform the customer before entering into an insurance contract about the nature of the insurance intermediary's remuneration, including whether he or she receives an economic benefit of any kind offered or provided in connection with the insurance contract[2]. It is worth noting that expressis verbis the legislator did not use the phrase incentive, while referring to the definition of incentive, it can be assumed that incentive also falls within the scope of this provision. This provision is supplemented by the obligation to disclose conflicts of interest in the form of an insurance intermediary's ownership of more than 10% of the voting rights or capital in a given insurance company, as well as when an insurance company owns more than 10% of the voting rights or capital of an insurance intermediary[3].

In addition, in the case of distribution of an insurance investment product, the customer should be informed of all costs and related fees, including the cost of advice, if such an insurance intermediary provides advice (that is, de facto only in the case of an insurance broker), the cost of the insurance investment product itself recommended or sold to the customer, and any third-party payments (Szczepańska, 2015). The insurance distributor should also indicate to the customer precisely the information about the protection part of the remuneration and the investment part, and explain their different function and purpose, in particular, the information should clearly indicate the division of the premium into protection and investment parts (Szczepańska, 2015).

The aforementioned information obligations are intended to enable the customer to make an informed decision regarding the purchase of a particular insurance product. It is worth noting, however, that making an informed purchasing decision requires the customer to have sufficient financial knowledge to be able to draw the right conclusions from the information presented to them. The Eurobarometer survey on financial literacy (financial knowledge and financial behavior were assessed) among EU citizens in 2023 shows that only 18% of EU citizens show a high level of financial knowledge, 64% of EU citizens remain at a medium level, and 18% present a low level of financial knowledge (Flash Eurobarometer, 2025, p. 4).

[2] Article 19 (1) (d) in conjunction with Article 19(1)(e)(iii) IDD.
[3] Article 19 (1) and (2) IDD.

One may, therefore, doubt whether the information obligation is adequately effective to protect the interests of customers. It seems that the legislator himself has acquired doubts about its effectiveness, proposing additional solutions in the RIS to protect the customer from the negative impact of incentives.

Thirdly, the legislator introduces an obligation on the part of the insurance intermediary to study the needs of the customer before offering him insurance, and obliges him to offer the customer a product adequate to his needs[4]. At the same time, it is worth noting that in the case of insurance with an investment element, due to the fact that these products are most often long-term, with high premiums and high sums insured, as well as being a form of pension security, the examination of needs must be more thorough than in the case of other types of insurance.

The legislator explicitly orders the insurance distributor to obtain, prior to concluding an insurance contract, the necessary information regarding the customer's knowledge and experience in the field of investment relevant to the type of product or service, that person's financial situation, including that person's ability to bear losses, his or her investment objectives, and risk appetite, in order to propose an insurance product suitable for him or her, in particular, corresponding to his or her risk tolerance and ability to bear losses[5].

In the case of the Polish insurance market, in order to make it easier for the insurance intermediary to determine the appropriateness of insurance products for individual customers, the Financial Supervision Commission has issued a recommendation, for insurance companies regarding the product management system (KNF, 2016). According to the recommendation, at the stage of product design, the insurance company should determine the target group of customers to whom the product is to be directed, as well as identify the anti-group, i.e. the group of customers for whom the product will not meet expectations and realize interests (KNF, 10.2, 10.5). With such a division, some customers may not belong, either to the target group for a given insurance product or to the antigroup. Avoiding misselling regarding customers in such a group is the most difficult, and it can be assumed that it involves an individualized analysis of their needs, expectations and interests (Orlicki, 2016, p. 15).

At the same time, it should be noted that a correct analysis of product adequacy is possible when the customer provides complete and true data, and when the insurance intermediary correctly interprets the information obtained from the customer. The doctrine emphasizes that the customer's requirements are the revealed will of the distributor to have insurance coverage for a given subject of insurance and of a certain shape (Orlicki, 2019, p. 3). Resuming, the introduction of the requirement for the insurance distributor to verify the adequacy of the offered contract can be treated as a transfer to the professional entity of a certain element of the decision-making process occurring within the framework of contracting (selection of offers in order to eliminate proposals that are inappropriate in a given situation (Dlugosz, 2017, p. 133).

[4] Article 30 IDD.
[5] Article 30 (1) and (2) IDD.

3. Incentives in RIS

The European Commission considered two ideas for regulating incentives during its legislative work on the RIS (RIS, 2023, p. 10). The first was to ban incentives altogether which would eliminate conflicts of interest arising from the acceptance of incentives by insurance distributors. The second concept was to maintain the current system allowing the payment of incentives under certain conditions while improving and harmonizing incentive disclosure. The second concept was decided upon, but it was assumed that if these solutions did not prove sufficient to protect customers' interests, the Commission would consider extending the ban on incentives.

The first change regarding incentives that the RIS makes to the IDD is a prohibition on accepting or offering incentives for advice provided independently[6]. In order for advice to be considered independent, an advisor must evaluate a sufficiently large number of insurance products available in the market that are sufficiently diverse in terms of type and product providers before making a recommendation[7]. At the same time, such an advisor may not receive any type of remuneration from entities other than the client, such as brokerage houses or insurance companies. The advice of an independent advisor can be limited to well-diversified, non-complex and cost-effective insurance investment products, in order to reduce the time of performance and the price of the service without sacrificing quality for the client[8]. In the case of dependent advice, insurance distributors may accept incentives, provided that the advice is not presented as independent and that the client is informed of the nature and source of the incentives.

The second change is to prohibit the acceptance of incentives in cases where an insurance distributor has not provided individualized advice when offering an insurance product[9]. With that said, incentives in the form of small non-monetary benefits with a total value of less than EUR 100 per year are not covered by the ban. Thus, it can be considered that, for example, advertising gadgets, due to their low value, do not constitute a prohibited incentive.

The third change is the introduction of enumerated requirements that an insurance distributor providing advice should meet in order to consider that advice to a client is provided in accordance with the client's best interests[10]. First and foremost, the insurance distributor should analyze a sufficient number of investment products. In addition, the insurance distributor is required to recommend to the client the most cost-effective insurance investment products from those studied and, for comparison, offer at least one financial product without additional features that are not necessary to achieve the client's investment goals and that generate

[6] Article 2 point 21 RIS.
[7] Article 2 point 22 d RIS.
[8] Article 2(20) RIS.
[9] Article 2 pt. 21in conjunction with Article 2 pt. 22 RIS.
[10] Article 2 point 21 RIS.

additional costs. This provides the customer with alternative options and, according to his preferences, he can choose the optimal or cheapest product.

At this point, it is worth proposing that during the implementation of the RIS, the legislator consider introducing a statutory minimum number of investment products to ensure that the insurance distributor analyzes a sufficient number of them.

4. Implications of the changes proposed in the RIS for the Polish insurance market

When analyzing the solutions introduced in the RIS regarding incentives in the Polish insurance market, it is necessary to refer to the types of insurance distributors listed in the Act of December 15, 2017, on insurance distribution, which is the implementation of the IDD into the Polish legal system (Journal of Laws 2024, item 1214). An insurance distributor can be an insurance company, as well as insurance intermediaries - an insurance agent and an insurance broker. An insurance agent acts for or on behalf of one or more insurance companies (depending on whether it is an exclusive agent or a multiagent), while an insurance broker represents the customer in seeking insurance coverage and provides a customized recommendation of the best insurance contract.

In view of the prohibition in the RIS on collecting incentives for insurance distributors who do not offer advice, it should be recognized that the prohibition will apply to insurance agents and insurance companies. Only insurance brokers will be allowed to accept incentives if they do not offer independent investment advice. Since insurance with an investment component is currently distributed mainly by insurance agents, the Polish Chamber of Insurers pointed out that in its current form, the implementation of RIS could lead to changes in the market structure, reducing the involvement of agents and insurance companies in offering such products (Bigaj, Durska, Wrzesinski, 2023).

It can also be assumed that due to the ban on the acceptance of incentives by independent advisors, the number of such advisors will decrease, or the prices of such services will increase significantly. This could result in the so-called advisory gap, i.e. a reduction in the availability of investment advice for less affluent clients. There is also a likelihood of a reduction in product offerings to clients due to lower product profitability.

It is also conceivable that the aforementioned restrictions or ban on incentives will create a temptation to introduce new types of fees or increase existing fees, e.g., preparation fee, advisory service fee, portfolio status report fee, portfolio management fee, etc., to make up for the losses caused by the restriction or lack of incentives. This is likely to create the need for more detailed regulations, e.g. in the form of a recommendation from the FSC, to make it more difficult to circumvent the ban.

In this context, during the implementation of the RIS into Polish law, it would be worth considering the introduction of statutory caps on additional fees, which would limit the freedom of insurance distributors in this respect. A similar solution was recently introduced in relation to loans, where the law imposed a maximum on non-interest loan costs.

Presenting the customer with a standard product and the cheapest product may cause customers to be guided in their choices mainly by the criterion of price rather than quality. In addition to a drop in profits for insurance distributors and mutual fund companies, this may cause customers to become disillusioned with the low rate of return on their investments and, consequently, a drop in confidence in the financial market.

In this regard, it is worth advocating for the introduction of financial education programs related to insurance products with an investment component, tailored to different target groups, so that as many clients as possible are able to correctly and independently assess the consequences of their financial decisions.

5. Summary

The idea of the RIS package improving the position of the retail customer is very momentous and necessary in view of the decline in confidence in the financial market. The proposal to introduce a partial ban on incentives seems a good solution, because of the possibility of observing the effects and modifying the system of rewarding insurance distributors adequately to the results obtained. However, due to the possible effects described, it could pose quite a challenge for the financial market. Since the RIS has not yet been enacted in the form mentioned above, changes to its content cannot be ruled out. Once the RIS is enacted, it will then be equally important how the RIS will be implemented into Polish law, which may result in significant changes in the functioning of the Polish insurance market, especially with regard to individualized recommendations (here, in particular, the regulation of the status of an insurance multiagent in terms of the selection of the product offered will be a challenge).

Consequently, before engaging in discussion on the shape of the RIS implementation, it is necessary to reflect on the continued relevance of the multi-agent insurance distributor, which should serve as a starting point for further analysis.

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GREENHOUSE GAS EMISSIONS IN SEAPORTS EXEMPLIFIED BY THE PORT IN GDYNIA

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Purpose: Faced with climate change, reducing greenhouse gas emissions is one of the most difficult and urgent global challenges. Seaports are large GHG emitters, and they have been assessing their carbon footprint and adopting decarbonization strategies. However, calculating the carbon footprint of ports is a serious challenge due to the specificity of the service-based activities they conduct. This article addresses the topic of GHG emissions in seaports, using the example of the port in Gdynia (one of the four largest Polish ports), where the port authority started estimating the carbon footprint as part of preparations for ESG reporting. The aim of this article is to identify challenges related to assessing and reporting carbon footprint in a seaport.

Design/methodology/approach: The study used secondary and primary data sources. A review of the literature on the subject was conducted, as well as the analysis of the summaries of reports published by the Gdynia port management for the years 2003 and 2020-2023 (in which the identified sources of GHG emissions were described and the amount of emissions was estimated), and data from non-standardized interviews conducted in January 2025 with employees of Polish ports were used, which allowed us to establish that the Port of Gdynia Authority SA was the first of all Polish ports to attempt to estimate the amount of GHG emissions in the port and prepare a report on the size of its carbon footprint.

Findings: It was established that the specificity of port activities results in various problems and challenges, which concern, among others, collecting the required and reliable data, using analytical tools dedicated to ports, methods of estimating the carbon footprint, taking into account the incomplete scope of emissions and making numerous "exclusions" (which may lead to doubts as to the reliability of the report), proposals for directions of actions to reduce GHG emissions in the port.

Research limitations/implications: The credibility of reports and the effectiveness of seaport carbon footprint reduction strategies depend on the reliability and discipline of the GHG emission estimation process.

Practical implications: The study of GHG emissions and the preparation of a reduction strategy in seaports is one of the primary challenges port authorities and port service companies face in light of the need for decarbonization. This article indicates problems and challenges that the authors of carbon footprint reports and reduction strategies in seaports must confront.

Originality/value: In the Polish literature on this subject, there is a lack of studies on the specifics of GHG emissions in seaports, reporting of port carbon footprint and related problems. This article identifies challenges and provides some recommendations.

Keywords: seaport, greenhouse gases, GHG emissions, carbon footprint of seaports, carbon footprint reporting.
Category of the paper: Research paper.

1. Introduction

Contemporary seaports, as important members of logistics supply chains, host various economic activities mainly related to the handling of passengers, cargo and means of transport. They are (especially large universal ports) multi-entity economic organisms within the boundaries of which many service and industrial enterprises operate. Their activities are accompanied by various emissions from greenhouse gases, noise, water and soil contamination. This article addresses the issue of greenhouse gas emissions in ports and the need to monitor and reduce them. The first step in this direction seems to be the study and reporting of the carbon footprint (CF), which may be the basis for taking action to reduce it, but it may also be a serious problem due to the specificity of seaport operations. The aim of this article is to identify the challenges related to estimating and reporting the CF in a seaport. The described example of a port that attempted to study and report its GHG is the seaport in Gdynia, one of the four largest Polish ports (in 2024, it handled 26.9 million tons of cargo), which was the first to publish data on GHG emissions (ZMPG-a SA, 2003, 2020, 2021, 2022, 2023). The study used secondary and primary data sources. A review of the subject literature was conducted along with an analysis of the summaries of reports published by the Port of Gdynia Authority for the years 2003 and 2020-2023 (which described the identified sources of GHG emissions in the Port of Gdynia and estimated the amount of emissions), and data from non-standardized interviews conducted in January 2025 with employees of Polish ports was also used, which allowed us to establish that the Port of Gdynia Authority SA was the first of all Polish ports to attempt to estimate the amount of GHG emissions in the port and prepare a report on the size of its carbon footprint. In the Polish literature on this subject, there is a lack of studies on the specifics of GHG emissions in seaports, reporting of port carbon footprint and related problems. This article identifies challenges and provides some recommendations.

2. Seaport as a specific economic object

Contemporary ports are complex economic centers that service international trade (currently, around 80% of the world's global trade cargo, i.e. around 12.3 billion tons, is transported by sea) (UNCTAD, 2024). They are equipped with appropriate infrastructure and equipment for moving cargo between the operated means of transport (sea and land),

but seaports are also convenient places for locating various economic activities, especially transport, logistics, industrial and commercial (Szymanowska, Dąbrowski, Klimek, 2024; Klimek, 2010). In addition to the port authority, which, among other things, oversees the port area and the infrastructure (sometimes also superstructure) and establishes developmental strategies for the entire port, the port is home to companies from the operating sphere that conduct service activities (Grzelakowski, Matczak, 2012; Klimek, 2010). The port users are cargo managers, shipowners, ship agents, brokers, land carriers, logistics operators and passengers (Szymanowska, Dąbrowski, Klimek, 2024).

In order to provide port services, infrastructure facilities and equipment, as well as superstructure, i.e. handling, storage and auxiliary equipment and facilities, are necessary. Their use generates various emissions into the natural environment, especially those related to the combustion of fuels to power equipment or the use of electric and heat energy and technical gases. The specificity of the provision of port services results in additional emissions related to the dusting of some cargo, accidental spills into port waters, and combustion of fuels to power ship engines and land transport vehicles. Ports are, therefore, places of high economic activity that cause air pollution, especially greenhouse gases. The authorities of some ports are implementing plans to reduce gas emissions from various sources. The basis for taking these actions is the estimation of the CF.

3. Greenhouse gases and their emission reporting

Greenhouse Gas (GHG), both natural and anthropogenic, contributes to the greenhouse effect. Regulation of the European Parliament and the Council (EU) 2018/1999 (in Annex V) identifies seven key types of GHG (which must be reported): carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), nitrogen trifluoride (NF_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs). Since GHGs have different greenhouse effect potential, their impact is converted to CO_2 equivalent (CO_2e) to make comparisons meaningful. The amount of GHG emissions generated at a given time by a person, organization, event or product is the carbon footprint (a commonly accepted indicator) expressed in CO_2 equivalents (Puig et al., 2014).

In 2023, global GHG emissions amounted to about 53.0 billion tons of CO_2e. This was the highest level on record, and emissions continue to rise despite agreements between countries to mitigate climate change (EDGAR, 2024; IPCC, 2021). EU countries emitted a total of 3.22 billion tons of CO_2e (Crippa et al., 2024), with transport accounting for almost a quarter of total emissions (EEA Report, 2024). The share of maritime shipping in global emissions amounted to about 3% (IMO, 2023). The international community is undertaking various initiatives aimed at reducing emissions (Agenda 2030, 2015; IMO, 2023; Fit for 55, 2021), and shipowners are

looking for alternative fuels for ships, examining the possibilities of using hydrogen, methanol or ammonia (DNV, 2022; Szymanowska, Daczuk, Klimek, 2022). GHG are also emitted by seaports and their value chains. The largest emitters in Europe in 2023 were the ports of Rotterdam (20.3 million tons of CO_2e) (Port Rotterdam, 2023) and Antwerp (17.0 million tons of CO_2e) (T&E, 2023). Constructive action by shipowners and ports to reduce GHG emissions requires estimating their amount (in accordance with the CSRD many companies in the EU have been required to calculate and report GHG emissions since 1 January 2025, and this will include others in the following years) (CSRD, 2022). However, on 26 February 2025, the European Commission has adopted a new package of proposals to simplify EU rules (the so-called Omnibus I), boost competitiveness, and unlock additional investment capacity. The reporting obligation for most companies will be postponed by 2 years (OMNIBUS I, 2025). In the second project, the EC envisages limiting the number of entities subject to ESG reporting, limiting the information reported in the value chain and reducing the costs of attesting ESG reporting (OMNIBUS II, 2025).

Companies use the standards and guidelines provided by the GHG Protocol (GHG Protocol, 2025a; WRI) to reliably and transparently account for and report their GHG emissions. Those that can measure their carbon footprint can also manage their GHG emissions by modifying their activities and processes. Emissions have been categorized depending on their source into the following scopes: 1. (direct, from fuel combustion, process and fugitive), 2. (indirect, energy) and 3. (indirect, generated in the value chain of the reporting company, included in 15 categories), but only the most important data are taken into account (GHG Protocol, 2025c).

Scope 3. emissions are particularly important because they come from a wide variety of entities that are not controlled by the reporting entity. The process of collecting data from multiple sources is a significant challenge for most organizations, including seaports. It is tedious and time-consuming. The data needed to estimate CF is scattered because port value chains are very complex. Large universal ports are visited by thousands of ships, trucks and trains each year. Data is very difficult to obtain, especially in the case of ports that do not have extensive electronic data exchange platforms connecting participants in port-maritime trade (port community systems PCS). A port authority preparing a report on emissions for the entire port (sometimes consisting of hundreds of companies) must obtain data from its suppliers, operating companies, shipowners, land carriers, cargo operators and participants in their value chains, as well as passengers. The importance of GHG emissions in scope 3. cannot be overestimated (e.g. they accounted for 96% of the carbon footprint of the Port of New York) (PortXchange, 2025b), but most ports currently do not monitor them in full. The scope and quality of their reports vary significantly. Some measure only selected emission categories. This was pointed out by Cammin et al. (2022). Often, these data are not published and certainly do not reflect the actual amount of emissions; preparing a report on CF that is based on the analysis of only selected data distorts the image of actual emissions and results in formulating

an incomplete strategy for their reduction, even though CF is calculated to manage and reduce emissions.

Cammin et al. (2020) identified the main challenges related to estimating GHG emissions in ports, e.g. difficulties in collecting data, lack of resources and fear of disclosing sensitive data. Some ports publish only aggregated data that cannot be linked to emission source categories. This may be related to building their positive image in the eyes of an increasingly critical public opinion (Stein, Acciaro, 2020). Munin and Saha (2021) emphasize that correct emission reporting is important for raising the environmental awareness of port workers and their stakeholders. In this sense, Santos et al. (2016) underscore that the involvement of a given entity in informing about its activities for the benefit of sustainable development may cause an imitation effect.

It seems that the solution to the problem of collecting and analyzing data necessary to determine the CF may be the use of analytical capabilities of artificial intelligence (AI), as evidenced by the example of the solution used by the authorities of the largest port in Europe, which is also one of the largest in the world. In 2019 in Rotterdam, a start-up PortXchange Products BV was called upon to develop a digital platform for optimizing port processes, enabling efficient data exchange between participants of port-maritime trade and facilitating their analysis and real-time sharing. It is the EmissionsInsider electronic platform and its improved version, EmissionInsider Carbon Insight Suite, which enables ports to accurately, quickly and inexpensively report GHG emissions. It is an innovative analytical tool dedicated to ports, based on BigMile technology (BigMile, 2025), used to measure, track and analyze emissions, enabling not only reporting but also more effective decision-making (Szymanowska, Dąbrowski, Klimek, 2024; PortXchange, 2025a). The launch of EmissionInsider was a key step towards creating a unified global standard for reporting GHG emissions in ports, available to all interested parties (PortXchange, 2025a).

4. Greenhouse gas emissions in the Port of Gdynia

The Port of Gdynia is one of the four largest seaports in Poland and an important international transport hub (in the TEN-T core network) in the Baltic Sea region. It is a universal port, i.e. it can handle various types of bulk and general cargo. In addition to the Port of Gdynia Authority SA (ZMPG-a SA), the port services supply center, operating under the Port Gdynia brand, consists of 11 port terminals and numerous other companies participating in handling port-maritime trade (Dąbrowski, Klimek, Rolbiecki, 2023; Port Gdynia, 2025).

Information on GHG emissions in the port in 2003 and 2020-2023 was published by ZMPG-a SA in the form of five report summaries on the port's website. The GHG emissions were estimated as part of preparations for fulfilling the ESG reporting obligation (resulting from the CSRD), which will apply to the company in relation to the year 2025.

In order to determine the size of the port's emissions, it was necessary to obtain data on the emissions of all entities operating in the port as well as entities in their value chains. In practice, it turned out to be very difficult or even impossible (data was obtained from approx. 160 different entities). Estimating emissions from means of transport required adopting assumptions and simplifications (ZMPG-a SA, 2023), which significantly affected the calculation results. The most important problems were related to collecting data from stakeholders. The research excluded port areas located outside the city, shipyards, the naval port and roadsteads. Process and fugitive emissions (scope 1.) were also not included, as well as, critically, emissions from port activity waste, business trips of employees and their commuting to work (scope 3.), which, due to the specificity of port activities and the size of employment in port enterprises, affected the size of the port's CF.

The CF study included emissions from commercial ships calling at the Port of Gdynia, other vessels floating in the port waters, land transport, transshipment equipment, terminal vehicles and other vehicles, as well as energy for electricity and heat used by various entities operating in the Port of Gdynia. The emission results were presented in two cross-sections, i.e. taking into account emission sources and scopes defined by the GHG Protocol, but without taking into account emissions from some of the sources mentioned above, which was justified by the decision of the managing board of ZMPG-a SA (ZMPG-a SA, 2023). The structure of GHG emissions calculated in this way, taking into account the scopes and sources, is presented in Table 1.

Table 1.
Structure of GHG emissions of the Port of Gdynia in 2003 and 2020-2023 taking into account the scopes and sources of emissions

Specification/year	2003	2020	2021	2022	2023
Scope 1. emissions [tCO_2e]	10 601	16 194	17 367	19 224	26 125
Scope 2. emissions [tCO_2e]	12 417	32 272	36 485	33 348	23 568
Scope 3. emissions [tCO_2e]	33 781	57 796	65 278	75 766	80 393
Total GHG emissions [tCO_2e]	**56 799**	**106 262**	**119 129**	**128 338**	**130 086**
GHG emissions per tonne of cargo [$kgCO_2e$/t cargo]	5,83	4,31	4,46	4,59	4,42
Port internal emissions [tCO_2e]	10 601	16 194	17 367	19 224	26 125
Maritime transport emissions [tCO_2e]	34 989	56 242	63 511	74 606	83 630
Land transport emissions [tCO_2e]	3 034	4 431	4 781	5 384	5 231

Source: own study based on: ZMPG-a SA, 2023, pp. 14-25.

In the reviewed years, there was an increase in total emissions in the port. This fact was justified by the increase in the volume of cargo turnovers and the number or size of ships served.

Reports prepared for the years 2020-2023 included a list of proposed actions to reduce GHG emissions in the port. These comprised powering the port fleet with alternative fuels, offering the possibility of powering ships with on-shore electricity (thanks to the installation of onshore power supply-OPS), offering alternative fuel bunkering for ships, giving priority and/or offering discounts on port fees to ships emitting less GHG, offering the possibility of automatic mooring of ships, implementing port facilities and terminal vehicles powered by green electricity or hydrogen, using green energy sources to power port boiler rooms, generating own electric energy (from solar and/or wind energy), installing LED lighting, automating transshipment processes (ZMPG-a SA, 2023).

5. Summary

The specific nature of port operations results in various problems related to determining the amount of emissions. One of the fundamental challenges is to collect (from all port entities and their clients, not just the main port companies) the required and reliable data. The scale of the undertaking requires the use of analytical tools dedicated to ports and the involvement of appropriately trained employees. Following the example of the port in Rotterdam, a special digital platform could be used to enable the exchange of data between participants in port-maritime trade, its fast analysis and reporting.

Another problem is the selection of the appropriate method for estimating the CF. The freedom in this area to date (EU guidelines could be treated as recommendations) has led to the exclusion of some emissions or their incomplete inclusion. The lack of explanation of the reasons for numerous "exclusions" may lead to doubts as to the reliability of the report (the justification for them by the decision of the managing board of ZMPG-a SA is insufficient). The exclusion of some scope 3. emissions from the research also seems unjustified. Such an approach will make it impossible to compare the port's emissions with those of other ports, and a change in the emission estimation method next year (when it will be mandatory) will make it impossible to compare next year's results with previous ones. The Gdynia reports describe the procedure too vaguely (without providing the sources of the coefficients necessary to convert individual emissions to CO2e, which is crucial for the reliability of the calculations).

The proposed directions of actions to reduce GHG emissions in the Port of Gdynia (repeated in four reports) were formulated very generically (they fit every port), without any connection with the assessment of their application possibilities, customer interest and without taking into account the solutions already implemented in the port (Port of Gdynia, 2025; Tariff). It should be added that ZMPG-a SA has no influence over the GHG emission reduction strategies of port enterprises. However, it is essential that its own strategy is based on reliable research results, which are crucial for planning GHG reduction measures and determining their expected impact.

It is hard to disagree with the statement from Cammin et al. (2022) that a well-prepared GHG emission report is an important instrument for assessing the effectiveness of the emission reduction strategy (which ZMPG-a SA will have to adopt) and the statement contained in the port reports that "achieving GHG emission reduction targets and slowing down climate change requires the involvement of entities from every sector of the economy, especially those with high emissions", and such are seaports, which "can be of great significance in activities aimed at reducing GHG emissions" (ZMPG-a SA, 2023). However, for this to happen, it is necessary to estimate the actual port emissions without excluding sources from which obtaining data is difficult or inconvenient.

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THE CONCEPT OF ESG IN A SYSTEMATIC ANALYSIS OF LITERATURE, MAPPING AND KEYWORD CLUSTERS

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Purpose: The purpose of this paper is to identify and classify the scientific publication of ESG and to identify potential directions for the development of future research.
Design/methodology/approach: A systematic review of the relevant literature is the method used in this research. The Scopus database was used for the search. The author has identified keyword co-occurrence mapping analysis in 1,111 publications and analyzed thematic clusters in terms of the research areas of the publication. The analyzed publications were selected based on research query that included TITLE-ABS-KEY ("ESG").
Findings: This work is based on the bibliometric analysis and identifies nine research areas included in thematic clusters: 1 - ESG and responsibility investing, 2 - the correlation between sustainable enterprise development and enterprise value, 3 - climate and social aspects in the functioning of a company and its investors, 4 - factors influencing sustainable development goals and ESG rating, 5 - impact of csr activities on stock liquidity, investor preferences, and efficiency in technological innovation, 6 - perception of the ESG ratings by firms and the impact of ESG components on company results, 7 - the impact of climate change on corporate finance and investments, 8 - the circular economy and green innovation, 9 - the impact of ESG on financial performance. The author also identifies potential areas for future research, such as green innovation, esg controversies, fintech, sustainability performance, and financial performance.
Research limitations/implications: The study has some limitations that should be noted. These result from being limited to the Scopus database and the omission of gray literature. The researcher also had to omit some analyses due to the need to present the publication within a certain character limit.
Originality/value: This article presents a comprehensive identification and classification of scientific publications on the ESG concept and the number of publications over the years. Dominant authors, countries and research units are indicated. Identification of thematic clusters and the research gap can help researchers and practitioners in designing future research and implementation plans.
Keywords: ESG, environmental, social, governance, systematic literature review.
Category of the paper: Systematic literature review.

1. Introduction

ESG is a concept in connection with sustainable development that includes environmental, social, and governance aspects as key elements of responsible organizational management (Gemra et al., 2024, p. 24), taking into account the internal interests of an organization as well as its impact on the external environment. Very popular today is the approach in which a company should focus not only on its own well-being and economic results, but how the organization should also take care of the ensuing benefits for the environment, the local community, and other stakeholders. Caring for the external environment can improve the company image, the opinion of potential investors (Egorova, Grishunin, Karminsky, 2022, p. 339), and customer purchasing choices. As a result, it may have an impact on the financial condition of the organization. Legal regulations impose an obligation to report on sustainable development whose aspects prove the relevance and importance of the ESG.

Taking all this into account, a summary of the current state of knowledge in the area of ESG has been conducted using a systematic review of the literature. The aim of this article is to identify and classify the scientific publication of ESG and to identify potential directions for the development of future research. The conclusions obtained from the completed research process can be used as a basis for planning other future research about ESG.

2. Theoretical assumptions of the concept of ESG

ESG includes three elements: impact on the environment, on social issues, and on consequent governance (Kotsantonis, Pinney, Serafeim, 2016, p. 10; Li et al., 2021, p. 1) by incorporating these areas into investment strategy (Maquieira, Arias, Espinosa-Mendez, 2024, p. 1; Cicirko, 2022, p. 118). The ESG concept is in connection with sustainable development and visualizes the achievements of a company in this area (Korzeb et al., 2024, p. 1). ESG contains areas and risk groups which will be included in a non-financial report (Zielińska, 2023, p. 129). In the environmental areas risks are identified as well as opportunities related to the natural environment and climate. The second area – social – includes values and relationships with the company's stakeholders, activities aimed at improving employee well-being, actions promoting inclusivity, and fair policies within the organization. The final area, corporate governance, refers to the organizational structure and executive compensation, as well as the approach to lobbying (Zielińska, 2023, p. 129; Chytis, Eriotis, Mitroulia, 2024, p. 1). ESG illustrates the way in which companies and investors integrate these areas into their business models (Gillan, Koch, Laura, 2021, pp. 1-16).

ESG helps to establish strategic goals in line with the three above aspects (Cicirko, 2022, p. 121), which are the basis for management decisions (Syed, 2017, p. 1). ESG is the standard and strategy used by investors in assessing corporate behavior and predicting future financial results (Li et al., 2021, p. 1). It can be considered that the popularization of ESG as a tool used to assess the sustainable development of companies has been contributed to by climate change and the need to move towards a low-emission economy (Daugaard, Ding, 2022, p. 1), but the main factor is the imposition of ESG reporting obligations through international regulations such as UE taxonomy (Zielińska, 2023, p. 129).

3. Methodology

The aim of this article is to identify and classify the scientific publication of ESG and to identify potential directions for the development of future research. To achieve the research objective a systematic review of the relevant literature was employed. This systematic review shows the level of development of the selected topic in current literature (Rollnik-Sadowska, 2023, p. 6), based on identified and summarized scientific publications. It also allows for the identification of a research gap (Carrera-Rivera, Larrinaga, Lasa, 2022, p. 3).

This comprehensive identification, assessment, and synthesis of scientific publications on the given topic (Rahmaniara, Pramanab, 2024 p. 751), while maintaining its relevance and correctness, constitutes a reliable summary of the current state of knowledge in this area (Whittemore, Knafl, 2005, p. 546) based on reliable scientific evidence (Harris et al., 2013, p. 1) from an extensive database of publications. Precise description of the method employed in conducting the research, and the inclusion of an extensive database of searched publications, works to reduce any bias (Mazur, Orłowska, 2018, p. 235; Hensel, 2020, p. 9).

In this article, the research process was carried out according to a methodology consisting of seven stages (Szpilko et al., 2023, p. 55; Orłowska, Mazur, 2018, p. 237) presented in Figure 1.

The research process consisted of planning the systematic literature review and its purpose, as well as formulating these research questions:

Q 1: What thematic areas can currently be identified in research on the ESG?

Q 2: What are the directions for future research on the concept of ESG?

Then, the researcher chose publication database for analysis – Scopus, which has a large number of scientific publications. This has also been observed in research by other authors who have also conducted a systematic literature review (Baas et al., 2020, p. 377). The next step was to select the keywords: the three components of ESG. To narrow the search eligibility criteria were used and analyses were conducted on English language literature with open access,

including: articles, conference materials, books, book chapters, reviews, editorials. The results of the searches are presented in Figure 2. Further analysis was based on 1111 search results.

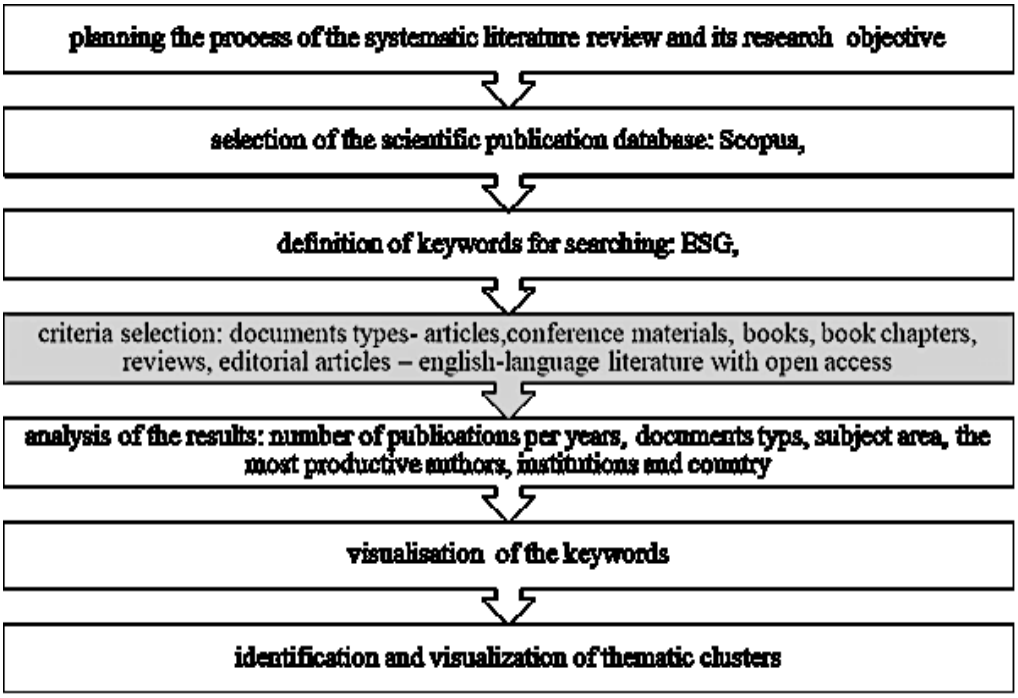


Figure 1. Methodology of systematic literature review.

Source: author's own study.

First search: Research query: All fields: ESG	
Number of articles before applying eligibility criteria: 46 762	Number of articles after applying eligibility criteria: 17 519
Second search: Research query: Article title, abstract, keywords: ESG	
Number of articles before applying eligibility criteria: 13 606	Number of articles after applying eligibility criteria: 5 112
Third search: Research query: Article title, abstract, keywords: "ESG"	
Number of articles before applying eligibility criteria: 2 640	Number of articles before applying eligibility criteria: 1 111

Figure 2. Search results.

Source: author's own study based on the Scopus database.

The author conducted an analysis of recurring keywords, which led to the creation of a map showing the co-occurrence of keywords related to the ESG. The researcher used VOSviewer software to create a keyword co-occurrence map.

4. Findings

Then the author analyzed the search results, including the number of publications over the years (Figure 3), type of publications (Figure 4) and by subject area (Figure 5) and identified the most productive authors, institutions, and countries (Figure 6). 1111 publications were included in analyzes.

The scientific publication on ESG was increase in 2021 and since then it has been constantly growing.

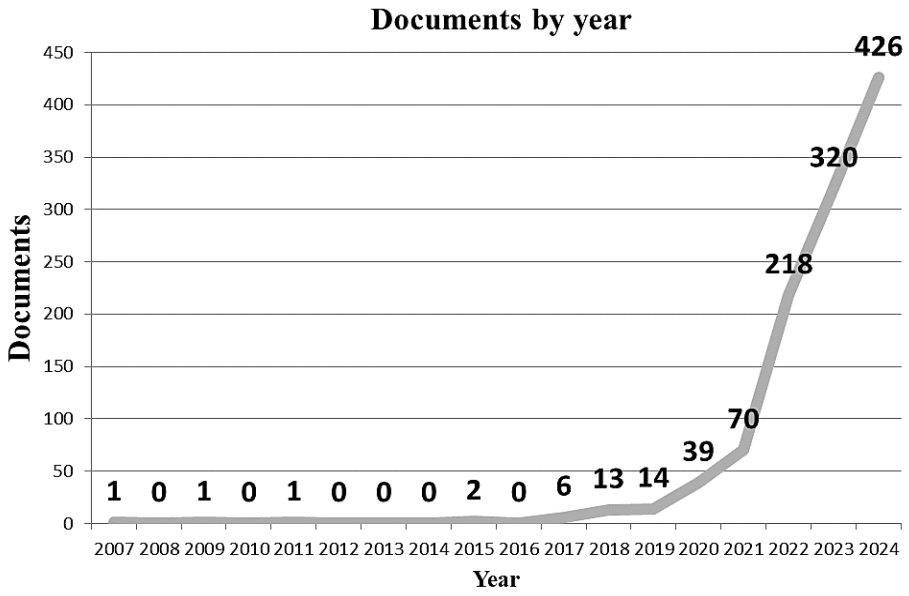


Figure 3. Number of publications containing the keywords "ESG".

Source: author's own study based on the Scopus database.

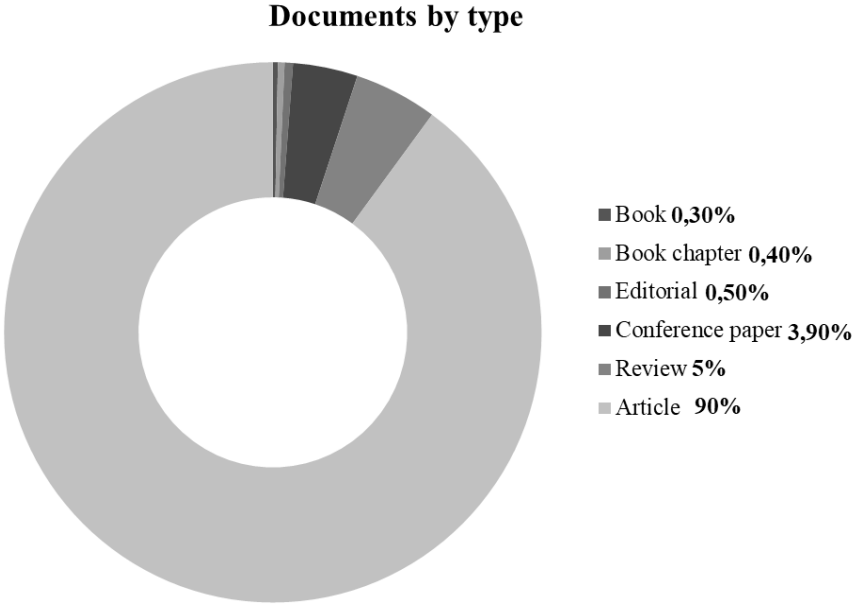


Figure 4. Type of publications containing the keywords.

Source: author's own study based on the Scopus database.

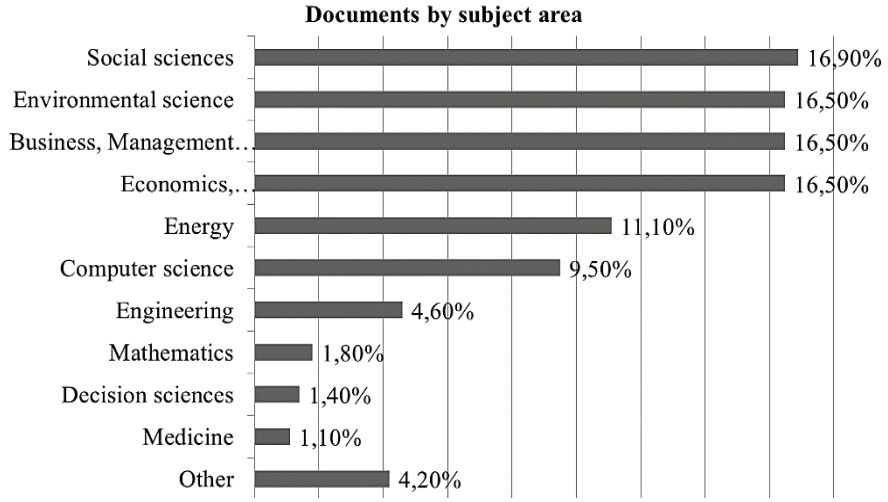


Figure 5. Documents of ESG by subject area.

Source: author's own study based on the Scopus database.

Documents by author	No. of publications	% of scientific publications
Garefalakis A.	5	0,45%
Lee J.H.	5	0,45%
Makarenko I.	5	0,45%
Passas I.	5	0,45%
Ragazou K.	5	0,45%
Rahi A.F.	5	0,45%
Treepongkaruna S.	5	0,45%
Barros V.	4	0,36%
Bax K.	4	0,36%
Cho J.H.	4	0,36%
Documents by country or territory	**No. of publications**	**% of scientific publications**
China	161	14,49%
United Kingdom	151	13,59%
United States	122	10,98%
Italy	100	9,00%
South Korea	87	7,83%
Germany	60	5,40%
Spain	60	5,40%
Australia	53	4,77%
Poland	50	4,50%
Malaysia	43	3,87%
Documents by institution	**No. of publications**	**% of scientific publications**
University of Oxford	16	1,44%
HSE University	14	1,26%
Sapienza Universita di Roma	13	1,17%
University College London	11	0,99%
Szkoła Głowna Handlowa w Warszawie	10	0,90%
Chulalongkorn University	10	0,90%
University of Cambridge	10	0,90%
Sungkyunkwan University	9	0,81%
Centre for Economic Policy Research, London	9	0,81%
Hogskolan & Gavle	9	0,81%

Figure 6. Most productive authors, countries and organizations.

Source: author's own study based on the Scopus database.

Articles are the dominant type of publication and account for 90%. Thematic areas containing the keyword ESG are mainly focused on: social sciences (16.9%), environmental science (16.5%), business, management and accounting (16.5%), economics, econometrics and finance (16.5%).

Authors with the highest number of ESG-related publications included in the Scopus database such as Garefalakis A., Lee J.H., Makarenko I. as well as others presented in Figure 6 are authors of 5 or 4 papers in this thematic area. The countries with a significant number of publications are China with 14,5 % of publications, United Kingdom with 13,6 % and United States almost 11%. Italy 9%, South Korea 7,8%, Germany 5,4%, Spain 5,4%, Australia 4,8%, Poland 4,5% and Malaysia 3,9% are territorial areas that also show a high level of interest in the field of ESG. The most productive institutions in terms of published works dedicated to environmental, social, and corporate governance issues are University of Oxford, HSE University, Sapienza Universita di Roma as well as the other institutions shown in Figure 6.

In the next stage of the research, the occurrence of keywords in publications from the Scopus database was visualized (Figure 7). The VOSviewer tool was used, and the keyword co-occurrence option was selected. The tool generated 2,865 keywords, after which a minimum occurrence of 7 was applied and reducing to 73 keywords. Subsequently, terms unrelated to the research topic (e.g. “literature review”, “systematic literature review”) were excluded, resulting in 61 keywords, which were organized into 9 clusters. The most frequently occurring keywords include ESG are ESG, sustainability, CSR, corporate social responsibility, corporate governance, governance, sustainable development.

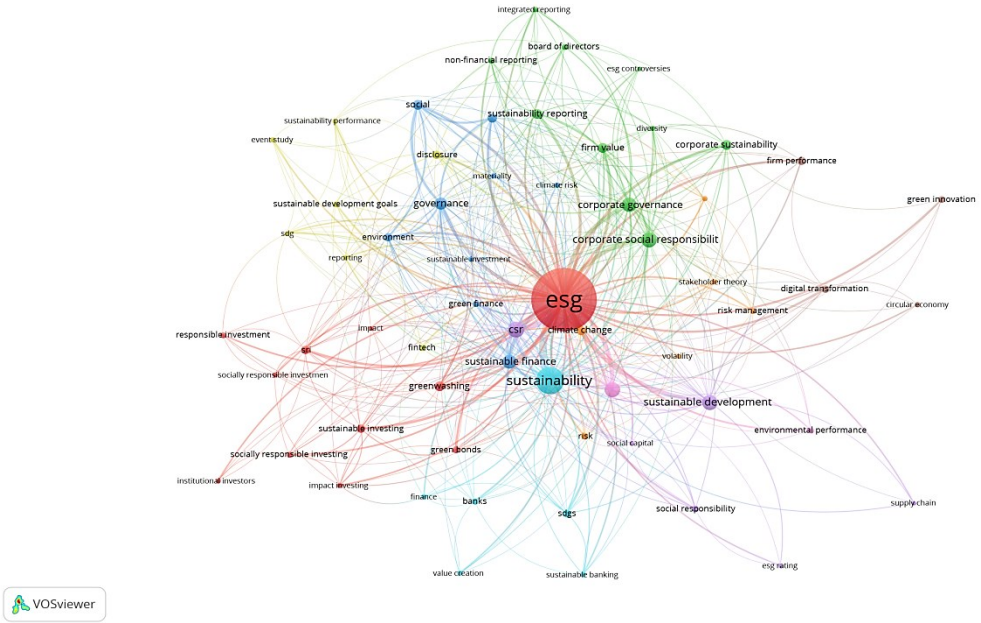


Figure 7. Keyword co-occurrence mapping for the topic “ESG”.

Source: author's own study based on Scopus, using the VOS-viewer program.

Based on the analysis made using the VOSviewer (Figure 7), 9 thematic clusters can be created, the first cluster consists of 11 items, the second 10 items, the third 9 items, the fourth 7, the fifth, sixth and seventh clusters contain 6 items each, the eighth 4 items and the ninth 2 items. The clusters were grouped according to the research areas of the publications included in the individual groups (Figure 8). Keyword mapping helps to characterize the ESG concept. Additionally, it allows to draw conclusions about the areas of interest of researchers. The publications included in Figure 8 are frequently cited publications and were therefore selected to draw conclusions about the research areas that are of particular interest to researchers.

Cluster 1 (red): ESG and responsibility investing
• Keywords: ESG, green bonds, greenwashing, impact, impact investing, institutional investors, responsible investment, socially responsible investing, socially responsible investment, sri, sustainable investing.
• Research areas: Identifying the relationship between ESG ratings and responsible investing. Investment portfolio choice based on ESG raitings. The influence of investment choices on the social and environmental impact of an organization. Impact of public environmental concern on corporate green investments.
• Selected publication regarding keywords: Pedersen L., Fitzgibbons S., Pomorski Ł.(2021), Pástor L., Stambaugh R.F., Taylor L.A. (2021) Yan G., Cheng H.K. (2021), Raghunandon A., Rajgopal S. (2022), Demers E. et al. (2021).
Cluster 2 (green) The correlation between sustainable enterprise development and enterprise value
• Keywords: Board of directors, corporate governance, corporate social responsibility, corporate sustainability, diversity, ESG controversies, firm value, integrated reporting, non-financial reporting, sustainability reporting.
• Research areas: Management and corporate social responsibility. Identification of the relationship between the sustainable development of business and their market valuation. Analysis of the impact of ESG scores on company value and profitability. Research on the relationship between sustainability disclosure (environmental, social and corporate governance) and company value. Analysis of the impact of harmonizing sustainability reporting standards in the context of investing based on ESG ratings. Determining how ESG contributes to creating shareholder value over the long term. Identifying whether ESG is becoming one of the key elements of how corporate functioning.
• Selected publication regarding keywords: Bohyun Y., Hwan L.J., Ryan B. (2018), Azeem Q.M. et al., (2020), Adams C.A., Abhayawansa S. (2022), Aydagmus M., Gulay G., Ergun K. (2022), Zumente I., Bistrova J. (2021), Hassan S.M. (2024).
Cluster 3 (blue) Climate and social aspects in the functioning of a company and its investors
• Keywords:
Climate risk, environment, environmental, governance, green finance, materiality, social, sustainable finance, sustainable investment.
• Research areas:
Exploring the effects of climate regulations on companies and investors, along with associated risks. The social aspect in the creation and use of ESG data and benchmark Identifying the relation between climate change and financial markets. Constructing investment portfolios resilient to climate risk.
• Selected publication regarding keywords:
Stroebel J., Wurgler J. (2021), Eccles R.G., Lee L.E., Stroehle J.C. (2020), Giglio S., Kelly B., Stroebel J. (2021), Pastor L., Stambaugh R.F., Taylor L.A. (2022), Jorgensen S., Mjos A., Pedersen L.J.T. (2022).
Cluster 4 (yellow) Factors influencing sustainable development goals and ESG rating
• Keywords:
Disclosure, event study, fintech, reporting, sdg, sustainability performance, sustainable development goals.
• Research areas:
The impact of conflicts of interest arising from commercial ties on ESG ratings Analysis of the impact of artificial intelligence and digital technology on ESG reporting and sustainability results. The impact of the organization's sustainable development activities on the implementation of ESG challenges included in the sustainable development goals.
• Selected publication regarding keywords:
Li X., Lou Y., Zhang L. (2024), Sætra H.S. (2021), Delgado-Ceballos J. et al. (2023), Camodeca R., Almici A. (2021), Wu S., Li Y. (2023).

Figure 8. Clusters of keywords.

Source: author's own study based on Scopus.

Cluster 5 (purple) The impact of csr activities on stock liquidity, investor preferences and efficiency in technological innovation
• Keywords: CSR, esg rating, social capital, social responsibility, supply chain, sustainable development.
• Research areas: Analysis of the impact of the functioning of company CSR committees on ESG ratings. Exploration of the individual stock market investors' preferences for ESG issues and influence of the investment purpose on decision-making process. Identification of the relationship between the amount of financial expenditures to CSR actions and firms' stock market liquidity. Exploring the impact of ESG considerations on supplier ratings. Identification dependencies between ESG results on efficiency in green technology innovation.
• Selected publication regarding keywords: Baraibar Diez E., Odriozola M.D. (2019), Sultana S., Zulkifli N., Zainal D. (2018), Roy P.P., Rao S., Zhu M. (2022), Rudnik K., Chwastyk A., Pisz I. (2024), Zhang C., Jin S. (2022).
Cluster 6 (azure) Perception of the ESG ratings by firms and impact of ESG components on company results
• Keywords: Banks, finance, sdgs, sustainability, sustainable banking, value creation.
• Research areas: Identifying how companies approach ESG ratings. Effect of ESG components on stock returns. Analyzing the impact of ESG disclosure on a firm's performance include growing stakeholder interest in ESG practices. Implication of environmental innovations to ESG ratings.
• Selected publication regarding keywords: Clementino E., Perkins R. (2021), Torre M.L. et al. (2020), Pulino S.C. et al. (2022),Varyash I. et al. (2020), Brandon R.G, et al. (2022).
Cluster 7 (orange) The impact of climate change on corporate finance and investments
• Keywords: Climate change, corporate financial performance, risk, risk management, stakeholder theory, volatility.
• Research areas: The impact of climate change on the stock prices of green firms and financial risk for investors. Identification of strategies for protecting investment portfolios of climate change. Identifying the impact of ESG factors on corporate financial performance, including profitability and financial risk. Verification of the impact of ESG reporting on reducing organisations' greenhouse gas emissions.
• Selected publication regarding keywords: Allahdadi M.R., Fretheim T., Vindedal K. (2024), Kim S., Li Z. (2021), Ardia D., et al. (2023), Peng L.S., Isa M. (2020), Luo L., Tang Q., (2023).
Cluster 8 (brown) Circular economy and green innovation
• Keywords: Circular economy, digital transformation, firm performance, green innovation.
• Research areas: Identifying the relationships between ownership structure and business model to corporate innovation and efficiency in the ESG ratings. Analyze the impact of sustainable strategic investment decision on the financial results in the circular economy. Integration of sustainable development goals and ESG' results in the circular economy. Analysis of the impact of ESG practices on corporate financial performance • Selected publication regarding keywords: Lin Y., Fu X.M., Fu X. (2021), Alkaraan F. et al. (2023), Fatimah Y.A. et al. (2023), Nguyen D.T., Hoang T.G., Tran H.G. (2022), Katsamakas E., Miliaresis K., Pavlov O. (2022).
Cluster 9 (multicolored) The impact of ESG on financial performance
• Keywords: Environmental performance, financial performance.
• Research areas: The effect of ESG on financial result of companies and company's market value. Impact of ESG disclosure on corporate performance through the lens of institutional theory and signaling theory.
• Selected publication regarding keywords: Umakanta G. et al. (2024), Friede G., Busch T., Bassen A. (2015), Zhou G., Liu L., Luo S. (2022), Taliento M., Favino C., Netti A. (2019), Abdi Y., Li X., Camara Turull X. (2022).

Cont. figure 8. Clusters of keywords.

Source: author's own study based on Scopus.

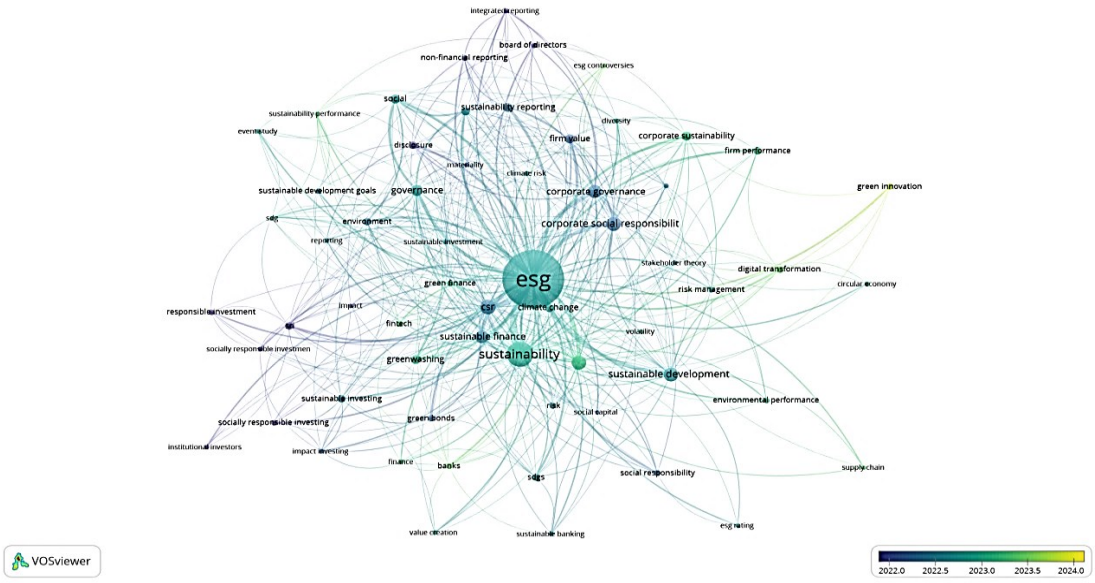


Figure 9. Mapping the co-occurrence of keywords for the topic "ESG" taking into account the year of publication.

Source: author's own study based on Scopus, using the VOS-viewer program.

To identify the latest and potential future research directions in the area of ESG, the author made a keyword co-occurrence mapping analysis, taking into account the year of publication (Figure 9). The keywords frequently occurring in recent publications include: green innovation, esg controversies, fintech, digital transformation, sustainability performance, financial performance, environmental performance, corporate sustainability, supply chain. It can therefore be concluded that there is a current interest among researchers in green innovations, the relationship between ESG and organizational financial performance, sustainable development and innovations, as well as the controversies surrounding ESG.

5. Results and limitations

The systematic literature review presented in the article highlights a multidimensional analysis of publications in the ESG domain and their evolution over the years. ESG can be considered an area of interest for researchers and business practitioners, with stricter legal regulations contributing to the relevance of the topic.

Based on the conducted analysis, the researcher has identified dominant countries, influential authors, and research institutions. It is evident that the first mentions of ESG in scientific publications appeared in 2007, but significant interest in this area only began to grow in 2021 and has been intensifying ever since. 90% of the publications are articles. ESG-related thematic areas are predominantly focused on the social sciences, environmental science, business, management and accounting, and economics, econometrics, and finance.

Nine thematic clusters were identified as a result of the analysis: 1 - ESG and responsibility investing, 2 - the correlation between sustainable enterprise development and enterprise value, 3 - climate and social aspects in the functioning of a company and its investors, 4 - factors influencing sustainable development goals and ESG rating, 5 - impact of CSR activities on stock liquidity, investor preferences, and efficiency in technological innovation, 6 - perception of the ESG ratings by firms and the impact of ESG components on company results, 7 - the impact of climate change on corporate finance and investments, 8 - the circular economy and green innovation, 9 - the impact of ESG on financial performance. Keywords in the latest publications indicate that future research directions in the ESG field should increasingly focus on green innovation, ESG controversies, fintech, sustainability performance, and financial performance.

The analysis reveals that publications related to ESG often examine, among other things, the impact of ESG implementation, ESG ratings on stakeholder perceptions, the market value of the company, and the level of organizational innovation. The rather fragmented research on the consequences of companies' failure to meet ESG criteria and their failure to comply with the obligation to report them may be considered a research gap. This may therefore constitute a direction for further research, taking into account the increasingly stringent legal regulations in this area.

The study has some limitations that should be noted. These result from being limited to the Scopus database and the omission of gray literature. The researcher also had to omit some analyses due to the need to present the publication within a certain character limit.

6. Conclusions

In reference to the formulated objective of the article and research problems, it can be stated that in recent years there has been an increase in interest in the ESG concept.

In response to the first research question, based on the nine thematic clusters identified by the author, it can be stated that the main research areas in scientific publications on ESG pertain to its impact on enterprises, stakeholder perceptions of companies, market value, financial performance, and organizational innovation.

Regarding the second research question, potential directions for future research include the relationship between ESG and green innovation, sustainability performance, the impact of ESG implementation on financial results, and ESG controversy. The topic of the consequences of companies' lack of ESG activities and failure to comply with their reporting obligations may also be considered a research gap.

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CONTEMPORARY CHALLENGES OF THE CIRCULAR ECONOMY

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Purpose: The purpose of this study was to identify the current challenges and conditions for circular economy (CE) development, overcoming which would enable the transformation of the linear economy into CE. The empirical part assesses the level of CE development in EU countries using a synthetic index.
Design/methodology/approach: The study used statistical data from EUROSTAT. A synthetic taxonomic index was proposed to assess the level of development of CE in EU countries using the taxonomic linear ordering method, taxonomic classification.
Findings: The study identifies economic, social, technological, and political challenges that condition the transformation of the modern economy towards CE. The results showed that Luxembourg had the highest level of the examined index, followed by Belgium, Italy, Austria, and the Netherlands. Relatively low levels of CE development were observed in Greece, Romania, Bulgaria, and Cyprus. This indicates a significant spatial disparity in the level of CE development across EU countries.
Research limitations/implications: The research identified challenges related to the availability of statistical data on CE at the EU country level in public statistics, which posed a limitation for this study. Future research directions could include the analysis and evaluation of spatial disparities in CE development within individual countries.
Practical implications: The study indicates desirable actions to support the adoption of the CE, providing recommendations for public policy initiatives.
Social implications: This research contributes to expanding knowledge about CE. It can serve as a source of information for businesses and society regarding the conditions for transforming the linear economy into a circular one.
Originality/value: The study found that financial support for circular enterprises, changes in the way products are produced and consumed, shaping demand for circular enterprises' products and services, efforts to develop an explicit legal framework for circular enterprises, and access to modern digital technologies are key to transforming the economy towards increasing circularity. The study also proposes a synthetic index for assessing the level of CE development in EU countries.
Keywords: circular economy, development conditions, European Union countries.
Category of the paper: Research paper.

1. Introduction

The concept of the circular economy (CE) is a response to environmental issues related to inefficient resource management within the traditional linear economy. The circular economy originates from ecological economics, environmental economics, and industrial ecology and represents an alternative model to neoclassical economics. The literature provides numerous definitions of CE. Research indicates that the circular economy is most commonly presented as a concept emphasizing reduction, reuse, and recycling, with its primary goal being economic well-being and improved environmental quality (Kirchherr et al., 2017). It is important to recognize that the circular economy should be understood as a fundamental systemic change. Its ultimate goal is to achieve economic growth without environmental pressure. CE requires the adoption of new production models in enterprises, increased responsibility and awareness among producers and consumers, the use of modern technologies and materials, as well as the implementation of appropriate policies and tools (Ghisellini et al., 2016).

The goal of the circular economy is to enhance efficiency and maximize resource utilization, which implies reducing environmental impact and, in the long term, achieving zero emissions and zero waste (by-products, damaged, or unnecessary materials should serve as raw materials in a new production cycle) (Liao, 2022). The circular economy aims to maintain resources in circulation for as long as possible, reducing raw material and energy consumption, emissions into the environment, and waste generation (Milhem et al., 2024). Consequently, the waste and recycling industry plays a crucial role in the circular economy (Karstensen et al., 2020).

Beyond environmental benefits, CE practices contribute to significant economic advantages, such as reducing demand for new raw materials (Koech, Munene, 2020). Implementing circular economy principles also generates other positive economic effects, such as financial and operational benefits for companies and increased firm value for their customers (Silva et al., 2024). These practices encourage job creation, stimulate market growth, and strengthen competitiveness (Milhem et al., 2024).

The purpose of this study was to identify the current challenges and conditions for circular economy development, overcoming which would enable the transformation of the linear economy into a circular economy. Additionally, the empirical part assesses the level of circular economy development in EU countries using a synthetic index.

2. Conditions for circular economy development

The transition to CE requires significant changes in technology, business models, and consumer behavior. Overcoming these challenges and transforming economic processes toward a circular economy necessitates increased awareness, engagement, and cooperation among various stakeholders through continuous learning, the implementation of appropriate monitoring systems, regulatory changes, and the adoption of Industry 4.0 technologies (Dennison et al., 2024).

The transition to a circular economy involves multiple challenges across different dimensions, including economic, social, technological, and political aspects.

Among the economic determinants of CE development, financial factors are of key importance. The lack of access to adequate financing and high initial investment costs in implementing circular economy practices constitute significant barriers (Badjeena et al., 2024; Rizos et al., 2016). These can be mitigated by reducing bureaucratic barriers to financing access. Furthermore, the economic benefits of implementing circular economy practices are often not immediately apparent, making it difficult for firms to justify transitioning from a linear to a circular model. This challenge is compounded by the need to use advanced infrastructure and technologies, which are often costly (Reuter et al., 2019). It is worth noting that the cost analysis system in the linear economy does not account for long-term social and environmental benefits, which are considered within the circular economy framework (including full life-cycle analysis, a product's contribution to sustainable development, and health benefits) (Singh et al., 2024). The transformation toward a circular economy requires changes in production methods—products should be designed to ensure greater durability, upgradability, and/or repairability, as well as reusability and circular consumption (Pavliashvili, Prasek, 2020). Consequently, transitioning to CE necessitates significant changes in business models. Circular economy business models include (Lacy et al., 2014):

- circular supplies – providing materials based on bio-products and/or renewable energy that can be fully recycled, enabling multiple uses of the same resources,
- resource recovery – using innovative technological solutions to recover useful resources or energy from disposed products,
- product life extension – maintaining products in economic usability for as long as possible through maintenance, repair, refurbishment, or remarketing,
- sharing platforms – increasing the efficiency of rarely used goods by enabling consumers and businesses to share and exchange them via online platforms,
- product as a service – offering access to a product instead of ownership, allowing customers to pay only for its effective use while ensuring durability and servicing.

An important group of CE development determinants consists of social and integrative factors. Some authors emphasize that social issues (e.g., social inclusion, well-being, and equality) are not sufficiently highlighted in the circular economy. Therefore, there is a need to address sustainable social development alongside environmental and economic goals, including integrating CE with human development approaches (Schröder et al., 2020) and ensuring inclusivity and fairness in CE practices (Clube, Tennant, 2022). A key challenge is increasing consumer awareness and promoting eco-friendly behaviours in society through educational and informational campaigns, showcasing best practices, engaging governmental and local authorities in encouraging circular behaviours, and implementing responsible procurement policies in the public sector. These measures will help increase demand for circular products and services, which is essential for the CE transition (Badjeena et al., 2024).

A crucial determinant of circular economy development is technological and technical factors related to the advancement of modern digital technologies. Transitioning to a more circular economy involves innovations across various domains (including technology, organization, society, financing methods, and policies) (COM (2014) 398) and the utilization of modern digital technologies (COM (2020) 67). Achieving sustainable development goals and transitioning toward minimal or zero net waste requires digitalization (Govindan, 2023). Waste management can be optimized through innovations, leading to higher resource recovery rates. This is possible by creating decentralized waste management systems closer to their source, in line with CE principles (Peters, Samarasinghe, 2021). The transformation from a linear to a circular model requires modern technologies for measuring sustainability impacts and ensuring responsible resource utilization (Hsieh, Wang, 2023). Digital technologies are a key determinant of circular economy development, providing tools for digitalizing numerous operations and processes. The significance of the relationship between CE and the smart economy is reflected in the emerging concept of the smart circular economy (Truant et al., 2024; Bressanelli et al., 2022). Research indicates that digital technologies, including ICT, are essential for enabling circular economy development and its transformation into a smart circular economy (Komor, 2024). The use of digital technologies will accelerate the circular transition and reduce reliance on primary raw materials, following the principle: waste + data = resources. Examples of digital technologies contributing to CE development and its transformation into a smart circular economy are presented in Figure 1. The role of digital technologies in transitioning from a circular economy to a smart circular economy is illustrated in Figure 2.

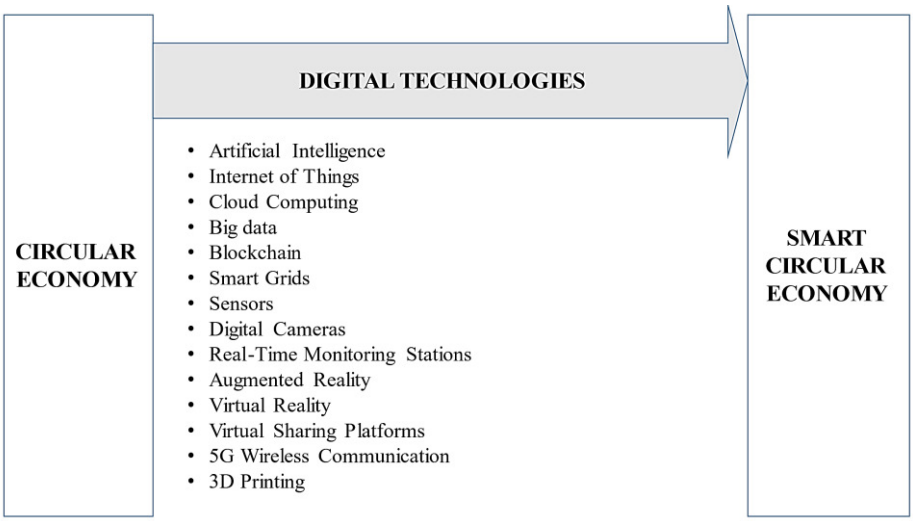


Figure 1. Selected digital technologies used in the transition from circular economy to smart circular economy.

Source: own study.

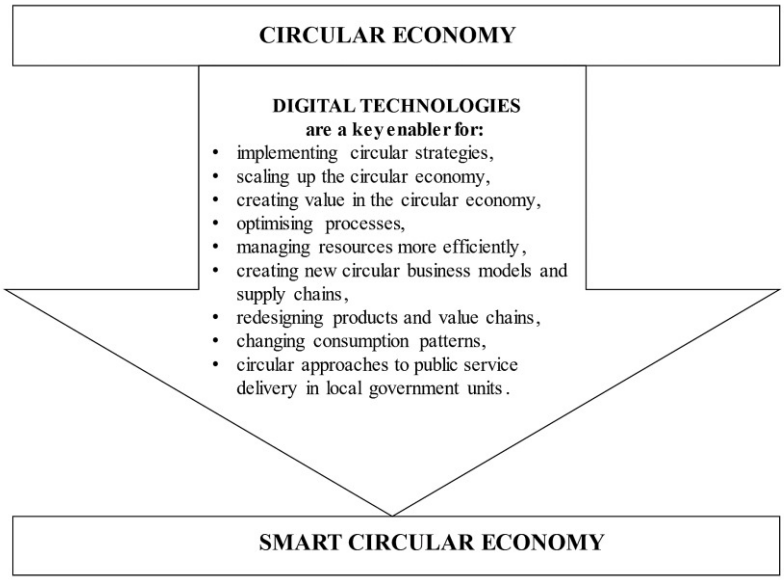


Figure 2. The role of digital technologies in the transition from a circular economy to a smart circular economy.

Source: Komor, 2024.

The next group of determinants for the transition to a circular economy are political and regulatory challenges. Political support and clear legal frameworks are crucial for CE implementation. European and national policies play an important role in encouraging eco-friendly consumer preferences, supporting businesses adopting circular business models (Rizos et al., 2016), and implementing responsible procurement policies in the public sector. Effective policy coordination across various levels - European Union, national, and local governments (Kaewunruen et al., 2024) - is essential to provide tailored support for circular entrepreneurs. Policies promoting circular entrepreneurship, economic incentives (e.g., tax relief and subsidies), and streamlined administrative procedures for financing can facilitate CE transition.

3. Materials and Methods

To conduct the study, statistical data from EUROSTAT were used. The research area covered 27 EU countries. The study period primarily included the years 2020-2023, utilizing the most recent available data for each indicator. The selection of indicators was guided by the research objective - assessing the level of circular economy development in EU countries - and data availability. A key limitation of this study was the lack of comprehensive statistical data on CE at the national level within the EU.

A synthetic taxonomic index of circular economy development (CE_INDEX) was constructed to evaluate CE development levels across EU countries. It comprised six diagnostic variables:

- X1 – circular material use rate (%),
- X2 – recycling rate of all waste excluding major mineral waste (%),
- X3 – share of private investments in CE-related sectors in GDP (%),
- X4 – share of gross value added from CE sectors in GDP (%),
- X5 – share of employment in CE sectors in total employment (%),
- X6 – number of patents related to recycling and secondary raw materials per million inhabitants (-).

The variables were assessed for formal criteria: measurability, completeness, and comparability. The correlation strength among diagnostic indicators was analysed, confirming that all variables were suitable for further research.

Table 1 presents the statistical characteristics of the diagnostic variables. Disparities among countries were identified, focusing on minimum and maximum values and the coefficient of variation. The relative measure of dispersion - the classical coefficient of variation (V_j) - was used to assess variability:

$$V_j = \frac{AV_j}{S_j} \tag{1}$$

where:

AV_j – arithmetic mean of indicator x_j.

S_j – standard deviation of indicator x_j.

Indicators with $|V_j| < 0.1$ were excluded. All indicators exhibited sufficient variability, with coefficient values ranging from approximately 0,32 (for the share of gross value added from CE sectors in GDP) to 1,54 (for the number of patents related to recycling and secondary raw materials per million inhabitants).

Table 1.
Descriptive statistics of diagnostic variables

Descriptive statistics	Diagnostic variables					
	X1	**X2**	**X3**	**X4**	**X5**	**X6**
Arithmetic mean	10,28	52,70	0,69	1,69	2,50	0,55
Standard deviation	6,97	18,38	0,32	0,53	1,37	0,85
Maximum	30,6 (Netherlands)	87 (Belgium)	1,4 (Belgium)	2,9 (Malta)	7,9 (Estonia)	3,97 (Luxembourg)
Minimum	1,3 (Romania)	10,0 (Estonia)	0,1 (Greece)	0,5 (Greece)	1,1 (Netherlands)	0,0 (Malta, Estonia, Croatia, Cyprus)
Coefficient of variation	0,68	0,35	0,46	0,32	0,55	1,54

Source: own elaboration based on EUROSTAT data. Retrieved from: https://ec.europa.eu/eurostat/data/database, 02.01.2025.

All features are stimulants, where low values are undesirable from the perspective of the analysed phenomenon. To achieve the research objective, the taxonomic linear ordering method was used, taxonomic classification (Hellwig, 1968). Diagnostic variables X1-X6 constituted the classification space, representing a set of characteristics defining the elements of the studied objects (i.e., EU countries). Based on these, a synthetic taxonomic indicator aggregating all diagnostic variables was constructed.

The first step involved normalizing the variables using the zero-unitarization method (Kijek, 2013; Kukuła, 2000):

For stimulants:

$$z_{ik}^t = \frac{x_{ik}^t - \min\limits_t \min\limits_i \{x_{ik}^t\}}{\max\limits_t \max\limits_i \{x_{ik}^t\} - \min\limits_t \min\limits_i \{x_{ik}^t\}} \tag{2}$$

For destimulants:

$$z_{ik}^t = \frac{\max\limits_t \max\limits_i \{x_{ik}^t\} - x_{ik}^t}{\max\limits_t \max\limits_i \{x_{ik}^t\} - \min\limits_t \min\limits_i \{x_{ik}^t\}} \tag{3}$$

where:

z_{ik}^t - normalized value of the k-th feature in the i-th object at time t (t = 1, 2, ..., T),

x_{ik}^t - original value of the k-th feature in the i-th object at time t.

It is worth noting that the indicator values range from <0;1>, with values closer to one indicating higher levels of the analyzed feature.

Next, a non-referential method with a fixed weighting system was selected for constructing synthetic metrics, influenced by the previously applied normalization method. Synthetic taxonomic indices were constructed as follows:

$$z_i^t = \frac{1}{k} \sum_{k=1}^{m} z_{ik}^t \tag{4}$$

Based on the synthetic index values, the analysed countries were classified into four groups based on their level of circular economy development. Group I included countries with the highest levels, while Group IV had the lowest. The class ranges were determined using left-closed intervals: Group I: Av + S(x), Group II: Av, Group III: Av-S(x), Group IV: 0 (where Av is the arithmetic mean, S(x) is the standard deviation).

4. Research Results

The highest synthetic index of circular economy development (CE_INDEX) was recorded in Luxembourg (Tab. 2). This was influenced by the highest number of patents related to recycling and secondary raw materials per million inhabitants in the EU, as well as relatively high values for the recycling rate of waste (excluding major mineral waste) and the share of private investments in CE sectors in GDP. Belgium ranked second, characterized by the highest recycling rate and the highest share of private investments in circular economy sectors in GDP. Italy ranked third in the CE development ranking, with relatively high indicators for the share of gross value added from CE sectors in GDP and waste recycling. The lowest synthetic index value was recorded in Greece, followed by Romania and Bulgaria. Greece had the lowest levels of private investments in CE-related sectors in GDP and the share of gross value added from CE sectors in GDP among the analysed countries. Romania had the lowest circular material use rate.

Table 2.
Circular economy development levels in EU countries

European Union countries	Diagnostic variables						Synthetic index of circular economy development (CE_INDEX)	Country ranking position
	X1	X2	X3	X4	X5	X6		
Luxembourg	0,304	0,792	0,692	0,250	0,456	1,000	0,582	1
Belgium	0,628	1,000	1,000	0,500	0,015	0,121	0,544	2
Italy	0,666	0,805	0,462	0,833	0,132	0,091	0,498	3
Austria	0,444	0,688	1,000	0,625	0,044	0,184	0,497	4
Netherlands	1,000	0,831	0,692	0,208	0,000	0,191	0,487	5
Malta	0,631	0,195	0,769	1,000	0,235	0,000	0,472	6
Estonia	0,573	0,000	0,462	0,583	1,000	0,000	0,436	7
Lithuania	0,089	0,805	0,538	0,542	0,456	0,136	0,428	8
Germany	0,430	0,584	0,615	0,708	0,088	0,139	0,427	9
Croatia	0,167	0,649	0,462	0,708	0,412	0,000	0,400	10
Denmark	0,266	0,688	0,615	0,542	0,029	0,123	0,377	11
France	0,556	0,481	0,538	0,458	0,103	0,101	0,373	12
Latvia	0,126	0,779	0,462	0,417	0,368	0,065	0,369	13
Poland	0,212	0,545	0,462	0,542	0,176	0,116	0,342	14
Ireland	0,034	0,403	0,385	1,000	0,029	0,194	0,341	15
Czechia	0,392	0,636	0,231	0,375	0,221	0,169	0,337	16
Slovenia	0,256	0,909	0,077	0,417	0,235	0,121	0,336	17
Slovakia	0,317	0,649	0,308	0,292	0,235	0,169	0,328	18

Cont. table 2.

Hungary	0,157	0,571	0,462	0,500	0,176	0,078	0,324	19
Spain	0,246	0,494	0,308	0,583	0,132	0,113	0,313	20
Finland	0,038	0,390	0,154	0,375	0,059	0,683	0,283	21
Portugal	0,051	0,377	0,538	0,417	0,176	0,134	0,282	22
Sweden	0,294	0,519	0,231	0,375	0,059	0,116	0,266	23
Cyprus	0,140	0,442	0,077	0,458	0,250	0,000	0,228	24
Bulgaria	0,123	0,169	0,385	0,417	0,235	0,018	0,224	25
Romania	0,000	0,351	0,308	0,208	0,176	0,065	0,185	26
Greece	0,133	0,221	0,000	0,000	0,059	0,013	0,071	27

Source: own elaboration based on EUROSTAT data. Retrieved from: https://ec.europa.eu/eurostat/data/database, 02.01.2025.

In the next step, the countries under study were classified into one of four groups based on their level of circular economy development, with Group I consisting of countries with the highest level of the synthetic index of circular economy development (CE_INDEX), and Group IV consisting of countries with the lowest level. A total of five countries were classified into the first group, which had the highest level of circular economy development: Luxembourg, Belgium, Italy, Austria, and the Netherlands (Tab. 3). The second group included: Malta, Estonia, Germany, Lithuania, Croatia, Denmark, France, and Latvia. The third group comprised: Poland, Ireland, Czechia, Slovenia, Slovakia, Hungary, Spain, Finland, Portugal, and Sweden. The lowest values of the studied indicator were recorded in Cyprus, Bulgaria, Romania, and Greece. Therefore, it can be concluded that these countries exhibited a relatively low level of circular economy development.

Table 3.
Classification of EU countries based on the value of the synthetic index of circular economy development (CE_INDEX)

Group	Number of countries in the group	Level of measurement	Countries
I	5	equal to and greater than 0.474	Luxembourg, Belgium, Italy, Austria, Netherlands
II	8	from 0.361 to 0.473	Malta, Estonia, Lithuania, Germany, Croatia, Denmark, France, Latvia
III	10	from 0,248 to 0,360	Poland, Ireland, Czechia, Slovenia, Slovakia, Hungary, Spain, Finland, Portugal, Sweden
IV	4	less than 0.248	Cyprus, Bulgaria, Romania, Greece

Source: own elaboration based on EUROSTAT data. Retrieved from: https://ec.europa.eu/eurostat/data/database, 02.01.2025.

5. Discussion

Circular economy offers a solution to overcome the current production and consumption model based on continuous resource use growth. Circular economy systems allow for the longest possible retention of the value of products, materials, and resources in the economy, enabling the repeated use of products to preserve their added value and eliminate waste,

contributing to the achievement of the Sustainable Development Goals (Roleders et al., 2022). Some authors argue that circular economy is one of the elements of the concept of sustainable development (Grzymala, 2023). Others emphasize that the terms circular economy and sustainable development are not identical, but there are various relationships between them (Geissdoerfer et al., 2017). According to other authors, CE goes beyond sustainable development by preventing resource extraction, production, and disposal, making products durable, reusable, repairable, and renewable, as well as utilizing recyclable materials (Raja Kamal, Singha, 2023). In another approach, circular economy is seen as a management model in the paradigm of sustainable development (Skawińska, Zalewski, 2018).

Given the importance of circular economy in the context of sustainable development, many authors have undertaken the study of CE, including the challenges for its development. Literature identifies studies on drivers and barriers to the adoption of circular economy based on a systematic literature review (Pasqualotto et al., 2023). The study identified ten categories of driving factors and barriers: environmental, supply chain, economic, informational, legal, market, organizational, public, social, and technological. These categories largely align with those identified in this study, with some of them being part of broader categories mentioned here (e.g., legal and public conditions are part of political conditions, while supply chain and organizational factors are part of economic conditions). The environmental aspect - mentioned in the aforementioned study as related to sustainable development, resource shortage, waste management, and recycling - is difficult to classify as drivers or barriers to implementing CE. It seems to be more of a characteristic of CE and the reasons and goals for its implementation.

A study on the conditions for the transition to circular economy in the pharmaceutical industry identified obstacles to CE implementation, such as technology, finance, return on investment, regulations, stakeholder management, and corporate strategy (Kharat et al., 2025). In this industry, challenges related to reverse logistics were particularly significant due to the toxicity of the products. In another study, interviews with managers of small and medium-sized Swiss enterprises identified four external barriers to implementing CE: technology, market, legislation, and society and consumers (Takacs et al., 2022), which correspond to the conditions identified in this study. Similar results were obtained by Grafström (2025), who identified four main barriers to the implementation of circular economy: economic, technological, social, and institutional/regulatory.

In the context of transforming economies toward a circular economy, monitoring and measuring the achievement of its goals is of great importance. The literature does not agree on a single, universally accepted set of indicators for conducting this measurement. A review of various approaches to monitoring and assessing the level of CE development was presented by Mazur-Wierzbicka (2021). Some authors suggest that the transition to CE is slower in Central and Eastern European countries and Southern Europe than in Western European countries (D'Adamo et al., 2024; Mazur-Wierzbicka, 2021).

This article proposes a synthetic index to assess the level of circular economy development in EU countries. The obtained research results are difficult to directly compare with the findings of other authors due to the diversity of methodological approaches. One study showed that the choice of research method - even with the same set of indicators to assess CE development - significantly influences the diversity of results (D'Adamo et al., 2024). The study analysed two scenarios using the same set of variables. In the baseline scenario, each indicator was assigned a weight, while in the alternative scenario, all indicators were given equal importance. In both scenarios, Belgium was the leader (the country ranked second in this study in the ranking of EU countries in terms of CE development level). In the baseline scenario, Italy, France, and Latvia followed, while in the alternative scenario, the Netherlands ranked second, ahead of Italy. It is worth noting that only two of the 27 countries held the same position in both scenarios, and at the bottom of the ranking in the baseline scenario were Cyprus, Malta, and Luxembourg. In another study, the five best countries in terms of CE efficiency were: the Netherlands, Luxembourg, Belgium, France, and Germany (Candan et al., 2022). Another study divided EU countries into three groups based on CE development level. The highest level was represented by Germany, the Netherlands, France, and Italy, while Belgium, Denmark, Poland, Spain, Luxembourg, and Austria were at the medium level (Gedvilaitė et al., 2024).

6. Conclusions

This study identified, based on literature reviews, the current challenges and conditions for the development of circular economy, whose overcoming will enable the transformation of the linear economy into a circular economy. These challenges are of an economic, social, technological, and political nature. Among the economic conditions, important roles are played by access to financing sources, high initial investment costs, the cost of acquiring and implementing modern technologies, as well as the need for changes in business models. The transition to CE requires a radical change in the way products are produced and consumed, focusing on durability, modernization potential, repairability, and reuse. Social conditions are significant, including promoting pro-environmental behaviors in society and shaping consumer awareness regarding circular products, which will contribute to increased demand for such products. Among technological conditions, digital technologies are a key factor enabling the development of the circular economy, providing tools for the digitalization of many operations and processes. This study identified the main digital technologies used in the transition from circular economy to smart circular economy and discussed their role in this process. Among political conditions, collaboration between European, national, regional, and local policies aimed at promoting consumer eco-preferences and supporting circular entrepreneurs is crucial. Effective implementation of CE principles often requires political support, appropriate and

clear regulatory frameworks, and economic incentives for companies adopting business models characteristic of the circular economy (e.g., tax breaks, subsidies, or streamlining administrative procedures for financing). It is important to emphasize that these conditions are universal; however, certain specific features may exist regarding particular sectors or countries.

In the empirical part of the study, a synthetic index for assessing the level of circular economy development in EU countries was proposed. It was shown that Luxembourg had the highest level of the studied indicator, followed by Belgium, Italy, Austria, and the Netherlands. A relatively low level of circular economy development was observed in Greece, as well as in Romania, Bulgaria, and Cyprus. This indicates significant spatial differentiation in the level of circular economy development in EU countries. The transformation of the EU economy towards greater circularity will only be possible after overcoming the challenges and conditions identified in this study.

In light of the research results, several key actions can be identified to further develop the circular economy:

- Support for circular enterprises, including easing bureaucratic barriers to access to financing, financial incentives for circular businesses, projects and programs supporting digitization processes in enterprises, developing clear legal frameworks for circular businesses, and providing expert support for circular processes.
- Stimulating demand for products and services from circular enterprises, including building consumer trust in businesses adopting circular practices, raising consumer awareness through education and training, promoting pro-environmental behaviours, and promoting green public procurement.
- Expanding ICT infrastructure to enable widespread use of digital technologies in business activities and public services related to circular economy. Investments in broadband internet, sharing platforms, and data management systems are crucial for supporting innovative solutions in CE.
- Strengthening communication and coordination between ICT entrepreneurship and other key sectors for implementing circular processes (e.g., waste management and resource recovery). This will enhance the effectiveness of circular economy initiatives and accelerate their implementation.
- Supporting local initiatives through financing and advisory services to help develop innovative circular projects, such as circular supplies.
- Encouraging cross-sector collaboration by creating platforms for knowledge and experience exchange between local governments, NGOs, the business sector, and local communities. This approach enables sharing best practices and implementing proven circular economy solutions.

During the research, problems with the availability of statistical data in public statistics on circular economy at the country level in the EU were identified, which was a limitation in this study. Future research directions may include the analysis and assessment of the spatial differentiation of circular economy development levels within individual countries.

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FACTORS AFFECTING JOB SATISFACTION AMONG YOUNG POLES

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Purpose: Observation and analysis of the behavior of young people in the modern labor market reveals that their expectations may differ from the expectations of previous generations. The aim of this article is to identify the factors influencing job satisfaction among young Poles in the context of employment. The article refers to current problems on the labor market related to the issue of matching the expectations of potential employees to the employment conditions offered by employers.
Design/methodology/approach: The study was conducted using the CAVI survey method on a representative sample of 1067 Polish men and women in the fourth quarter of 2024. Two age groups were distinguished: individuals aged 18-24 and 25-39. The study employed random, proportional sampling, and only employed individuals were surveyed. The analysis was deepened by calculating the Cramer's V correlation coefficient between declared expectations and membership in a specific age group.
Findings: The results show no significant differences in employment expectations between Generation Y and Z and older generations. Across all age groups, key factors valued in employment include job stability, a low-stress working environment, and adequate compensation.
Research limitations/implications: Conducting in-depth individual and group interviews with members of Generations Y and Z could provide more detailed insights into their work-related motivations and attitudes in the workplace.
Practical implications: The findings can support organizations in developing effective recruitment strategies targeting young people.
Originality/value: This article explores the employment-related expectations of Poles across different age groups, with a particular focus on Generations Y and Z. The study's findings may serve as a valuable resource for organizations looking to tailor their recruitment processes and workplace structures to better align with the evolving career aspirations of younger employees.
Keywords: labor market, Generation Y, Generation Z, work-life balance, career expectations.
Category of the paper: research paper.

1. Introduction

Currently, young people belonging to the so-called Generation Z are entering the labor market. Their expectations regarding employment differ significantly from those expressed by previous generations (Muster, 2020). Another important aspect of this issue is the growing influence that these young individuals are likely to exert on the functioning of organizations. This is largely due to a declining fear of unemployment and an increasing tendency to seek employment that aligns with one's own expectations and values. Moreover, young people are more willing to change jobs if their current position does not meet their satisfaction.

Based on a review of the existing literature, several factors influencing job satisfaction among young Poles have been identified. The pursuit of a balance between professional and private life - commonly referred to as work-life balance - no longer appears unusual. In today's fast-paced world, more and more individuals seek joy and rest beyond their professional roles. Successive generations are increasingly aware of the negative consequences of excessive dedication to work at the expense of personal well-being.

It would be inaccurate to claim that young people lack professional aspirations. On the contrary, in many respects they approach employment with a heightened sense of awareness. However, the rise in the number of fixed-term or civil law contracts suggests that many employees, especially younger ones, lack employment security. As a result, precarious employment is becoming more widespread, leading to a sense of uncertainty and instability in the labor market. This, in turn, affects young people's ability to achieve independence or make long-term life decisions, such as starting a family. granted, the birth rate is declined each year, which - alongside increasing life expectancy - contributes to a range of demographic, social, and economic challenges.

The aim of this article is to identify the factors that influence job satisfaction among young people in Poland. The study was conducted using the CAVI (Computer-Assisted Web Interviewing) method on a representative sample of 1067 employed Polish men and women during the fourth quarter of 2024. Two age groups were analyzed: individuals aged 18-24 and those aged 25-39. A random, proportional sampling method was used. The study focused exclusively on employed individuals, and the analysis examined correlations between reported employment expectations and the respondents’ age group.

2. Young people on the job market

When defining who young people are, it is essential to first consider the concept of "generation," which is understood in various ways in the literature. Significant differences arise from the characteristics that most strongly shape each generation's identity. These definitions can be categorized into three main groups. The first is demographic, where age is the defining feature. The second is demographic-historical, which, in addition to age, emphasizes a specific period - shared life experiences that shape individuals during a given time frame. The third group consists of historical-psychological definitions, which disregard age and focus on the events that shape a generation's worldview and influence its attitudes (Mirosław, 2014). The idea of generations was explored by Mannheim (Mannheim, 1992), who defined a generation as a group of individuals whose common life experiences have a profound and lasting impact on their lives. It is evident that each generation perceives issues such as values, family, education, work, and responses to change differently. These differences stem from evolving political, economic, and social contexts, as well as unique personal experiences (Aronowska, 2014).

In this analysis, two age groups were distinguished: individuals aged 18-24 and those aged 25-39. Within these groups, we identify Generation Y and Generation Z. Generation Y, also known as Millennials, consists of people born between 1980 and 1995 (Bencsik et al., 2016). Members of this generation are often characterized by contrasting traits. They seek autonomy but also have a strong need for belonging. While group affiliation is important, they challenge many established norms. Generation Y has significantly influenced the labor market, particularly in terms of organizational culture, values, and management practices (Baran, Kłos, 2014). Millennials are adept at adapting to change, which has become a constant element in modern life. While unpredictability and uncertainty create challenges for many, Generation Y adapts better than previous generations, who prioritized stability (Myers, Sadaghiani, 2010). Generation Y employees often value a positive work atmosphere, which fosters strong relationships among colleagues and motivates them to perform well, not to disappoint their peers. They are also more aware of ethical and unethical corporate practices and are typically reluctant to work for companies with poor reputations (Piątek, Kobylińska, 2018). The use of new technologies is not a major challenge for them, as they are the first generation to show signs of digital addiction, often spending excessive time on mobile devices and social media. This constant connectivity shapes their behavior. Generation Z, those born after 1996, who are now entering the labor market, share similar traits. They also seamlessly navigate digital environments and, in terms of employment, value independence, variety, nd the ability to creatively complete tasks. Remote work and flexible hours are also crucial to them (Czyczerska et al., 2020). Given the growing awareness of burnout, Generation Z is particularly mindful of the risks associated with the persistent lack of work-life balance

(Konkel, 2023). Young people entering the labor market today are more likely to change employers and explore various positions, which has led to shorter contracts and frequent job changes (Świerkosz-Hołysz, 2016). Many start their academic careers believing that a higher education will give them a competitive edge in the job market. While a university degree does not always guarantee success, it remains a valuable asset in a potential employee's CV (Sobotka, 2023). Moreover, an increasing number of young people who continue their education also seek employment. Gaining work experience as early as possible is essential for them, as it enhances their competitiveness in the labor market. The trend of students working while studying affects various aspects of their lives. Remote work and flexible hours allow students to work even while pursuing a full-time education. However, this raises concerns about the impact on the quality of education, as lack of concentration or absence from classes can hinder learning. Furthermore, this lifestyle may contribute to burnout, a growing issue for many individuals today. Nonetheless, one positive aspect of this trend is that it enables young people to quickly determine whether their chosen career path aligns with their expectations. Research shows that students who work while studying tend to have more realistic expectations of the labor market (Wronowska, 2015). While a university diploma is no longer a guarantee of employment, individuals with higher education tend to fare better in the labor market. Currently, people with higher education in Poland constitute the largest part of the professionally active population (Figure 1).

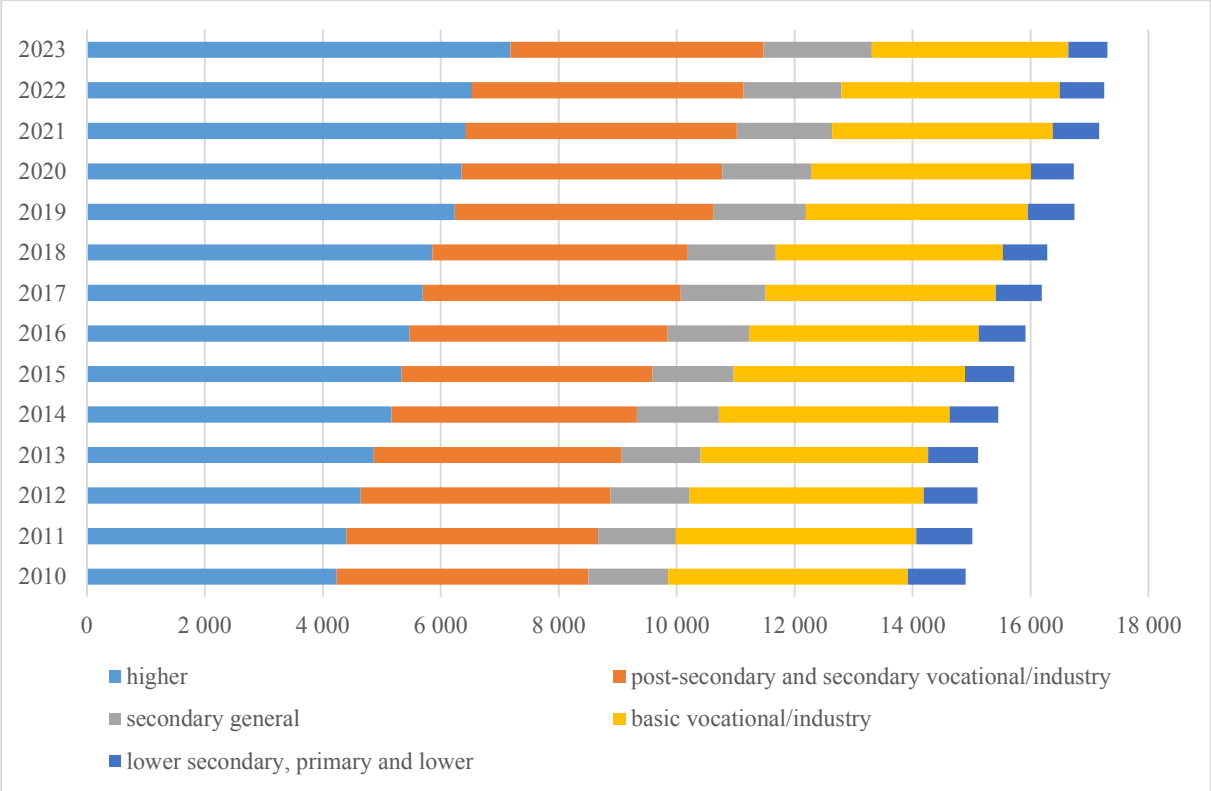


Figure 1. Professionally active persons by education level in 2010-2023 in Poland [in thousands].
Source: own study based on Central Statistical Office data.

Currently, a decline in the total number of unemployed individuals within the labor market in Poland is observed (Figure 2). Analyzing the structure of the unemployed by education level, it is evident that, both in 2010 and 2023, the largest proportion was represented by individuals with basic vocational or industrial education (33% in 2010 and 29% in 2023). The share of individuals with higher education among the unemployed increased from 13% in 2010 to 19% in 2023. Meanwhile, individuals with post-secondary and secondary vocational or industrial education accounted for 26% of the professionally active unemployed in both years under analysis.

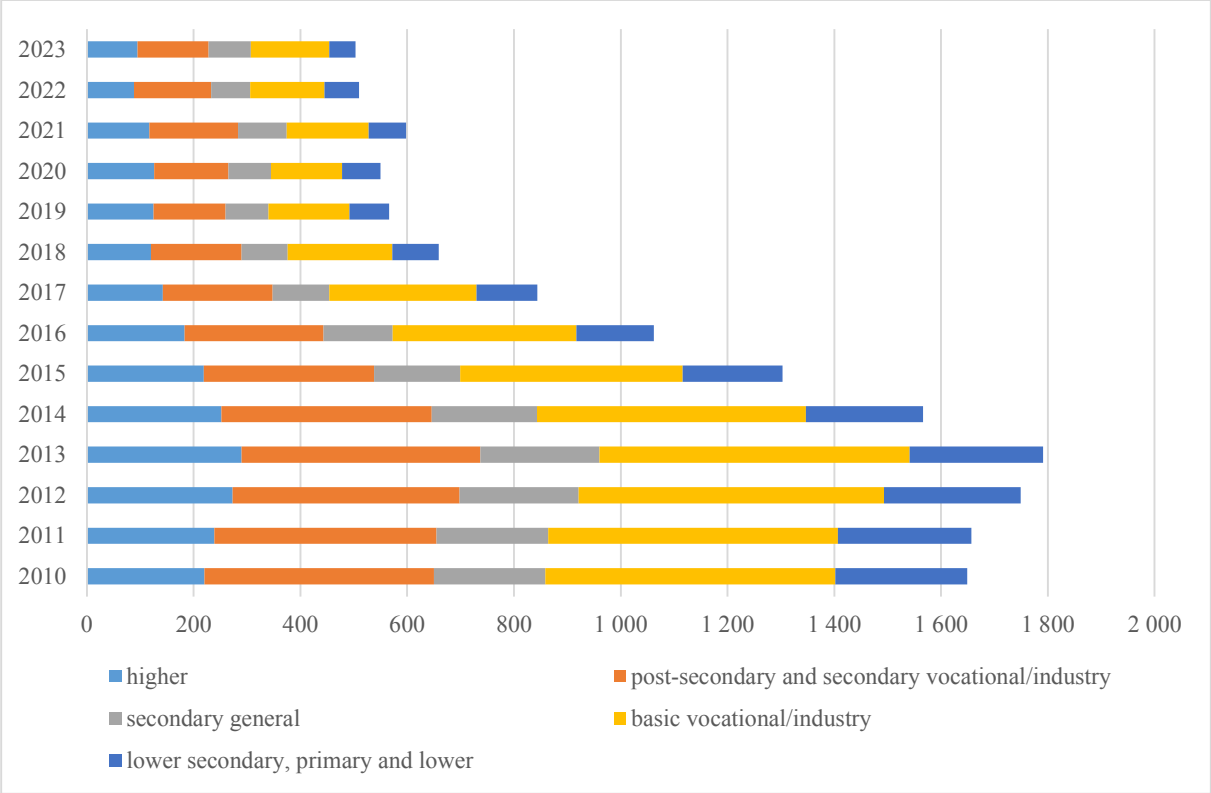


Figure 2. Economically active unemployed by education level in 2010-2023 in Poland [in thousands]. Source: own study based on Central Statistical Office data.

The research suggests that dividing society into specific generations in relation to the labor market is unjustified, given the minimal differences in the characteristics and employment expectations across generations. Furthermore, actions taken by some organizations to adapt to the expectations of younger generations may prove ineffective (Costanza et al., 2012). In contrast to the concept of distinguishing specific generations and their influence on the labor market, Hackman and Oldham's model (Hackman, Oldham, 1975) identifies five characteristics of work that contribute to employee satisfaction, regardless of their age. Work will meet employees' expectations if it requires the use of a variety of skills. The opportunity to utilize individual talents enhances the sense of meaning in carrying out professional tasks. Another characteristic is task identity, which occurs when an individual is responsible for a task from start to finish, allowing them to identify with it and observe the results. If the work is perceived

as important to the organization or the external environment, this becomes another factor that increases job satisfaction. Autonomy, defined as the ability to independently plan and execute assigned tasks, is another crucial characteristic. Finally, feedback allows employees to assess their effectiveness in relation to the effort invested. This model emphasizes that the source of job satisfaction should be sought in the nature of the work itself rather than in generational specifics. However, given the dynamic changes in the workplace, work itself is evolving, directly influencing employee expectations and requirements. The rise of remote work, the growing emphasis on work-life balance, and the increasing prevalence of digitization and artificial intelligence are transforming the labor market in significant ways.

3. Expectations of young people regarding employment in the context of the current situation on the labor market

When analyzing the current situation on the labor market, it is essential to consider the concept of VUCA. This acronym encapsulates four characteristics that define the contemporary socio-economic environment:

- Volatility, which refers to rapid and unpredictable changes in various spheres, such as the economy, politics, and the environment. These fluctuations make it increasingly difficult to forecast future developments. Volatility creates instability, thereby increasing uncertainty, which may discourage individuals from planning their future career trajectories.
- Uncertainty, which directly influences the ability to predict the outcomes of the actions taken by both individuals and organizations.
- Complexity, a condition where multiple, often overlapping factors influence different aspects of human life, making it challenging to isolate specific causes or effects.
- Ambiguity, characterized by situations in which connections between particular events or phenomena remain unclear or uncertain. Misinterpretations arising from ambiguity may lead to suboptimal decision-making (Jeruszka, 2023).

Despite the volatile nature of the current environment, economists argue that it is still possible to identify and anticipate shifts in the labor market, particularly regarding the evolving demands for specific competencies and professions. A key area that warrants attention is the need to align the education system more closely with the needs of the labor market, which would help mitigate the issue of youth unemployment among individuals with specific educational backgrounds, as well as address employers' difficulties in finding appropriately skilled candidates. This alignment will be achievable if the interrelationship between the labor market and the education system takes into account broader economic shifts (Kwiatkowski, 2001). By responding proactively to these economic changes, it will be possible to more

effectively match the skills, knowledge, and competencies of young individuals with the demands of the labor market upon their completion of formal education.

The recruitment process, designed to hire the most suitable candidates, is often resource-intensive, time-consuming, and costly for both employers and prospective employees who seek jobs that align with their professional aspirations (Włodarczyk, Sikorska, 2017). This is attributable, among other factors, to the inherent imperfections of the labor market, particularly its lack of transparency. The absence of sufficient information and transparency leads to less effective and often costly recruitment practices (Ostoj, 2015). In this context, the concept of social capital, including organizational capital, provides a useful framework for reducing recruitment costs, as well as time and effort spent in the search for optimal candidates. Social capital is rooted in trust, wherein employers leverage the knowledge and networks of existing employees to identify and recruit new talent (Stiglitz, 2000). The pursuit of a work-life balance is integral to achieving high levels of job satisfaction and overall well-being. The challenge of maintaining such a balance often results in conflicts across various dimensions of life. An excessive workload, in particular, can undermine personal relationships and lead to difficulties with focus and productivity in the workplace.

Based on a comprehensive review of the literature and empirical research conducted to date, several key factors influencing job satisfaction among young Poles with regard to employment can be identified (Zwardoń-Kuchciak, 2021; Świerkosz-Hołysz, 2016). These factors include:

- competitive salary,
- job security and stability,
- clear, well-defined expectations and responsibilities,
- the ability to maintain a work-life balance,
- a positive workplace atmosphere,
- opportunities for career advancement,
- the chance to develop professional skills and competencies,
- flexible working hours,
- autonomy in task execution,
- additional employee benefits.

The survey, conducted with a representative sample of 1,067 respondents, included participants from various age groups: 18-24 years - 61 people, 25-34 years - 232 people, 35-44 years - 312 people, 45-54 years - 276 people, and over 54 years - 186 people. The results of the survey, specifically the responses to the question ‘What do you consider most important in professional work?’ are presented in figure (Figure 3) in percentage terms.

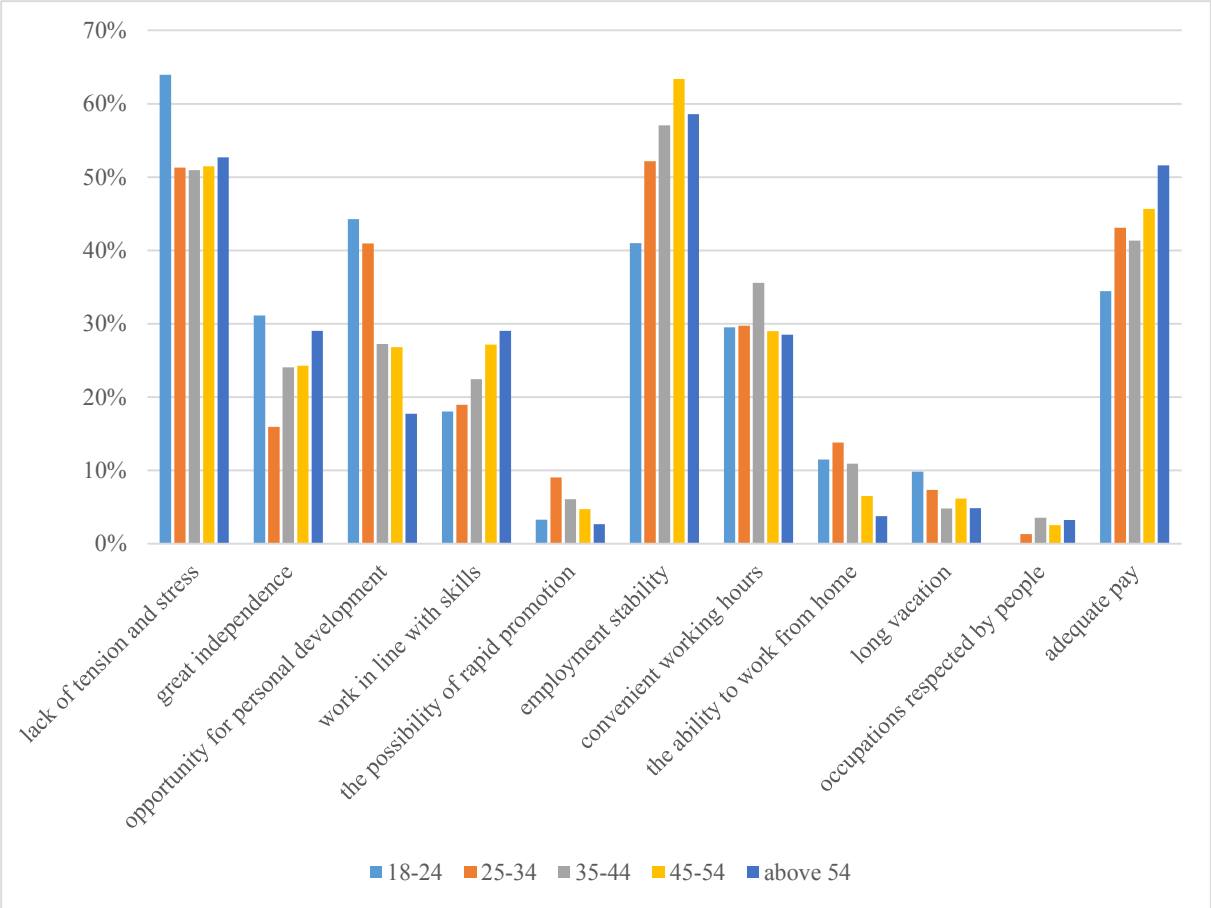


Figure 3. Expectations of Poles regarding employment based on the answers provided in the survey [in percent].

Source: own study based on the conducted survey.

Analyzing the responses provided by the participants in the survey, three factors emerge as having the greatest impact on job satisfaction among Poles: the absence of tension and stress, employment stability, and appropriate compensation. Work that does not cause excessive stress was considered important by respondents of all age groups, with the youngest group (18-24 years old) identifying this factor most frequently. Employment stability, on the other hand, was more highly valued by older respondents, particularly those in the 45-54 age group. For younger participants in the labor market, the opportunity for personal development and a high degree of independence were significant, while the prestige of the job appeared to be less important. Notably, none of the respondents aged 18-24 considered the prestige of their job to be a key factor. In addition to these primary concerns, respondents also highlighted other factors such as "convenient location", "proximity", "working with colleagues in the office", and "separation of work from private life." A potential area for further research could involve exploring the issue of compensation in greater detail, specifically identifying what level of remuneration would be deemed satisfactory for different age groups.

Table 1.
Summary of the number of respondents' answers to the question "What do you think is most important in professional work?" depending on age group

	lack of tension and stress	great independence	opportunity for personal development	work in line with skills	the possibility of rapid promotion	employment stability	convenient working hours	the ability to work from home	long vacation	occupations respected by people	adequate pay
18-24	39	19	27	11	2	25	18	7	6	0	21
25-34	119	37	95	44	21	121	69	32	17	3	100
35-44	159	75	85	70	19	178	111	34	15	11	129
45-54	142	67	74	75	13	175	80	18	17	7	126
above 54	98	54	33	54	5	109	53	7	9	6	96

Source: own study based on the conducted survey.

Based on the data presented in Table 1, the Cramer's V correlation coefficient was calculated at 0.08497, which indicates a very small correlation between the number of indications of specific important issues in the area of employment and a specific age group.

4. Conclusions

The existence of differences in how subsequent generations approach the issue of employment is inevitable. When analyzing the expectations of specific generations, it is important to consider the numerous changes in various aspects of life, which undoubtedly shape a person's worldview and their way of functioning. Regardless of age, Poles place particular importance on job stability, the absence of tension and stress in the workplace, and adequate compensation. Conducting in-depth individual and group interviews with representatives of Generations Y and Z could provide valuable insights into what motivates them in the context of employment and the attitudes they adopt in the workplace. While the expectations of young Poles may overlap with those of older generations, their approach to work and their perceptions of it are distinct. More detailed interviews with both young people and employers could yield a deeper understanding of the expectations of Generations Y and Z regarding employment.

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MANAGING CULTURAL DIVERSITY: THE ROLE OF HR AND LEADERS IN EFFECTIVE MULTICULTURAL TEAMS

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Purpose: This article investigates how HR teams and leaders facilitate effective collaboration in multicultural teams. By examining real-world practices in European companies, the study identifies practical strategies for managing cultural diversity.
Design/methodology/approach: This qualitative study employs semi-structured interviews with representatives from various multinational corporations in Europe. Data were analyzed using thematic analysis to identify key strategies and challenges in cultural diversity management.
Findings: The results indicate that leadership adaptability, cultural awareness, and HR-led initiatives play a crucial role in fostering team cohesion and enhancing performance. Inclusive policies and structured frameworks strengthen the unique advantages of diverse teams, driving innovation and supporting business objectives.
Originality/value: This article contributes to the field by offering practical strategies and empirical insights on improving team performance through cultural diversity management. It provides actionable recommendations for organizations seeking to leverage diversity as a competitive advantage.
Keywords: cultural diversity, HR, leaders, multicultural teams, adaptive leadership styles.
Category of the paper: Research paper.

1. Introduction

In today's globalised workplace, cultural diversity is no longer just an asset—it is a necessity. Managing culturally diverse teams is both rewarding and challenging, as diverse perspectives can drive innovation but also lead to misunderstandings if not effectively managed. This study explores the dynamics of multicultural teams, focusing on how leadership adaptability, organisational support, and team structure foster collaboration and boost productivity. Set within the European context, where cross-cultural integration is increasingly prevalent, it offers practical approaches that move beyond theory.

As organisations expand internationally, managing diverse teams has become a crucial skill for leaders and HR professionals. A McKinsey report highlights that companies in the top quartile for ethnic and cultural diversity are 36% more likely to outperform those in the bottom quartile, illustrating the competitive advantage diversity offers (McKinsey & Company, 2018). However, the same report warns that improper management can lead to misunderstandings and reduced team cohesion.

Building on prior research—such as Hofstede's (1984) cultural dimensions and Earley & Ang's (2003) work on cultural intelligence—this study examines how European organisations can harness the strengths of multicultural teams through adaptive leadership and structural support. By incorporating real-world insights from professionals actively managing diversity, it provides relevant strategies for creating inclusive, high-performing environments essential in a globalised market.

While studies like those by Thomas and Ely (1996) and Hofstede (1984) highlight how diversity fosters innovation, they often lack practical strategies for overcoming real-world challenges. This research addresses that gap by exploring the experiences of HR managers and team leaders in Europe. Through interviews, it investigates how professionals handle cultural differences and adapt leadership styles to improve team performance. Additionally, it examines the impact of foreign versus local leaders, drawing on Deloitte's findings that cultural intelligence is a key skill for global leaders (Deloitte, 2019).

By bridging theory and practical examples, this study offers HR professionals and leaders evidence-based strategies for managing multicultural teams. It not only emphasises the importance of diversity but also provides actionable solutions to foster effective collaboration in diverse teams across Europe.

The main objective of this study is to explore how adaptive leadership styles, organisational policies, and team structures influence team dynamics and performance in multicultural settings. Through detailed interviews, this research uncovers strategies that leaders and HR professionals can apply to enhance collaboration and productivity within culturally diverse teams, thus translating theoretical knowledge into practical recommendations.

To gain a deeper understanding of the elements that contribute to successful multicultural teams, this study addresses the following research questions:

- How do leaders adapt their strategies to manage multicultural teams effectively?
- In what ways do organisational support and policies enhance or hinder team cohesion in diverse settings?
- How does the structure of a team impact collaboration and performance in a multicultural context?

This article unfolds in four main sections. First, we explore key literature on multicultural team management and cultural diversity. Next, outline the research approach, including the methods and variables at the core of this study. Then, we dive into the findings and discuss

what they reveal about cultural dynamics in teams. Finally, we wrap up with key insights, practical takeaways, and ideas for future research on managing diverse teams effectively.

2. Literature review

Cultural diversity in organisations offers a fascinating paradox. On one hand, it ignites creativity, fosters innovation, and brings fresh perspectives to problem-solving. On the other hand, it can create friction, misunderstandings, and conflicts if not managed thoughtfully. This dual nature of cultural diversity is what makes it both a challenge and an opportunity for modern organisations (Comu et al., 2011).

Hofstede's (1984) seminal work on cultural dimensions provides a foundational lens for understanding how national cultures shape behaviours, from communication styles to attitudes toward hierarchy. Building on this framework, Earley and Ang (2003) introduced the concept of cultural intelligence, highlighting the ability to adapt behaviour to cultural contexts as a crucial skill for enhancing team cohesion and effectiveness. Cultural intelligence—the capability to function effectively in multicultural contexts—is a critical competency of effective global leaders. When leaders work primarily in domestic settings, organizations should place more emphasis on developing within-culture capabilities, such as EQ. In contrast, when leaders work extensively in international or cross-border settings, organizations should emphasize development of cross-cultural capabilities, such as CQ (Rockstuhl et al., 2011).

These insights lay the groundwork for exploring how leaders and HR managers in Europe navigate the complexities of diversity management. Diversity in teams has often been described as a "double-edged sword". Mannix and Neale (2005) illustrate how diverse teams, when led effectively, can unleash unparalleled creativity and innovation. However, without skilled leadership, these same teams risk falling prey to misunderstandings and clashes arising from conflicting work styles. Ely and Thomas (2001) add another dimension by stressing the importance of inclusive organisational structures. They argue that fostering an environment where differences are celebrated rather than suppressed enables teams to harness the full potential of cultural diversity.

Walaszczyk and Mazur (2019) highlight both the challenges and opportunities of managing cultural diversity, especially in Poland. They point out common issues like communication gaps, misunderstandings, and conflicts that can weaken team cohesion. However, they emphasize that skills such as cultural awareness, emotional intelligence, and conflict resolution can turn these challenges into opportunities, helping teams work better together and unlock the full potential of diversity.

Further supporting this perspective, Kim and Ko (2021) conducted a longitudinal study involving 347 senior business students organized into 84 teams. Over a 12-week simulation game, their research demonstrated that higher levels of team emotional intelligence significantly enhanced team cohesion, with trust and self-efficacy serving as mediators in this relationship. This finding underscores the importance of emotional intelligence in fostering cohesive and high-performing teams.

Additionally, Iskhakova and Ott (2020) investigated the development of team-level cultural intelligence (CQ) and its impact on performance. Their study, which included 23 teams comprising 86 participants, revealed that working in culturally diverse teams fosters the development of team-level CQ, which in turn positively influences team performance. This suggests that exposure to cultural diversity within teams can enhance collective cultural intelligence, leading to improved outcomes.

These findings suggest that organizations should invest in training programs focused on enhancing emotional intelligence and cultural intelligence among team members. Such initiatives can mitigate potential conflicts arising from cultural differences and promote a more cohesive and productive work environment.

Leaders who demonstrate empathy and a willingness to understand cultural differences are better equipped to build trust and open communication channels. Walaszczyk and Mazur (2019) highlight that the need for intercultural competence has become a necessity for organizations, they emphasize that these competencies are not inherent but can be developed through targeted training initiatives. To address this need, they advocate for integrating cultural sensitivity workshops and leadership development programs into organizational training frameworks, preparing leaders to effectively navigate the challenges of managing multicultural teams.

Managing diversity offers many advantages but also presents challenges, particularly its high costs. Successfully handling diversity often requires significant investment in training programs for supervisors, employees, and managers to improve interactions with diverse colleagues and clients. These programs can be expensive, with substantial costs for travel and participation (Dike, 2013).

Another perspective highlights that diversity can be highly cost-effective, as diverse teams often contribute more than traditional teams. As Gardenswartz et al. (2010) state, “Diverse workforces can bring a wider variety of intellectual power and life experience to support the challenge of creating innovative solutions and products”. Diversity management practices and programs are increasingly observed in enterprises, particularly in large corporations. However, they are less frequently systemic actions that form part of a human resources strategy (Rakowska, 2014).

Diversity and Inclusion (D&I) programs are essential in shaping organizational culture, defined as "a system for identifying and processing information" (Kostera, 1999, p. 10) and "a common system of meanings that forms the basis of communication and mutual understanding" (Furnham, Gunter, 1993, pp. 70-71). Investments in cross-cultural training

should be seen as initiatives with measurable returns on investment, enhancing communication, collaboration, and organizational effectiveness. Research supports the link between robust D&I practices and improved performance; for example, Khan et al. (2023) found that firms with higher D&I scores showed better financial outcomes based on an analysis of 8089 firm-year observations from global companies. However, the effectiveness of D&I initiatives, particularly diversity training, remains contentious. Dobbin and Kalev (2016) reviewed three decades of data from over 800 U.S. firms and found that mandatory diversity training often fails, sometimes activating bias or causing backlash. They emphasize the need for tailored, voluntary initiatives such as mentoring and data-driven recruitment over one-size-fits-all training programs. These findings underscore that D&I initiatives can enhance organizational performance but require careful implementation and alignment with organizational contexts. A nuanced approach, including continuous evaluation and customization, is critical for success. This study examines whether training programs alone suffice or if alternative approaches are necessary to foster cross-cultural understanding and leverage team diversity effectively.

Building on these insights, the study focuses on how European leaders and HR managers can transform cultural diversity challenges into strategic advantages. By integrating theoretical frameworks of cultural intelligence and inclusivity, it explores how leadership behaviors, organizational structures, and team dynamics influence high-performing multicultural teams. "Good relations with a business partner lower transaction costs, build customer commitment, and allow access to knowledge and technology — increasing the length and intensity of cooperation" (Danik, 2015, p. 8). By understanding these dynamics, organizations can develop targeted strategies to optimize performance in diverse environments.

3. Research methodology

This study adopts a qualitative research design to examine how leaders and HR professionals manage cultural diversity in multinational organisations. A qualitative approach was chosen for its ability to capture rich, nuanced insights essential for understanding the complexities of diversity management, which quantitative methods often overlook. By focusing on participants' lived experiences, this method highlights real-world strategies and challenges faced by those working with multicultural teams.

Data were collected through semi-structured interviews with 10 HR managers and team leaders from multinational organisations across Europe. This flexible method allowed participants to share personal experiences while addressing consistent themes. Interview questions were informed by foundational literature, including Hofstede's cultural dimensions and Earley and Ang's cultural intelligence framework, ensuring alignment between theoretical insights and practical applications (Hofstede, 1984; Earley, Ang, 2003). The open-ended format

enabled participants to elaborate on their experiences, covering critical topics such as leadership adaptability, organisational policies, and team dynamics.

Thematic analysis, as outlined by Braun and Clarke (2012), was used to identify recurring themes and patterns in the data. Key aspects of diversity management, such as decision-making, intercultural communication, adaptation to local customs, and organisational support, were examined. An iterative coding framework, informed by the literature (Neale, 2016), provided a structured yet flexible approach to analysing and refining themes as new insights emerged, ensuring alignment with both theoretical constructs and practical realities.

The combination of qualitative methods and thematic analysis effectively captured the depth and complexity of cultural diversity management. This approach emphasised individual perspectives and real-world strategies, offering insights often missed in quantitative studies. Thematic analysis further provided a clear narrative of the challenges and opportunities in managing multicultural teams.

4. Results and Discussion

Respondents noted that culturally diverse teams bring unique insights, enabling organizations to better understand and serve diverse customer bases. This aligns with Cox and Blake's (1991) assertion that diversity can enhance organizational effectiveness by broadening perspectives and improving problem-solving approaches. One participant shared:

My experience was always positive because diversity brings productivity and fosters new ideas. It took us a couple of months to align and understand what everyone could contribute, but the productivity was amazing once we achieved this [Anna].

However, the findings highlight a critical distinction: diversity alone is not enough. Without intentional efforts to foster inclusivity, organizations risk superficial diversity — where cultural differences exist but fail to translate into meaningful contributions to team dynamics. This disconnect can result in misunderstandings, weakened cohesion, and missed opportunities to leverage the full potential of diverse teams.

The second aspect worth highlighting is the role of leadership in managing cultural diversity, which emerged as a critical factor. Leaders with high cultural intelligence (CQ) were consistently identified as instrumental in creating cohesive and high-performing teams. These leaders demonstrated a deep understanding of cultural nuances and adapted their behaviors accordingly. For instance, one respondent noted:

In the Middle East, building trust takes time and often starts with personal connections. You need to establish emotional safety before delivering feedback. This approach is vastly different from the U.S., where feedback is context-driven and data-based. Effective leaders recognize these cultural dynamics and adjust accordingly [Oleh].

This ability to navigate diverse communication styles helped foster collaboration and mutual respect within culturally diverse teams.

Emotional intelligence was also crucial. Leaders who showed empathy and openness built stronger trust and connections with team members from diverse cultures. This aligns with Goleman's (1998) research, which highlights the importance of self-awareness and interpersonal skills in leadership. My research confirmed this idea. One respondent shared:

To build trust in the Middle East, you need to show genuine interest in personal lives. This empathy strengthens relationships and improves business interactions [Oleh].

Effective leaders in multicultural environments need to develop both cultural and emotional intelligence. Training programs focused on enhancing these competencies can equip leaders with the skills necessary to navigate cultural complexities. Additionally, organizations should consider cultural intelligence as a key criterion in leadership selection and development processes.

A key takeaway from the study is the interplay between personal relationships and professional working styles, particularly in leadership and communication. Many respondents emphasized that in certain cultures, personal connections serve as the foundation for effective professional collaboration. One participant shared:

In international companies, personal and professional lives often overlap. This diversity has enriched both aspects of my life and helped me grow in many ways [Ben].

Another noted:

Personal and professional lives intertwine daily. It allows for continuous growth and learning [Oleh].

Culture extends beyond formalities or the principles of organizational culture. It often reveals itself in how individuals act according to their cultural roots, rather than strictly adhering to organizational norms. One interviewee highlighted the importance of informal interactions in uncovering and understanding cultural nuances:

The French place great importance on personal relationships. To build trust, you need to understand their interests, especially when it comes to food and drinks. They value informality and personal conversations, which might not work during first meetings with Americans or British people, but with the French, it works perfectly [Jakub].

This approach contrasts sharply with the more task-oriented nature of Western cultures, where professional relationships are typically prioritized over personal ones. Reflecting on these differences, one respondent shared:

Through daily interactions with people from different cultures, I not only gained new professional skills but also developed empathy and understanding for other perspectives. These experiences enrich both my professional and private life, making me more open and flexible in approaching diversity [Wiktoria].

Working in multicultural environments offers unique opportunities for personal and professional growth. Many individuals value such settings for broadening perspectives and fostering development. A Polish employee in a Scandinavian company reflected:

Working in this culture really suits me. Before joining the company, I felt that Polish culture didn't entirely align with my personality. For example, in raising my son, I noticed that Polish culture is more based on 'very strict rules,' whereas Scandinavian culture promotes a more relaxed approach and emphasizes individuality. This environment aligns with my values, fostering learning and nurturing my beliefs [Wiktoria].

Another individual highlighted the value of adopting meaningful rituals from other cultures:

In this culture, at the start of our daily meetings, we share how we're feeling or if something might be distracting us. This helps everyone understand what's going on and not take things personally. These check-ins set the tone for our meetings — they're not just about work but about recognizing that we're all human [Oleh].

Such practices encourage open communication, mutual understanding, and supportive work environments. The interlocutors claim:

I love working in a culture that values how we feel and encourages us to bring our whole selves to work [Jakub].

Our team's success came from embracing our differences and learning from each other's experiences [Paulina].

These insights underscore the power of diversity to drive innovation and client understanding:

Thanks to diversity, we can better understand the needs of our clients and implement innovative solutions [Kinga].

Embracing diversity and cultural practices enriches individuals personally and professionally, enabling them to bring their best selves to work while enhancing collaboration, innovation, and client satisfaction.

6. Conclusions

This study demonstrates that adaptive leadership, cultural intelligence, and HR strategies play a crucial role in effectively managing multicultural teams. The findings confirm that inclusive leadership and organizational support facilitate better collaboration, creative problem-solving, and goal achievement among multicultural teams. These results support the thesis that appropriate management practices transform cultural diversity from a challenge into a strategic asset.

The study corroborates Cox and Blake's (1991) assertion that cultural diversity contributes to increased organizational effectiveness, understood as an organizational resource. Respondents emphasized that diverse teams provide unique insights, enabling organizations to better understand and serve diverse customer bases. However, the study also highlights that diversity must be accompanied by inclusivity to fully realize its potential. Without deliberate inclusivity measures, diversity may remain superficial, leading to misunderstandings, reduced team cohesion, and missed opportunities.

A key theme in the study is the integration of personal and professional relationships, particularly in the context of leadership and team dynamics. In cultures such as the Middle East, France, and India, personal relationships form the foundation of effective professional collaboration, whereas in task-oriented cultures like the United States, greater emphasis is placed on formal processes. This duality underscores the need for cultural flexibility and the role of informal interactions in building trust. Integrating personal and professional relationships fosters empathy, enhances collaboration, and promotes innovation by leveraging diverse perspectives.

Multicultural work environments offer unique opportunities for both personal and professional development. Respondents shared how exposure to different cultures broadened their perspectives, improved their interpersonal skills, and aligned their personal values with professional practices. For instance, adopting cultural rituals, such as daily emotional check-ins before meetings, contributed to a supportive and empathetic work environment, enhancing team dynamics and overall productivity.

From a business perspective, the study underscores the importance of training leaders to develop cultural and emotional intelligence. By doing so, organizations can create inclusive environments where all employees feel valued, fostering innovation and improving team performance. Based on the research findings, several practical recommendations are proposed:

- Organizations should prioritize training programs that enhance cultural and emotional intelligence to enable leaders to effectively manage multicultural teams.
- Fostering inclusivity alongside diversity is essential to maximizing team potential and avoiding superficial diversity.
- Organizations should recognize the importance of personal relationships in professional settings, particularly in multicultural environments. A relationship-oriented approach can be instrumental in designing inclusive policies and practices.
- Companies should leverage the unique cultural insights of their teams to develop innovative solutions tailored to the needs of diverse customers.
- Encouraging employees to adopt valuable practices from other cultures can support both personal and professional growth, fostering a more empathetic and dynamic work environment.

This study is qualitative in nature, based on interviews with a limited group of interlocutors, and therefore has constraints in terms of generalizability. Due to its qualitative approach, the study does not precisely quantify the extent to which factors such as adaptive leadership or cultural intelligence influence team effectiveness. A logical direction for further research would be to conduct a quantitative study to establish statistical relationships between cultural intelligence, inclusivity, and team performance. Future research could also seek to identify the variables that have the most significant impact on multicultural team effectiveness. Additional investigations could examine the effectiveness of various leadership styles in Polish multicultural teams, the impact of cultural diversity on innovation in Polish companies, or best practices for implementing inclusivity policies in Polish organizations.

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SHARED MOBILITY AS AN ALTERNATIVE TO PRIVATE TRANSPORT IN CITIES

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Purpose: The aim of this paper is to analyze the shared mobility trend in Poland and assess its impact on the propensity to own a private car.
Design/methodology/approach: The research methodology integrated three primary methods: literature review, data analysis and inductive approach. The literature review served to identify impact of car-sharing on travel choice and car ownership. After establishing the theoretical context, an analysis of quantitative datasets on shared mobility vehicles and private passenger cars was conducted. The data comparison formed the basis for drawing conclusions and identifying the factors that contributed to the significant increase in the number of private cars.
Findings: The data analysis showed that despite the significant growth of shared transport systems in Poland, the number of private cars has risen considerably.
Research limitations/implications: The primary limitation in studying the quantitative changes in the development of shared mobility is a lack of official data on shared mobility vehicles and users. Future research should primarily include larger groups of respondents from different cities, as qualitative research to date has been very limited. The research should cover both regular users of shared transport and non-users to identify the factors that prevent them from changing their transport behavior. Further research also could focus on the differences between generations.
Originality/value: The article compared the results of studies on the impact of the development of car-sharing systems on private car ownership, conducted in various locations around the world, with the situation in the Polish market. The reasons for the contrasting trend in Poland were identified, where the increase in the number of shared vehicles coincided with a notable rise in the number of private cars. Research gaps in the study of attitudes towards car ownership were identified. Several actions were suggested to encourage the transition from private car ownership to car-sharing, offering valuable guidance for urban transportation authorities.
Keywords: shared mobility, car-sharing, micromobility, private cars.
Category of the paper: research paper, viewpoint.

1. Introduction

The management of passenger transport in urban areas poses many challenges to those responsible for organizing transport services for residents. While the importance of public transport, cycling, and walking for sustainable mobility policies is widely accepted, the role of shared mobility services is more debatable.

The main challenge for cities is the inefficiency of transport systems due to the number of vehicles in traffic exceeding the infrastructure's capacity, resulting in congestion. An unfavorable trend has been observed in the structure of passenger transport: the share of travel by private cars has increased, while interest in public transport has declined. New opportunities to reverse this trend have emerged with technological progress and new social trends. Significant changes in information technology and the rise of social networks have contributed to the rapid development of the sharing economy, and transport is one of the areas most susceptible to its implementation. The concept of sharing unused tangible and intangible resources is emerging as a new paradigm that allows access to goods and services without ownership.

The literature demonstrates many benefits of shared mobility for both users and society. However, looking at the level of motorization in Polish society, one may wonder whether wider access to shared modes of transport could induce people to use private cars less or even to give them up. The study of the impact of new mobility services in the urban environment should take into account changes in the functioning of all modes of urban transport, as these services have a significant impact on each other.

Over the past few decades, shared mobility has grown in importance worldwide, as well as the need to integrate it into urban transport systems and make it more efficient from a social, economic, and environmental perspective. Research interests naturally gravitate towards newer and more innovative modes of transport. Most research has treated shared mobility as an isolated system, neglecting the complexity of its interaction with other modes of transport. As a result, estimating its impact on the overall transport system has been difficult, leading to a tendency to overestimate the influence of this type of service.

This paper aims to examine the trends in shared mobility in Poland and assess its impact on the propensity to own a private car.

2. The idea and types of shared mobility

Shared mobility involves sharing vehicles or making shared journeys instead of owning the means of transport. It uses telecommunication technologies to connect users with service providers. Shaheen and Chan (Shaheen, Chan, 2016) define shared mobility as the sharing of a motor vehicle, bicycle, or other means of transport to enable travelers to gain short-term access to transport on demand. This form of mobility includes renting bicycles, scooters, car-sharing, carpooling or renting vehicles via mobile apps.

However, it is difficult to draw the boundaries of shared mobility, as the term encompasses a wide range of services, including traditional car rentals, while others emphasize the importance of intermediation using contemporary information and communication technologies in their definitions (Le Vine, Polak, 2015). "The bone of contention" among researchers is also the demarcation of which types of shared mobility should be considered part of the sharing economy, particularly regarding the classification of on-demand transportation services (e.g. Uber).

Transport is an area in which the sharing economy is thriving, both in B2C and C2C relationships, sometimes also with the support of local authorities. The most popular model is B2C, which involves the interaction between consumers looking for services or vehicles and the companies that own or manage these assets. In the C2C model, individuals interact to trade or exchange services through smartphone apps or online platforms. The company that operates such a platform is not directly involved in the transaction (European Parliament, Directorate General for Internal Policies, 2016).

Sharing in transport can take many forms. Shaheen and Chan (2016) proposed a classification of shared mobility based on whether a vehicle or a ride is shared:

1) Vehicle sharing:
   - car-sharing – short-term access to a car,
   - micromobility – short-term access to bicycles, electric scooters and motor scooters.
2) Journey sharing:
   - ridesharing: connecting passengers with drivers to travel together,
   - on-demand ride services: private car owners offer rides for hire,
   - microtransit.

The choice of the form of shared journey depends on whether the journeys are long-distance or short-distance and on their frequency. Demand for long-distance intercity journeys is usually occasional. People undertaking long-distance travel often seek fellow travelers heading in the same direction. Travelers looking for a car are motivated by economic considerations (lower cost of travel compared to rail and bus), greater convenience of travel and the opportunity to spend time in pleasant company. The rating system on platforms such as BlaBlaCar allows them

to choose someone of a similar age, with similar interests, and who has good feedback from other users.

Short-distance journeys are usually shared within cities or suburban areas. This type of transport can involve a group of people travelling together regularly, usually to work or school, using the car of one of the travelers (carpooling). Another possibility is to rent a car for a specific period (car-sharing). For the occasional need for short-distance transport, a private car with a driver can be ordered via an app, which can be seen as an alternative to taxis (e.g. Uber, Bolt, FreeNow). It is a form of transport classified as on-demand services. The role of micromobility, such as scooters and bicycles, is limited to covering relatively short distances, effectively serving as a means of first- and last-mile transport, specifically for pick-up and drop-off to public transport points.

Systems based on short-term rental of private vehicles are relatively flexible in terms of rental duration and travel distance. In the case of P2P transactions, the external assistance of the company controlling the entire rental process consists of the organization giving users information support, technical support, mediating the transaction, and providing a platform where the transaction can take place (Cohen, Shaheen, 2013).

3. Exploring the relationship between the development of shared mobility and individual motorization: a literature review

Individual motorized transport is the dominant mode of transport in most cities, and its share of urban transport has increased steadily. The development of various forms of shared mobility has raised hopes of convincing part of the population to abandon the use of private cars for urban trips. Car-sharing has grown rapidly in recent years. It is estimated that there were 55 million users worldwide in 2023, compared to only 36 million in 2017 (Statista, 2025).

The advantages of car-sharing systems benefit not only users and service providers but also the city and its residents. In the literature, the main arguments for the development of car-sharing systems include: fewer car journeys, a reduction in traffic intensity and congestion (Martin, Shaheen, 2011b; Shewmake, 2012), a decrease in the number of private vehicles (Martin, Shaheen, Lidicker, 2010), lower energy consumption (Minett, Pearce, 2011), lower emissions of CO_2 into the atmosphere (Martin, Shaheen, 2011a), decreased parking demand (Millard-Ball, Murray, Ter Schure, 2006), lower travel costs for users due to reduced fixed costs compared to car ownership (Litman, 2015), increased travel comfort (Machado et al., 2018), enhanced mobility and alternative transport options (Bondorová, Archer, 2017), and the ability to complement public transport in areas not well served, particularly in peripheral parts of the city (Shaheen, Chan, 2016; Bondorová, Archer, 2017).

In the context of striving for sustainable urban transport, it is particularly important to reduce the number of trips made by private cars. In countries with a long history of shared mobility, where its development effects have been observable, studies have examined the impact of these transport modes on the travel behavior of the population, particularly car-sharing as the closest substitute for private cars. Although the development of car-sharing could be expected to reduce the rate of motorization, this outcome is not entirely clear, as users of these new services include not only former private car owners and users but also individuals who previously used public transport. The availability of a convenient, easy-to-use, and cost-effective service may encourage users of other modes of transport to choose shared transport (Bucsky, Juhász, 2022).

Shared transport, including carsharing, is significantly more developed in Western European countries and the United States than in Central and Eastern Europe. This is partly due to the fact that these services were introduced much earlier in those regions (Kuźma, Połom, Żukowska, 2022). Researchers have conducted numerous studies, mainly surveys on the potential impact of car-sharing on travel choice and car ownership. They calculated the substitution rate for car-sharing users, i.e. what percentage of them would be willing to give up car ownership. The results of these studies were varied. The rate of car-sharing users willing to give up their cars ranged from 3.5% in London, 5% in several North American cities, 6% in Basel, to 36% in London, and 43% in Philadelphia (Bucsky, Juhász, 2022, p. 2210). The discrepancy in the results of the London survey is puzzling, as surveys conducted in the city four years apart have produced entirely different outcomes. Surveys with relatively small samples are difficult to consider fully reliable, as the sample may not accurately reflect the population, and the surveys may be subject to various biases. Additionally, the results of the survey obtained during the initial stage of development of shared mobility systems may differ from those gathered during the maturity phase.

A survey conducted in Switzerland included both car-sharing users and those who did not use it (Becker, Ciari, Axhauseeten, 2018). The survey was initiated with the launch of car-sharing, and a second round was conducted one year later. The results showed that car-sharing users had a significantly lower car ownership rate (0.27 compared to 0.84 for non-users). This indicator changed only slightly one year later (to 0.24 and 0.83 respectively). A comparison of ex ante and ex post results revealed a 6% decrease in car ownership among car-sharing respondents, indicating that it had little impact on car ownership across the city.

More accurate results are provided by empirical studies determining the substitution rate. Such a study was conducted by Kolleck (2021) in 35 cities in Germany. He considered not only the number of registered vehicles but also new car registrations and end-of-life registrations between 2012 and 2017. The substitution rate was calculated for vehicles rather than users and was between 0.9 and 1.9. This means that each shared car replaced one or two cars, a much smaller effect than what other studies have suggested.

Jain, Rose and Johnson (2022), based on a study in Melbourne, Australia, found that many car-sharing users reduced their car ownership, with most of these changes occurring in the year before joining the scheme. A third of car-sharing users had sold their car or given up buying a car. However, the relationship between car ownership and car-sharing use is not clear. The reduction in car ownership may have been due to the frequent use of car-sharing, or it may have been due to changes in personal circumstances or general attitudes towards mobility.

Bucsky and Juhász (2022) compared changes in motoring rates in regions with and without car-sharing systems, as well as changes over time before and after the introduction of these services. Their analysis of data from across the EU revealed that previous questionnaire-based studies had greatly overestimated the impact of car-sharing on car ownership. In fact, car-sharing has a marginal effect on changes in car ownership, with more developed car-sharing systems in certain regions being associated with smaller declines in car ownership rates. Such a result does not seem to support theoretical considerations. However, the conclusion has been drawn that the more affluent urban areas of Europe, which have introduced car-sharing systems, are closer to reaching saturation in private car ownership.

4. Impact of the development of shared mobility on the number of passenger cars in Poland

Shared mobility began to develop in Poland relatively late compared to western European countries and the United States. However, since Poland acceded to the European Union, the level of motorization in Polish society has increased rapidly, and in the largest cities, the share of passenger car travel now exceeds 40% (Wolański, 2023).

The first car-sharing system was launched in 2015 in Wroclaw (GoGet), followed by Krakow (Traficar) and Warsaw (4Mobility) in 2016. The following year, Panek CarSharing, Easyshare and Vozilla appeared on the market. Other local systems were launched but failed to sustain themselves in the market. There are currently three companies that together dominate the market: Traficar, Panek CarSharing and 4Mobility. Table 1 provides data on shared transport modes.

Table 1.
Vehicles of shared transport in 2022

City	Car-sharing	Electric scooters	Motor scooters	Bicycles	Car-sharing vehicles per 1000 inhabitants**	All shared vehicles per 1000 inhabitants
Warsaw	1394	14472	49	3835	0,75	10,62
Tri-City	1001	8080	86	4000*	1,31	12,57
Kraków	647	6778	0	154	0,81	9,43
Wroclaw	335	3302	0	1714	0,50	7,94
Poznan	311	4009	104	1397	0,57	10,75

Cont. table 1.

Łódź	285	1578	0	1334	0,43	4,86
Szczecin	233	1866	56	666	0,60	7,2
Katowice	142	1347	0	563	0,51	7,32
Lublin	50	713	0	511	0,15	3,85
Rzeszów	30	699	50	20	0,15	4,05

Note. * in Tri-city the Mevo city bike sharing system was launched in 2023; ** own calculations based on the number of inhabitants in 2022.

Source: Stowarzyszenie Mobilne Miasto (2023).

Traficar has the widest range and is available in 28 Polish cities. It offers services mainly in the largest cities such as Kraków, Katowice conurbation, Wroclaw, Poznan, Warsaw, Łódź, Tricity, Szczecin, Lublin, Rzeszów, as well as in a dozen or so smaller cities located near large conurbations. Panek CarSharing operates in 8 cities, while 4Mobility in 7. The number of users registered in car-sharing applications is increasing year on year. However, the number of shared cars per 1000 inhabitants remains relatively small and does not sufficiently meet the needs of the population.

To answer the research question of whether the development of shared mobility has influenced vehicle ownership in Poland, changes in the number of registered cars and the motorization index were analyzed in the largest cities, where shared mobility systems are developed (Table 2).

Table 2.
Number of registered passenger cars between 2016 and 2022

City	2016		2022		Increase in the number of vehicles 2016-2022	Increase in the number of vehicles 2016-2022 (%)
	Number of vehicles	Number of vehicles per 1000 inhabitants	Number of vehicles	Number of vehicles per 1000 inhabitants		
Warsaw	1 194 068	680,8	1 460 479	815,4	324 247	27
Tri-City	432 405	570,4	526 064	690,8	93 659	22
Kraków	448 004	585,4	561 986	699,6	113 982	25
Wrocław	403 063	632,1	506 821	751,9	103 758	26
Poznan	356 788	660,3	431 181	796,5	74 393	21
Łódź	365 931	525,4	434 956	660,5	69 025	19
Szczecin	205 779	508,2	247 261	631,5	41 482	20
Katowice	199 139	668,0	233 939	834,9	34 800	17
Lublin	172 128	505,6	214 298	647,0	42 170	24
Rzeszów	96 672	515,8	125 195	634,9	28 523	30

Source: GUS, Bank Danych Lokalnych (2025).

An analysis of the data in Tables 1 and 2 shows that, despite the significant development of shared transport systems in Poland, private car ownership has not been abandoned. In fact, the number of private cars has increased significantly. Between 2016 and 2022, the percentage increase in the number of private cars ranged from 17% in Katowice to 30% in Rzeszów. At the same time, it is worth noting that in 2022 Katowice had the highest level of car saturation, with 834.9 vehicles per 1000 inhabitants, while in Rzeszów the rate was only 634.9 – one of the lowest in the country. Therefore, the example of Poland does not confirm the results of studies carried out in other countries.

The reasons for the identified phenomenon can be attributed to various factors, including the insufficient availability of shared transport and the influence of factors that drive the desire or necessity to own a private car. Shared transport in Poland is still in an early stage of development and there are too few vehicles, particularly car-sharing cars. This limits the availability of these services and creates uncertainty about the availability of a car when needed. Especially during peak demand times, there may be a shortage of available vehicles, which limits the flexibility of using the service. The car-sharing fleet in Poland has not developed at the pace or in as many locations as market demand would suggest, primarily due to the difficulties faced by car-sharing companies in acquiring enough new vehicles.

Brychcy and Przybyłowski (2018) surveyed Traficar users in Tricity, which showed that more frequent use of car-sharing could be encouraged by the lower price of the service, greater availability of vehicles and a larger spatial zone of service. The cost of renting a car is another factor limiting car-sharing use. This cost can be higher than when using one's own vehicle, due to charges for car use time and mileage. Car-sharing users also highlight the formalities involved in renting a car, as well as concerns about insurance and potential additional costs arising from damage to the vehicle.

Various factors of an economic, social or cultural nature influence the continuous growth of the number of private cars in Poland, despite the development of shared mobility. Over the years, Poland has been catching up in terms of cars per capita compared to highly developed countries, and it is now one of the EU countries with the highest ratio. Higher incomes and a broad availability of credit enable an increasing number of consumers to purchase cars, while those with lower incomes are opting for more affordable used vehicles. The increase in the number of cars in households is also linked to urbanization changes and the development of suburbs, as this increases the need for daily travel related to work and living needs. Owning one or more cars in a family becomes a necessity when adequate public transport services are not provided.

In Poland, there is a specific attitude toward car ownership, as it not only serves as a means of transport but also symbolizes independence, prestige, and comfort, further motivating the public to purchase a car. People value independence and flexibility, which is reflected in the ability to use a car whenever necessary, the freedom to plan the route and the flexibility to determine the exact time of travel. For many, the car has ceased to be a luxury item and has become a basic household necessity. Owning a car facilitates to carry out everyday tasks, such as shopping or taking children to school.

It is also worth emphasizing that the rise in the number of passenger cars in Poland is driven not only by households but also by the business sector. According to data from the Polski Związek Przemysłu Motoryzacyjnego (Polski Związek Przemysłu Motoryzacyjnego, 2025), enterprises registered around 68% of new passenger cars. Passenger cars are an indispensable working tool in many industries, both for customer service and for the daily operation of the company.

5. Conclusions

Promoting shared mobility solutions has become a standard component of urban transport development strategies, serving as a solution within the concept of sustainability. Unfortunately, there is a lack of official data on shared mobility vehicles, making it nearly impossible to monitor changes and assess whether expected effects are occurring. An attempt to obtain data on the number of vehicles and users in each city from the main car-sharing operators was unsuccessful. Only one of the three main companies operating in the Polish market provided data. This is one of the primary limitations in studying the quantitative changes in the development of shared mobility.

The discrepancy between the results of studies conducted in other countries and trends in car ownership in Poland is, among other factors, due to the fact that when shared mobility systems were introduced, Western European countries already had higher rates of private car saturation than Poland. The second important reason is the attitude of Poles towards cars. The mentality towards car ownership is multidimensional, resulting from historical, cultural, and socio-economic conditions. The scarcity of cars during communist times meant that the private car was perceived as a coveted symbol of prestige and a marker of social success. Combined with low-quality public transport and underdeveloped shared transport, this attitude has become deeply entrenched.

It can be predicted that, in the coming years, the increase in the number of passenger cars in Poland will no longer be significant due to the already high motorization rates compared to other developed European countries. Another reason is that younger generations do not attach as much importance to owning a car on their own. So, they may not buy a car if they have the option of using a vehicle when needed. Some studies have found that there is a higher incidence of car-sharing users who do not own a car and do not buy, rather than those who decide to sell their vehicle. People who own cars only rent car-sharing vehicles on rare occasions.

To date, research on shared mobility in Poland has been quite limited, typically focusing on small samples of local car-sharing and micromobility users. They are mainly qualitative studies aimed at determining the preferences of users of these systems, the level of satisfaction with the use of services, expectations regarding improved infrastructure and integration with public transport, as well as factors that have encouraged respondents to use this form of transport. Directions for further research should primarily include larger groups of respondents from different cities. Furthermore, the research should cover both the group of users who regularly use shared transport and those who do not, in order to find out the factors that prevent them from changing their transport behavior. Perhaps there are differences in attitudes towards urban travel between generations of users. In view of the observed phenomenon of a continuous increase in the number of private cars, it would be worthwhile to carry out an in-depth study of the factors causing Poles' reluctance to give up owning a private car and what might persuade them to use other forms of transport.

There is a substitution between modes of transport, meaning that transport needs can be met in various ways. The choice of a particular mode of transport is influenced by how well it meets the user's cost and quality requirements. Therefore, it is necessary to take initiatives to increase the attractiveness of using shared modes of transport. The guiding idea behind such solutions is to better integrate the different modes of shared mobility, as well as with public transport. Infrastructural integration requires the setting up of dedicated locations where different vehicles and shared mobility services are made available. Such places, called mobility hubs or centres, should be established at public transport interchanges, office buildings, or shopping malls, i.e. places where large numbers of people travel. Finally, it is important to integrate access to information on the availability of different services, as well as the ability to book vehicles and pay fares, into a single mobile application. This type of integration can be described as digital integration. An example of such an advanced digital tool is the integrated platforms linking public and shared modes of transport, known as Mobility-as-a-Service (MaaS), which are operating in an increasing number of cities around the world. MaaS systems not only allow users to find the best travel alternatives based on their needs, but also enable payment for travel across different modes of transport as if it were a single service

It is conceivable that implementing solutions that improve the convenience, accessibility, reliability and affordability of shared mobility could encourage more people to use these services. Additionally, congestion commonly found in cities could serve as an unlikely ally, and an organizational solution to promote the shift from private cars to car-sharing could involve allowing shared vehicles to use bus lanes, as is the case with taxis.

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SOCIO-ECONOMIC IMPORTANCE OF BIOENERGY PRODUCTION IN EU MEMBER STATES

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Purpose: This study aimed to assess the socio-economic importance of bioenergy production for the economy of the European Union and its individual members in relation to its competitiveness and situation on the labour market.
Design/methodology/approach: This study analyzes the socioeconomic importance of bioenergy production in EU countries in the context of the turnover generated, volume of employment, and labour productivity in the various sections that produce energy from biomass (bioelectricity, bioethanol and biodiesel). This study uses figures extracted from the EU Bioeconomy Monitoring System (Data-Modeling platform, 2025) for 27 EU countries.
Findings: The study showed that bioenergy production in the European Union member countries has a significant importance for its labour market, because the scale of employment in the three analyzed bioenergy sectors doubled between 2010 and 2021 to nearly 50 million employees. During this period revenue from bioenergy production increased more than threefold. In terms of labour productivity, which determines the competitiveness of bioenergy production, the situation in the three examined sectors varies greatly across European Union member states.
Practical implications: The findings presented in this article, illustrating the efficiency of individual types of bioenergy production, may provide guidance for private investors regarding capital allocation in the renewable energy sector and for public authorities to support the development of renewable energy sources in EU countries.
Social implications: The research results presented in this article can be used in promotional and educational activities to achieve a greater degree of acceptance of the EU climate and energy strategies through the large-scale use of renewable energy by the inhabitants of the European Union, and thus improve the condition of the natural environment and their quality of life.
Originality/value: This study fills the research gap by assessing the importance of bioenergy production for the labour market in the European Union.
Keywords: bioenergy, bioeconomy, European Union, labour market, labour productivity.
Category of the paper: Research paper.

1. Introduction

One of the main socio-economic challenges of the world, due to the growing population, increased scale of human economic activity, and associated exploitation of natural resources, is the need to protect the environment, combat climate change, and sustainably use of natural resources (Adamowicz, 2017, p. 29). To address this challenge, the European Commission (2012) adopted the Bioeconomy Strategy in 2012, which was updated in 2018. The updated strategy confirmed its five original objectives: ensuring food and nutrition security, managing the sustainable development of natural resources, reducing dependence on non-renewable resources, mitigating and adapting to climate change, strengthening Europe's competitiveness, and creating jobs (European Commission, 2018). These goals, in line with the latest European Green Deal strategy adopted in 2019 (European Commission, 2019), are now more relevant than ever in the context of the Russian invasion of Ukraine and the need to accelerate the achievement of climate and energy independence (European Commission, 2022b). The EU Bioeconomy Strategy enables a green and just transition and covers all three dimensions of sustainability: environment, society, and economy. To achieve these goals, the updated Bioeconomy Strategy is accompanied by a targeted action plan with three main areas of action: strengthening and scaling up bio-based sectors, unlocking investments and markets, rapidly implementing local bioeconomies across Europe, and understanding the ecological boundaries of the bioeconomy (European Commission, 2022a).

The bioeconomy encompasses all sectors and systems that rely on biological resources (animals, plants, microorganisms and their biomass, and organic wastes). The EU Bioeconomy Strategy should help identify, assess, and resolve trade-offs between policy objectives and competing uses of land, sea, and biomass. By optimizing the use of biological resources from land and sea, the bioeconomy maximizes co-benefits such as biomass production, climate change mitigation, and enhanced biodiversity, while protecting and benefiting from other ecosystem services (Faber, Jarosz, 2023, p. 5).

Bioenergy is a key element in combating climate change, securing energy supplies, and providing income for producers in regional biomass supply chains. Bioenergy is the conversion of biomass - such as agricultural and forestry by-product residues and wastes, organic municipal waste, low-risk indirect land use energy crops, algae, biological CO2 - into useful energy carriers, including heat, electricity and transportation fuels (Perišić et al., 2022, p. 2; IEA, 2023, p. 4). Bioenergy supports the transition to a low-carbon economy in several ways and offers numerous benefits to society. It replaces fossil fuels, thereby reducing greenhouse gas emissions. Bioenergy and biofuel facilities can act as sources of biogenic CO2 for carbon capture, storage, or use, in certain cases, and even offer the possibility of achieving negative net CO2 emissions (Tiwari et al., 2024; IEA, 2023, p. 5). Therefore, bioeconomy sections related to bioenergy production require special attention. However, there is a clear

research gap in this area, especially in the context of the role of these sections in the development of the bioeconomy. The present study blends into the current of bioeconomy research, with the main goal of assessing the importance of bioenergy production in European Union member states from a socio-economic perspective.

2. Data and methods

This study uses figures extracted from the EU Bioeconomy Monitoring System, including the database Data-Modeling platform of resource economics created by the European Commission's Joint Research Center (Data-Modeling platform, 2025). The purpose of this system is to provide a consistent approach to monitoring progress toward bioeconomy goals across EU member states, reflecting the five goals of the Bioeconomy Strategy (European Commission, 2022a). The analysis considers the official classification of economic activities in Europe called NACE 3, which includes 10 sections of the bioeconomy (Ronzon, M'Barek, 2018, p. 2): Agriculture; Forestry; Fishing and aquaculture; Food, beverages and tobacco; Biotextiles; Wood products and furniture; Paper; Biochemicals, pharmaceuticals, plastics and rubber (excluding biofuels); Liquid biofuels (bioethanol and biodiesel); and Bioelectricity (electricity generation from biomass). The analysis conducted in this study focuses on employment and labour productivity issues in the divisions that comprise bioenergy production, that is, biofuel production and bioelectricity. Its timeframe covers the period from 2010 to 2021 and is based on the availability of statistical data. This study analyzes the socioeconomic importance of bioenergy production in EU countries in the context of the turnover generated, volume of employment, and labour productivity in the various sections that produce energy from biomass. The productivity index was calculated as the ratio of the gross value added of each bioeconomy section to the number of people employed. The study covered 27 EU countries, excluding the UK, which formally left the EU in early 2020.

3. Results and discussion

The analysis of the potential and effectiveness of its use in selected sections of the bioeconomy related to bioenergy production included indicators illustrating the level of employment in individual sections, the amount of generated revenues (turnover), and labour productivity indicators measured by value added per employee.

First, the potential of the studied bioeconomic sections and their socioeconomic importance are presented through the prism of the volume of employment in the three sections related to bioenergy production (Figure 1). In 2021, the three analyzed bioeconomy sections related to bioenergy production employed 49,962.6 thousand people. Compared with 2010, this number doubled (209%). Of the three analyzed sections, the production of electricity from harvested biomass had the highest employment. In 2021, it employed 36.4 million people, and the average annual increase in the number of employees between 2010 and 2021 was more than 2 million. The growth rate of employment in this section was 231% over the years under review. On the other hand, the section related to bioethanol production employed 10,277.9 thousand people in 2021, while biodiesel production employed 3334.0 thousand people. The dynamics of growth in the number of employees compared with 2010 were 143.3% and 376.7%, respectively.

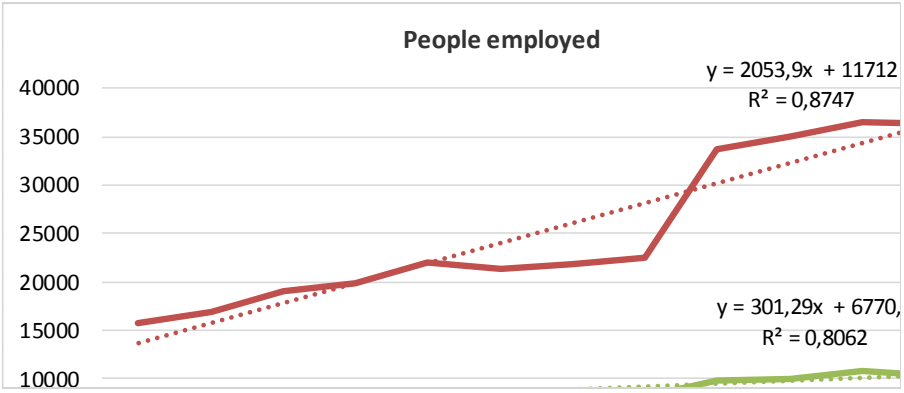


Figure 1. Changes in employment in selected sections of bioenergy production in the EU from 2010 to 2021.

Source: own elaboration based on the database Data-Modelling platform of resource economics.

The following analysis presents the economic importance of the sections in terms of generated revenue value (turnover). They correspond to the market sales of goods or services provided by these sections and are therefore higher than the gross value added in most cases (Ronzon, M'Barek, 2018, p. 3). The total value of turnover of the three sections under study was 64,697.9 million euros and 19,700.1 million euros in 2021 and 2010, respectively (Fig. 2). This represents a more than three-fold increase in their value. The growth dynamics of the analyzed sections varied. Turnover in the bioenergy sector grew at an average annual rate of €2273 million and its dynamics from 2010 to 2021 reached 401%. In the case of biodiesel, turnover increased sharply in the last year of the study, amounted to 14,082.8 million euros. In contrast, the turnover of bioethanol increased by 74% in the years under study, amounted to 8978.6 million euros.

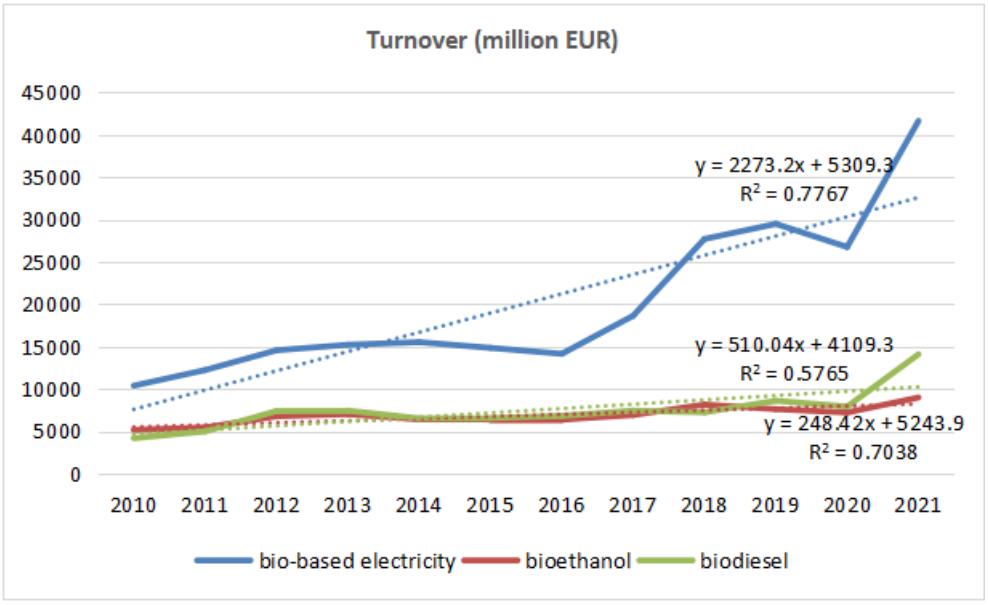


Figure 2. Changes in the value of turnover in selected sections of bioenergy production in the EU from 2010 to 2021.

Source: own elaboration based on the database Data-Modelling platform of resource economics.

In addition to the level of employment and volume of turnover, gross value added (GVA) is among the most commonly used indicators for monitoring the bioeconomy and measuring its size (Kuosmanen et al., 2020). It reflects both the production possibilities inherent in the accumulated and utilized stock of production factors and their market realization made possible by the existence of effective demand (Cyrek, 2014). In 2021, the total GVA of the three surveyed sections was €13,233.9 million, an increase of 270% from 2010. The largest GVA was generated by the bioenergy production section, with an average annual increase of 343.8 million euros (Figure 3).

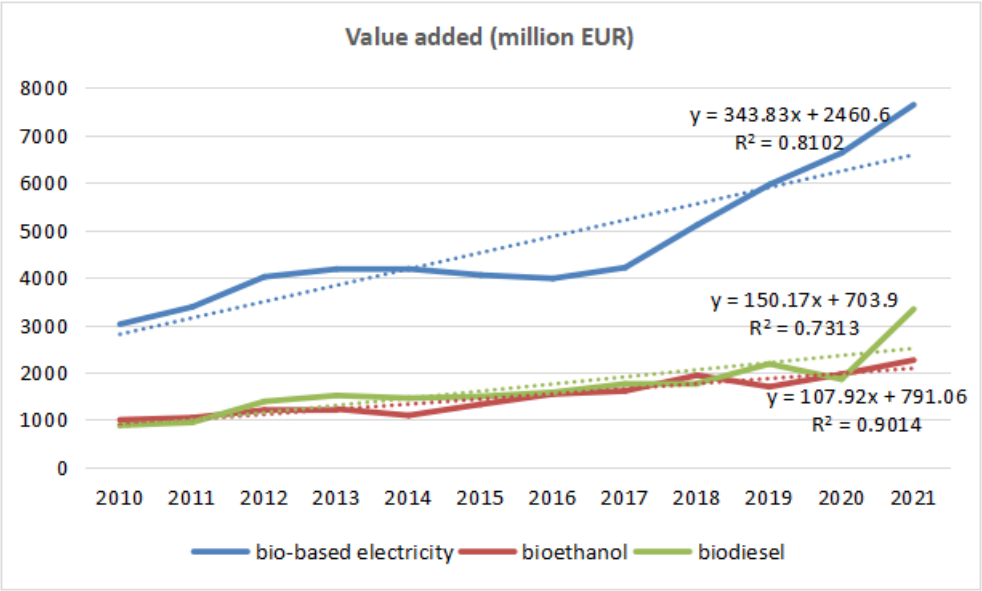


Figure 3. Changes in gross value added in selected sections of bioenergy production in the EU from 2010 to 2021

Source: own elaboration based on the database Data-Modelling platform of resource economics.

Labour productivity is a measure of a sector's competitiveness in the economy. It is the ratio of gross value added to the number of employees (Faber, Jarosz 2023, p. 8). Labour productivity, which is fundamental to economic competitiveness, depends on technical progress and structural transformations. The increase in labour productivity is seen as an important source of economic growth, progress, and improvement in society's standard of living (Hearne, Lewis 2024, p. 447). As can be seen from the data presented in Table 1, the highest average labour productivity in 2010-2021 was characterized by the section on bioenergy production, but its growth rate was relatively low (109.6%). The other two sections were characterized by higher growth dynamics of the studied productivity index and a higher coefficient of variation, with the bioethanol production section having an absolute value of labour productivity that averaged 149.6% of the level achieved in the biodiesel production section in the years under study.

Table 1.
Labour productivity in selected sections of bioenergy production in the EU from 2010 to 2021

Years	Gross value added per employee (€1000/person)		
	Bioelectricity	**Bioethanol**	**Biodiesel**
2010	191.7	139.4	90.9
2011	200.6	143.9	92.2
2012	211.5	148.2	93.8
2013	210.7	141.6	103.2
2014	190.4	138.3	105.1
2015	189.7	167.1	109.0
2016	181.6	179.5	115.4
2017	186.6	197.3	129.3
2018	151.5	197.5	127.2
2019	170.5	170.4	130.2
2020	181.4	181.2	117.9
2021	210.2	219.8	139.0
Dynamics (2010 = 100)	109.6	157.7	152.9
Mean	189.7	168.7	112.8
Coefficient of variation	9.3	16.1	14.5

Source: own elaboration based on the database Data-Modelling platform of resource economics.

There are significant differences between EU member states in the level of labour productivity in the analyzed sections of the bioeconomy. Due to the minor importance of the selected sections for the development of the bioeconomy of some EU countries and the availability of data, all EU members were not included in the analysis. In the case of bioethanol production, labour productivity for all EU countries in the years under study increased by 57.7%, from €139,424.3 to €219,818.0 per employee (Fig. 4). The highest level of this indicator in 2021 was characterized by countries such as Romania 404,267.1 euros, the Netherlands 387,520.7 euros and Belgium 285,307.2 euros per employee. In contrast, Croatia, Bulgaria, and Slovakia had the lowest levels. The greatest progress in this regard in the years under review was made by former Eastern Bloc countries such as Romania, where the dynamics amounted to an impressive 2328.0 percent, followed by Bulgaria (595.2%) and Hungary (436.7%). Large changes were recorded in Italy 373.2% and Poland (261.3 %). In contrast, a decrease in

the value of this indicator was recorded only in the case of Slovakia (down 19.2 p.p.) and a slight dynamic in countries such as Finland (108.0%), France (111.6%), and Germany (116.8%). The figures presented here determine the importance of the production of liquid fuel biocomponents in the form of bioethanol for a country's economy, both for its situation in the internal labour market (employment levels and labour efficiency) and its export position in international markets (Nowak, Jarosz-Angowska 2024, p. 87).

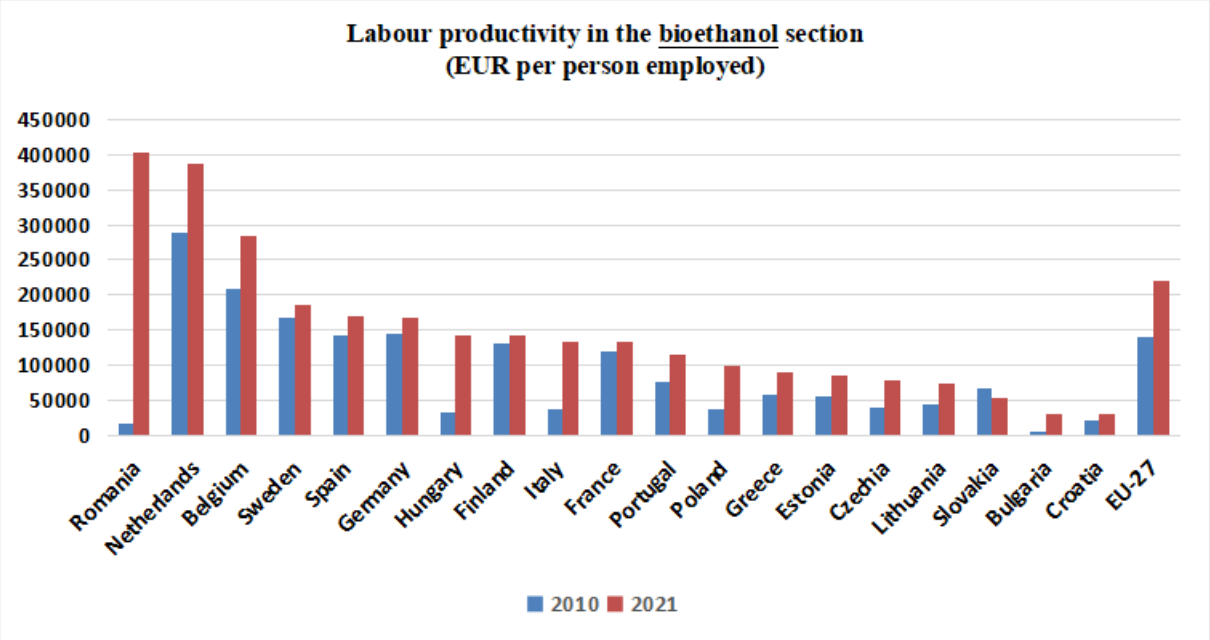


Figure 4. Labour productivity in the bioethanol production section in selected EU countries, 2010-2021. Source: own elaboration based on the database Data-Modelling platform of resource economics.

A similarly diverse situation across the European Union was observed in biodiesel production (Figure 5), where labour productivity more than doubled (i.e., by 208.2%) from 90,897 thousand euros to 189,249 euros per employee. In this case, the undisputed leader in the level of labour productivity in 2021 was Lithuania, with an indicator of 436 451.6 euros per employee. In the case of this country, the dynamics of change of this indicator were also impressive, increasing more than nine times (935.4%) in the years under review. This was followed by Finland (189 248.8 euros), Belgium (174574.0 euros), and Austria (167609.1 euros). The lowest labour productivity in the biodiesel production section was recorded in Croatia (37204.4 euros), Romania (34887 euros) and Bulgaria (27106.7 euros). The analyses presented show the varying importance of biodiesel production in EU countries and determine the labour market situation related to the development of the bioeconomy in terms of biofuel production, as well as the efficiency of the sections studied. The changes that have been observed in the socioeconomic importance of bioenergy sections are a consequence of the availability of the raw material base as well as the extent of private and public investment that has been made in connection with the implementation of EU climate and energy policies in individual countries.

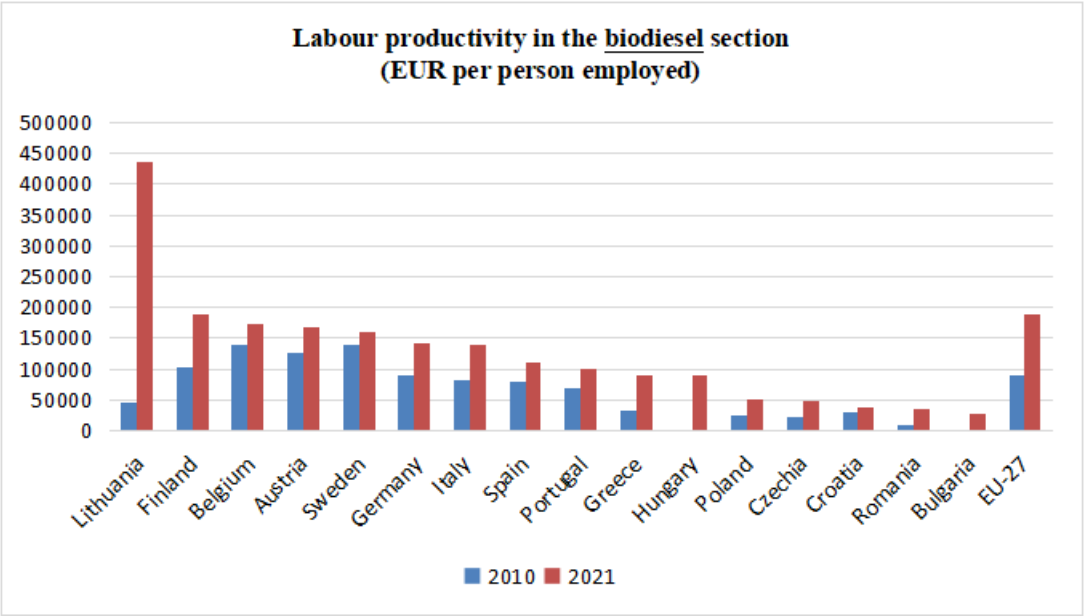


Figure 5. Labour productivity in the biodiesel production section in selected EU countries in 2010 and 2021.

Source: own elaboration based on the database Data-Modelling platform of resource economics.

The last section analyzed in the study related to bioenergy production is bioelectricity (Figure 6). Here, labour productivity varies considerably between EU countries. At the level of the European Union as a whole, the change that took place in the years under review does not appear to have been too great, as labour productivity increased by less than 10%, from €191 730.7 in 2010 to €210 191.9 per employee. In this case, the leader in the size of the labour productivity index in 2021 was Spain (€737,362.9), followed by the Netherlands (€455,107.0) and Belgium (€431,455.6). Countries with the lowest level of this indicator included Romania (€87,085.0), Latvia (€86,179.1) and Slovenia (€80,006.9). In terms of the growth rate of this indicator in the years under review, Lithuania (345.2%), Spain (327.2%), and Bulgaria (257.6%) stood out positively. In contrast, a decrease in the growth rate of the labour productivity indicator was recorded in Portugal (by 53 p.p.), Sweden (by 52.5 p.p.), and Latvia (by 20.6 p.p.). It can be assumed that the changes recorded were due to the amount of investment and restructuring activities undertaken by the country in the bioenergy production sector and the scale of innovation implemented in the technologies used, resulting in an increase in labour productivity and value added. In turn, an increase in the efficiency of bioenergy suppliers results in improved competitiveness in other industrial sectors using cheaper energy compared to traditional suppliers using fossil resources.

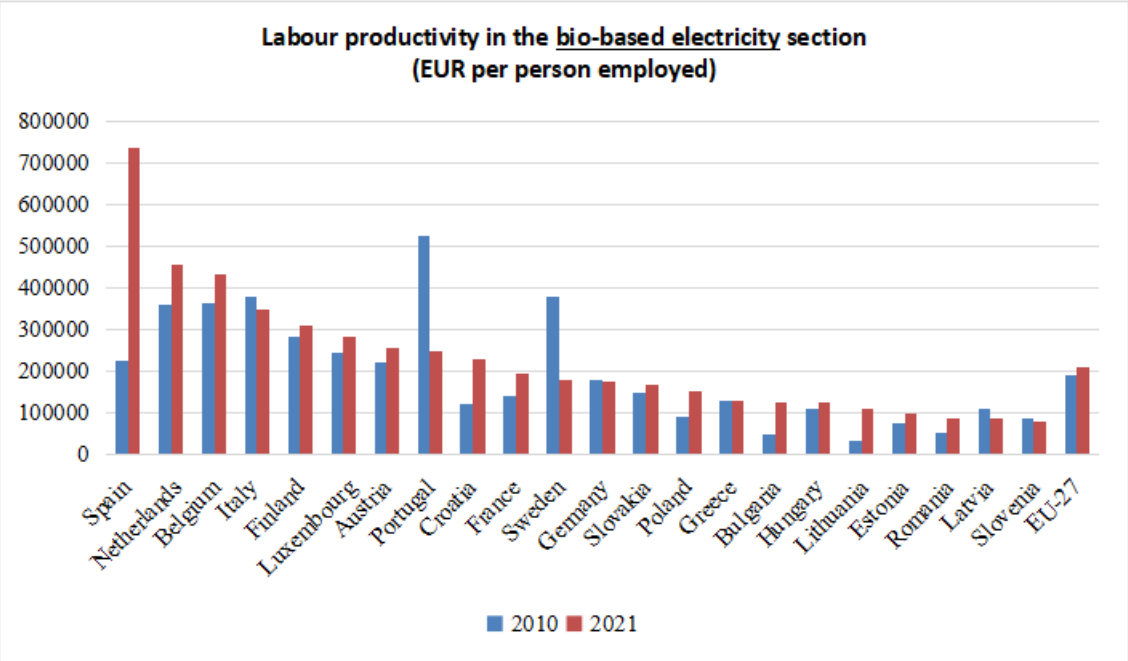


Figure 6. Labor productivity in the bio-based electricity production section in selected EU countries in 2010 and 2021.

Source: own elaboration based on the database Data-Modelling platform of resource economics.

The issue of renewable energy sources has been one of the more frequently discussed issues in recent years, related to both environmental and economic issues. Renewable energy production is considered to provide a sustainable strategy for replacing fossil fuels and mitigating climate change by meeting the growing global energy demand (Adeh et al., 2018, p. 13). This issue can also be addressed from the perspective of the bioeconomy sections analyzed in this study, which have rarely been studied by other authors. As part of the green economy, the bioeconomy plays a key role in replacing fossil fuels on a large scale, not only in energy applications but also in chemical and material applications (Scarlat et al., 2015, p. 31). Tiwari et al. (2024, p. 53) emphasized that the energy sector should make an important contribution to the EU CO2 reduction targets. As shown by the results of this study, both the size and efficiency of the sections related to bioenergy production in the EU are increasing. This is also confirmed by Nowak and Jarosz-Angowska (2024, p. 77), who analyzed the importance of all sections of the bioeconomy from a labour market perspective. The analysis of Cîrstea et al. (2019), on the other hand, show that bioenergy correlates positively with the degree of innovation in a particular field or with natural gas energy and negatively with the economic efficiency of a country. These authors confirmed that bioenergy production can make a significant contribution to climate change mitigation while ensuring the diversification of energy resources in the long term.

4. Conclusions

Research shows that the EU's climate and energy policy has a positive impact on the development of bioenergy sectors, leading to an increase in their efficiency in countries where renewable energy plays an important role and has implemented measures to financially support public and private investment and the necessary restructuring processes. An important element in the development of these sectors is the implementation of efficient technologies for the production and supply of renewable energy, as well as in the biomass supply sectors such as agriculture and forestry. The development of renewable energy in the European Union has a positive impact on the labour market and offers new employment opportunities, particularly in rural and post-industrial regions. Renewable energy, especially that produced locally, supports local communities, reduces dependence on external energy supplies, and creates new opportunities. However, the transition process needs to be properly managed to mitigate the effects of climate and energy policies on traditional energy sectors and to support workers in adapting to new labour market demands. With the bioenergy production sector being export-oriented, higher productivity allows domestic companies to compete better in international markets, which helps to increase a country's trade balance. Given the internal diversity of the European Union, further research should focus on the specific circumstances of individual countries, their potential for renewable energy production, and their environmental and climate protection economic policies.

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MARKETING IN SCIENCES AND IN THE POLISH SCIENCE CLASSIFICATION SYSTEM

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Purpose: The article explores marketing's place among disciplines, contributing to the debate on its scientific status, especially in Poland, by consolidating various perspectives.
Design/methodology/approach: The research uses a literature review methodology (desk research) to gather opinions from scientists. It analyzes marketing's status as a science, its affiliation with various fields, and its place in the scientific classification system, emphasizing discrepancies between its legal status and treatment in literature.
Findings: The analysis discusses trends and debates on marketing as a science in Poland, recognizing it as a science per classical definitions but noting its absence in the official science classification. The article also explores whether marketing should be a sub-discipline of management or a separate discipline within economic sciences.
Research limitations/implications: The article is based on the analysis of available literary sources, thus its findings are dependent on the availability, timeliness, and representativeness of the examined publications.
Practical implications: The article emphasizes the need for scientific reflection on marketing, especially given administrative decisions marginalizing the field within science and economics education. Practically, this calls for promoting marketing as a crucial area of knowledge in both academic and business contexts.
Originality/value: The paper contributes to the discussion on the scientific status and classification of marketing, offering a comprehensive review of different perspectives and identifying key areas of contention. It is addressed to both academics and practitioners interested in the theoretical and practical aspects of marketing.
Keywords: Marketing, marketing management, scientific discipline, interdisciplinarity, science classification.
Category of the paper: literature review, general review.

1. Introduction

Marketing integrates theoretical reflection with practical application, attracting both academics and practitioners (Oczachowski, 2010, p. 65). Practitioners seek effective solutions in economics and management, addressing market challenges, customer relationships, brand management, social impact, and digital transformation. The discussion on marketing's place in science should begin with assessing its recognition as an independent discipline and its alignment with existing classifications. Given the principle of scientific verifiability, establishing marketing's scientific status is crucial to distinguishing it from speculation while maintaining its practical relevance.

2. Is marketing a science? Discussion

Marketing has influenced consumers for over a century, yet its status as a scientific discipline remains debated (Niestrój in: Altkorn, 1997; Kaczmarczyk, 2016). While definitions focus on practice and its variations, marketing lacks a clear, universally accepted definition, hindering its recognition as a science. Scientific validity requires testable theories, which is challenging for marketing due to its practical orientation.

Popper argues that science explains phenomena, and in marketing, functional and intentional explanations are particularly relevant, as it examines consumer motivations and behaviors shaped by social interactions (Strawiński, 2011, p. 324). While Popper emphasizes falsifiability in natural sciences, social sciences, including marketing, must adapt to specific temporal and spatial conditions (Woleński, 2022). Kuhn defines science as an evolving process of knowledge accumulation through dominant paradigms that undergo revolutionary shifts (Kuhn, 1968). Marketing has long been dominated by the applied paradigm, where managers use the marketing mix to manipulate tools for competitive advantage, influence purchasing behavior, and increase profitability (Kamiński, 2017, p. 30). Alternatively, the macromarketing paradigm focuses on systemic analysis of growth and change in the digital economy, business networks, and socio-environmental impact (Kamiński, 2017, p. 30; Kaczmarczyk, 2016). Marketing is also considered a multiparadigmatic science, integrating social and postmodernist approaches (Żabiński, 2000; Mazurek-Łopacińska, Sobocińska, 2013; Sagan, 2016). Thus, marketing can be recognized as a science under classical definitions.

Marketing is recognized as a science based on social and historical criteria, as it meets institutional and academic standards through publications, conferences, and scientific hierarchies, and is acknowledged by both theorists and practitioners (Sułkowski, Lenart-Gansiniec, 2021, p. 217; Sułkowski, 2004). It employs interdisciplinary research methods from

social, humanities, and natural sciences. Oczachowski (2010, p. 67) emphasizes that while marketing does not formulate universal laws, it aligns with modern scientific trends by integrating diverse methodologies, making it an interdisciplinary field. Żabiński (2005, p. 6) classifies marketing as an applied science with a distinct research subject separate from microeconomics and management studies, encompassing mature local paradigms that foster new concepts (e.g., service, global, and territorial marketing), indicating its dynamic development and links to microeconomic, psychological, and broader social science theories. Mantura (2015, p. 12) also defines marketing as an applied science, with marketing engineering as its core achievement – bridging theory and practice with both cognitive (theory-building) and practical (action-optimization) goals. Marketing evolves through methodological advancements and research tools, with engineering surpassing theory in development. According to research by the Polish Scientific Society of Marketing (PNTM), 93.3% of Polish marketing scholars consider marketing science to include both positive and normative knowledge, while 61.8% believe that marketing education should focus on enhancing practical applications and developing applied marketing skills, confirming its dual theoretical and practical nature.

Opponents argue that marketing is a collection of practical tools rather than a science. Figiel (2006, p. 36) and Karwowski (1998, p. V) view marketing as a practical activity without theoretical foundations. Dietl (2004, p. 16) contends that marketing is not a scientific discipline because it lacks a unified theory, original research methods, and a clearly defined subject scope. Instead, marketing should be seen as a pragmatic activity that draws on knowledge from various fields such as economics, psychology, and sociology, with marketing publications categorized within disciplines like economic psychology, microeconomics, or sociology (Dietl, 2004, p. 17).

The definitions of the American Marketing Association (AMA) have evolved from practical ones (1935) to broader social contexts (2013), reflecting the development of marketing thought. Polish researchers attempt to bridge theory and practice, but there is a discrepancy between academics and practitioners (Mazur, 2010, p. 25). Additionally, there are systematized yet broad approaches to marketing in four dimensions: as a philosophy of action, a process, a function within the enterprise, and a set of action tools (Mruk, Pilarczyk, Słowińska, 2012, p. 19).

In summary, marketing is recognized as a science because it meets institutional and social criteria, including its presence in academic discourse, scientific publications, organized conferences, and academic degrees and hierarchies. As an applied science, marketing fulfills the criteria required to be considered a distinct discipline, with a well-defined area of study. However, the lack of a unified theory and unique research methods generates controversy among some scholars. As a social science, marketing is not as universal as natural sciences and must be adapted to the specific conditions and contexts in which organizations and their audiences operate. Marketing, as an interdisciplinary science, develops through the integration

of various approaches and paradigms, drawing from the contributions of social, humanistic, and natural sciences, which proves its interdisciplinarity. Nonetheless, a minority view among researchers still holds that marketing is merely a practice using scientific methods or a collection of practical experiences, rather than a fully developed theoretical concept.

3. Marketing in the fields and disciplines

Since marketing is considered a science, further discussion should focus on identifying which scientific field it belongs to and where it fits within the structure of scientific disciplines. A scientific field is a broad area encompassing various scientific disciplines, which in turn consist of subdisciplines focused on narrower research topics (Sudoł, 2014, p. 23). A scientific discipline, on the other hand, is a distinct part of science, recognized as a fundamental unit of classification based on its subject matter and research objectives (Krzyżanowski, 1994, p. 44).

There is no consensus among researchers regarding the position of marketing within the scientific field. On one hand, marketing is recognized and advocated to be classified as a distinct discipline, on par with fields such as economics, finance, or management and quality studies (Kamiński, 2016). It is suggested that "the evolving discipline of marketing science requires urgent definition" (Kaczmarczyk, 2016, p. 103). On the other hand, according to the current scientific classification in Poland, marketing is described as "a relatively young subdiscipline of management sciences" (Wiśniewski, 2016) and "a part of management sciences, i.e., a subdiscipline" (Sudoł, 2016a, p. 164), considered one of the specialties within the scientific discipline of management (Lenik, 2014) and "one of the fastest-growing subdisciplines" (Sułkowski, Lenart-Gansiniec, 2021, p. 216). Marketing, alongside Human Resource Management (HRM), accounting, and quality management, is categorized as a subdiscipline of management and quality studies (Sułkowski, Lenart-Gansiniec, 2021, p. 21). A similar view is presented by Kaczmarczyk (2015, p. 207), who argues that marketing management is one of the globally recognized concepts for managing an entire company, alongside methods such as management by objectives, TQM, process management, or knowledge management. Some authors use terms such as "marketing management" or "management of marketing" while avoiding the word "marketing", which clearly indicates the perception of marketing as a subdiscipline within management and quality studies and its practical understanding through the lens of management functions.

Sudoł views marketing as a subdiscipline of management sciences (2016a, p. 164), presenting two perspectives: a broad one, where marketing encompasses all social processes between suppliers and consumers, and a narrow one, focusing on the sale of goods or services. He rejects the broader perspective and treats marketing as a management function, analogous

to planning, motivating, organizing, and controlling, thereby considering marketing a concept of management.

A different perspective is presented by Żabiński (2005, p. 8), who distinguishes between marketing theory and marketing management. Marketing management, a subdiscipline, focuses on enterprise-level strategies and demand influence. In contrast, marketing theory examines the broader market system, studying interactions among producers, intermediaries, and customers, aligning more with economics. While marketing theory is analytical-descriptive, marketing management is application-oriented.

Since the early 20th century, marketing evolved within economics, initially focusing on goods distribution and exchange institutions. Over time, it became an independent discipline, integrating insights from various fields (Oczachowski, 2010, p. 65). While some scholars, such as Żabiński (2005, p. 6), still consider marketing part of economics, it is increasingly seen as separate due to its interdisciplinary role in understanding market behavior (Dudzik, 2010, p. 59). As economics became more practical, Nobel-winning works increasingly overlapped with marketing (Dudzik, 2010, p. 74). Żabiński argues that marketing belongs to economics as it applies market theories to value creation (Żabiński, 2005, p. 6). Marketing's focus shifted from economic contexts to managerial decision-making by the 1960s (Mazur, 2010, p. 21), and by the late 20th century, it expanded into social processes, attracting scholars from various fields (Mazur, 2010, p. 21).

According to the results obtained by the Polish Scientific Society of Marketing (PNTM), 68% of Polish scholars believe that marketing and management are two areas of knowledge with overlapping aspects, while 24% of respondents think that the knowledge within the field of management encompasses all the knowledge from the field of marketing (PNTM, 2018). At the same time, 51.6% of respondents believe that marketing should be a subdiscipline within the discipline of management sciences, 30.7% would consider marketing as an independent scientific discipline within economics, and 7.1% as a subdiscipline within economics.

If a subdiscipline should fit within a discipline, discrepancies between management and marketing are evident. Management is defined as "a social discipline that makes organizations the object of analysis" (Sułkowski, Lenart-Gansiniec, 2021, p. 82), while marketing extends beyond the organization, examining relationships between market participants. Marketing involves generalized knowledge of decision-making principles within company-market interactions (Rosa, 2016). According to Niestrój, marketing includes identifying and analyzing external market signals, forecasting trends, and developing strategies adapted to market changes, considering external factors and interactions (Niestrój in: Altkorn, 1997, p. 26). Marketing ideas extend beyond sales, influencing human resources management (personal marketing) and quality management (customer orientation) (Khedher, 2014, p. 29; Sułkowski, Lenart-Gansiniec, 2021, p. 186).

It should be noted that among researchers, there is also no agreement regarding the classification of management (currently perceived as superior to marketing) within the framework of scientific disciplines. Moreover, the scope of management science is not clearly defined, and the concept of management itself has not yet been uniformly specified (Sudoł, 2018, p. 100). It has been postulated that management science should be recognized as an independent field of study (Sudoł, 2016b, p. 8), on par with social sciences, to which management is currently assigned, or, for example, the field of humanities.

The distinction between practical and theoretical approaches in management and quality studies reflects the field's current state, balancing practical achievements with theoretical development. Both aspects of marketing are emphasized in literature, highlighting the role of theory in guiding practice and the application of marketing concepts to improve strategies in dynamic markets. Theory provides essential concepts to identify key actions and rational directions (Rosa, 2016), while marketing practice involves applying methods and techniques (Sztucki, 1992, p. 40). The marketing mix, an instrumental approach, is widely discussed in the literature (McCarthy, 1960; Kotler, 1994; Rosa, 2016).

The paradigms of marketing in management and quality studies shape how scholars perceive and analyze phenomena (Grochmal, 2013, p. 87). Kuhn defines them as widely accepted frameworks for solving scholarly problems (Kuhn, 1968, p. 12). Sudoł (2014, p. 23) views paradigms as core scientific assertions forming the basis for further research. While some scholars argue management and quality sciences are pre-paradigmatic (Płoszajski, 1985, p. 33), most consider them multi-paradigmatic, integrating diverse methodologies from economics, sociology, and psychology (Sułkowski, 2015, p. 123).

Marketing, as part of management and quality studies, is also understood as a discipline composed of multiple paradigms (Szumilak, 2005). The dominant paradigm in marketing (NFS - neo-positivist-functional-systemic) is based on tangible products, objective data, and one-way mass communication. Alternative paradigms emphasize symbolic products, subjective interpretations, and interactive, individualized communication with feedback loops. The key difference lies in the approach to the product, communication, and the relationship with the customer (Sułkowski, Lenart-Gansiniec, 2021, p. 220).

Marketing’s strength lies in its epistemological and methodological pluralism, which may blur its subdiscipline identity (Sułkowski, Lenart-Gansiniec, 2021, p. 221). It uses an eclectic, interdisciplinary approach, drawing from economics, sociology, and anthropology. The division between theory and practice and the role of the researcher versus practitioner remain debated, leading to ongoing reflection. Limiting marketing to marketing management excludes contemporary aspects and reduces future research possibilities, narrowing its scope and diminishing interdisciplinarity (Sułkowski, 2016; Sułkowski, Lenart-Gansiniec, 2021, p. 103).

4. Marketing in the science classification system

Despite being recognized as a science by most academics, marketing is not listed among scientific disciplines in the Polish system of science classification. Initially, it appeared in proposals as a subdiscipline (Sudoł, 2014, p. 31), but was ultimately replaced by marketing management (Bełz, 2019). The current division of fields is based on the classification adopted by the Organisation for Economic Co-operation and Development (OECD) and was developed with input from various academic and governmental bodies. The subdiscipline of marketing management is classified within the field of management and quality studies, under the social sciences, which confirms the dominant managerial approach to marketing. In the proposed classification of subdisciplines in management and quality studies v. 2.0 (Bełz et al., 2019), found on the website of the Committee for the Science of Organization and Management of the Polish Academy of Sciences, marketing management is placed at the functional level within the practical stream, although literature indicates its strategic nature in the context of businesses and organizations. Marketing is described as: the philosophy of business management (McNamara, 1972), the philosophy of doing business and operating enterprises (Mruk, 1994), the concept of action according to market rules (Rydel, 1996), an organization's strategic approach to the market (Niestrój in: Altkorn, 1997), more than just the coordinated use of instruments – it is a distinct philosophy of managing a company or organization (Karwowski, 1998), the philosophy of business (Kotler, 1999). The literature clearly distinguishes and defines the scopes of strategic marketing – general, long-term actions such as target market selection, defining the company's mission, operational philosophy, and higher objectives – and operational marketing – detailed, short-term planning, subordinate goal analysis, specifying elements of the marketing mix (Rosa, 2016).

The omission of marketing from the theoretical stream disregards over 100 years of research contributions, which include both positive knowledge about the relationships between organizations and the market, as well as normative knowledge regarding the principles of effective market actions (Niestrój in: Altkorn, 1997, p. 19). The development of marketing as an academic discipline began in the early 20th century in the United States, with the first marketing lectures appearing in 1905 (Dietl, 1985, p. 13; Rosa, 2016, p. 23). After World War II, marketing became established as a scientific discourse (Kotler, 2005b, pp. 114-116) and reached European academia in the 1960s (Daszkowska, 2015).

In the classification of sciences by the National Science Centre (NCN 2022), which serves as the basis for the qualification and evaluation of research projects, marketing is classified under the Humanities, Social Sciences, and Arts (HS) section, specifically in panel HS4 – Individuals, institutions, markets: economics, finance, management, demography, social and economic geography, urban studies. It is listed as one of the subtopics within panel HS4_08: Behavioral economics, consumption and consumer behavior, marketing. This classification

aligns with the view of marketing's focus in economic terms (e.g., Żabiński, 2005, Dudzik, 2010) and deviates from the prevailing perception of marketing as a subdiscipline of management and quality studies (e.g., Kamiński, 2016; Kaczmarczyk, 2016; Sudoł, 2014; Sułkowski, Lenart-Gansiniec, 2021).

The classification of marketing varies by country. In the United States, according to the JEL (Journal of Economic Literature) system used by the American Economic Association, marketing is included in group M, alongside accounting and human resource management, with the M3 subgroup specifically distinguishing it from advertising. Notably, there is a clear separation between marketing and advertising, even though many marketing target audiences consider these terms synonymous (Al-Noorachi, 2014, p. 11). In the OECD classification, marketing is not listed. Within the field of Social Sciences (Category 5), under group 5.2 Economics and Business, marketing is covered by 5.2.c Business and Management.

5. Summary

Marketing is considered a science (a view shared by most authors), but it does not appear in Polish scientific classifications: neither in the state classification nor in the scientific classification of the Polish Academy of Sciences (PAN). In the NCN classification, marketing is listed alongside behavioral economics, which contrasts with the prevailing recent perception of marketing as a subdiscipline of management and quality studies, or as marketing management. Due to the practical and useful nature of the solutions it offers, marketing is commonly viewed as a set of tools aimed at achieving market goals, with its scientific nature still questioned by researchers, despite its over 100-year legacy and meeting the conditions that would be considered sufficient for other fields to be classified as sciences. Marketing operates within the academic sphere: publicly funded research is conducted that clearly falls within the scope of marketing, scientific societies (e.g., PNTM) are active, conferences are organized, publications are issued, and marketing knowledge is passed on to students. However, those conducting research and publishing results are not recognized as marketing scientists, because according to the current classification, which is used for awarding academic titles, marketing does not appear.

Reflection on the scientific identity and interdisciplinary nature of marketing is essential, especially amid profound changes in social sciences (Gorynia, 2019; Oczachowski, 2010). The boundaries between disciplines are shifting, fostering integration, new fields, and cross-disciplinary influences, particularly in management sciences, which merge sociology, psychology, mathematics, and IT to generate innovative concepts (Sudoł, 2016a). The interdisciplinarity of management sciences, including marketing, will intensify, blurring distinctions and challenging academic structures (Sułkowski, Lenart-Gansiniec, 2021).

Despite ongoing debate about marketing's scientific classification, its core principles—satisfying customers while ensuring profitable sales—are widely accepted (Altkorn, 1995). Rooted in market adaptation, marketing theory is empirical and interdisciplinary, with observation as a key research method (Marcinkiewicz, 2011; Dudzik, 2010). However, reducing marketing to advertising and communication trivializes its role, and administrative decisions further marginalize it within economics education (Dudzik, 2010). A 2018 study by the Polish Scientific Marketing Society found that most scholars view marketing as both theoretical and practical, with over 60% supporting applied business education (PNTM, 2018). Marketing courses exist in higher education, but they focus mainly on tools and practical applications.

Restricting marketing to management sciences narrows its interdisciplinary scope, emphasizing strategic and operational tasks while overlooking its broader theoretical framework, which aligns more closely with economics. A multidisciplinary approach—including economics, psychology, and sociology—is crucial for understanding consumer behavior and market dynamics. Marketing's expanding scope supports the argument for recognizing it as a distinct discipline or closely linking it with economics (Żabiński, 2005).

The development of marketing as a scientific discipline has involved both theoretical and practical aspects, emphasizing its interdisciplinary nature. Contemporary approaches show that marketing extends beyond management, supporting its classification as a distinct discipline or closely related to economics. This is confirmed by its inclusion in the NCN (National Science Centre) classification of 2022, alongside behavioral economics, consumption, and consumer behavior. Although marketing's evolving nature may challenge its identity, it also demonstrates the dynamic growth of the field (Sułkowski, Lenart-Gansiniec, 2021). Marketing management is one of the fastest-growing subdisciplines within management and quality studies.

In the author's humble opinion, considering the validity of the discussion on the marketing identity and interdisciplinarity, with increasingly evident tends to blending of scientific disciplines, perhaps the possibility of uniting disciplines (since their borders are blending) should also be discussed, instead of fragmenting them. Omitting much of marketing's output by limiting it to marketing management is detrimental to researchers dealing with the "economic" part of marketing issues, such as consumer behavior. Furthermore, dividing marketing into the part influenced by managers (marketing management) and the part concerning its effects on the market (behavioral economics) seems like an artificial complication. Management and quality studies, as well as economics and finance, are separate disciplines within the field of social sciences in the Polish classification, which makes it difficult to assign research results to a discipline, thus complicating funding acquisition and seeking research results. Meanwhile, due to the lack of consensus among scientists themselves, the discussion "where should marketing be in the structure of sciences?" remains open.

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IMPORTANCE OF LABOUR FACTOR IN BIOECONOMY SECTORS – POLAND VS. EUROPEAN UNION COUNTRIES

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Purpose: Bioeconomy is one of the largest and most important sectors of the European Union economy. It employed over 17 million people in 2021 and generated an added value of approximately EUR 728 billion. This study assessed the utilisation of the labour factor in bioeconomy sectors in Poland compared with other European Union countries.
Design/methodology/approach: An analysis was conducted on employment levels and labour productivity from 2010 to 2021. The study also attempted to classify EU countries based on relative measures of average labour productivity in the bioeconomy and the dynamics of changes observed.
Findings: In Poland, the bioeconomy recorded a labour productivity of EUR 12,552 per employee, which represented only 38% of the EU average. Poland ranked 25th in the bioeconomy labour productivity. Throughout the analysed period, labour productivity in Poland rose by 78%. Changes in the sectoral employment structure were noted, with a shift of employees from low-productivity sectors to those with higher productivity. Like most countries that joined the EU after 2004, Poland is one of the countries that are "catching up" due to low labour productivity, which is growing at an above-average rate. Investing in technology and innovations that enhance labour efficiency is essential for competing with countries that have high labour productivity.
Research limitations/implications: The key methodological limitations identified in the analysis concern data availability, both temporal and cross-sectional.
Originality/value: In this article, the authors attempt to classify EU Member States according to relative measures of average labour productivity in the bioeconomy and the dynamics of its changes in the years 2010-2021 in order to indicate the existence of beta convergence.
Keywords: bioeconomy, labour, productivity.
Category of the paper: Research paper.

1. Introduction

Many authors have noted the lack of consensus concerning a uniform, universally accepted definition of bioeconomy (NASEM, 2020; Maciejczak, Hofreiter, 2013; Kozyra et al., 2023). Since the first presentation of the bioeconomy concept by Enriquez and Martinez in 1997 (Enriquez, 1998), its definition has been evolving – it has been expanded and narrowed down, and the emphasis on its various aspects has shifted. Nevertheless, many authors have stressed the common elements, such as, for example, the importance of the concept of sustainable development, the application of knowledge, research and innovation in biotechnology, and replacing fossil fuels with biological resources (Maciejczak, Hofreiter, 2013). Individual definitions emphasise various aspects and priorities: technological, economic and social, and address various conditions and concepts of development, such as sustainable or innovative development (Adamowicz, 2017). According to the definition of bioeconomy formulated by the European Commission, it "includes production of renewable biological resources and transformation of such resources and streams of waste into added-value products, such as food, fodder, bioproducts and bioenergy" (European Commission, 2012a, p. 3). This gives bioeconomic sectors considerable potential for innovation because they make use of multiple fields of science and various technologies.

The bioeconomy concept was introduced in the European Union as a strategy under the title "Innovations for sustainable growth: bioeconomy for Europe" in 2012 (European Commission, 2012). This is the European Union's answer to the most topical challenges, such as ensuring food security, sustainable management of natural resources, mitigating climate change and limiting dependence on non-renewable resources (Nowak, Kobiałka, Krukowski, 2021). The aim of this strategy was to present a comprehensive approach to current issues, including ecological and environmental issues, energy generation, supply chains and challenges concerning the protection of natural resources in Europe. This served as a foundation for domestic strategies aimed at bioeconomy development in individual member states, implemented in countries such as Finland, Austria, France, Germany, Ireland, Italy, Latvia, the Netherlands, Spain, and Portugal (The bioeconomy…, 2025). Poland still does not have a separate strategy for the bioeconomy. There is no single ministry in Poland which is responsible for developing its framework centrally or for defining its development directions due to the cross-sectional and intersectoral nature of the bioeconomy (Mapa drogowa…, 2021). However, Poland participates in the macroregional bioeconomy initiative, BIOEAST, developed by countries of Central and Eastern Europe, which was joined by the Visegrád Group countries as well as Bulgaria, Romania and Slovenia (Kozyra et al., 2023). The domestic bioeconomy strategy is being developed within the BIOEAST platform (Knowledge Centre…, 2025). The main documents concerning bioeconomy in Poland include:

- Roadmap for transformation towards circular economy (2019).
- National Smart Specialisation (MR, 2020).
- State Scientific Policy (MEiN, 2022).

According to Adamowicz (2017), the bioeconomy concept can play an important role in the integration of various economic sectors. The intensification of bioeconomy research and its support for the practical development of bioeconomy can be important factors in boosting Poland's international competitiveness.

Issues related to the bioeconomy have been dealt with in many scientific papers. For example, a search for the word "bioeconomy" in the Mendeley database yielded 12,261 records with scientific papers and 1648 books (Mendeley). Many of these studies have dealt with the theoretical problems of a bioeconomy (Maciejczak, Hofreiter, 2013; Adamowicz, 2020; Heiden, Lucas, 2022), while others have focused on the dominant role of agriculture in the bioeconomy (Nowak, Kobiałka, Krukowski, 2021). There are also papers presenting analyses of individual sectors of the bioeconomy (Ronzon et al., 2017; Ronzon et al., 2020) and analyses of the bioeconomy in European Union countries (Bălan, Cismas, 2022; Morone, D'Adamo, Cianfroni, 2022; Ronzon, Iost, Philippidis, 2022).

Research on bioeconomy as a crucial economic strategy within the European Union supports the objective of this study, which aims to evaluate the labour factor's application in the bioeconomy sectors across the EU, with a specific focus on Poland.

2. Methods

The study used data on the bioeconomy and its individual sectors during the period between 2010 and 2021. The data were obtained from the EU Bioeconomy Monitoring System, which is the source of the most important information on the bioeconomy in the EU (Data-Modelling platform…). The geographical range covers EU member states (27 states without the UK). Bioeconomy by sectors in the Statistical Classification of Economic Activities in the European Community (NACE) (Giuntoli et al., 2020) includes the following sectors:

I. Agriculture (A01).
II. Forestry (A02).
III. Fishing and aquaculture (A03).
IV. Food, beverage and tobacco (C10, C11, C12).
V. Bio-based textiles (C13, C14, C15).
VI. Wood products and furniture (C16, C31).
VII. Paper (C17).

VIII. Bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels) (C20, C21, C22).
IX. Liquid biofuels (C2014, C2059).
X. Bio-based electricity (D3511).

The assessment of the labour factor in the bioeconomy involved a comprehensive analysis of employment and labour productivity. This analysis aimed to classify EU member states based on relative measures of average labour productivity in the bioeconomy and the dynamics of its changes. Specifically, the employment analysis utilised structure and dynamics indices, while labour productivity was calculated using data on added value and employment within each bioeconomy sector. This productivity index demonstrates how effectively the labour factor is utilised to generate added value. Additionally, changes in productivity encapsulate the cumulative effects of capital modifications, as well as advancements in technology, organisation, and efficiency. These changes also reflect the influence of economies of scale and varying degrees of production capacity utilisation (OECD, 2001). The data analysed were primarily presented as averages over the study period.

3. Results

Average annual employment in the EU bioeconomy during the period of 2010-2021 was nearly 18 million people (Data-Modelling platform…, 2024), with the largest portion (nearly 10 million) working in agriculture (Fig. 1). This was followed by the food, beverage, and tobacco production sectors, as well as the wood products and furniture manufacturing sectors. Poland was the country with the highest employment in the bioeconomy sector of all the EU countries in 2021 (2.4 million). Agriculture alone employed 1.6 million people, which accounts for 65% of all those employed in the bioeconomy in Poland. As in the whole EU, the sector of food, beverage and tobacco production was the second largest bioeconomy in terms of employment.

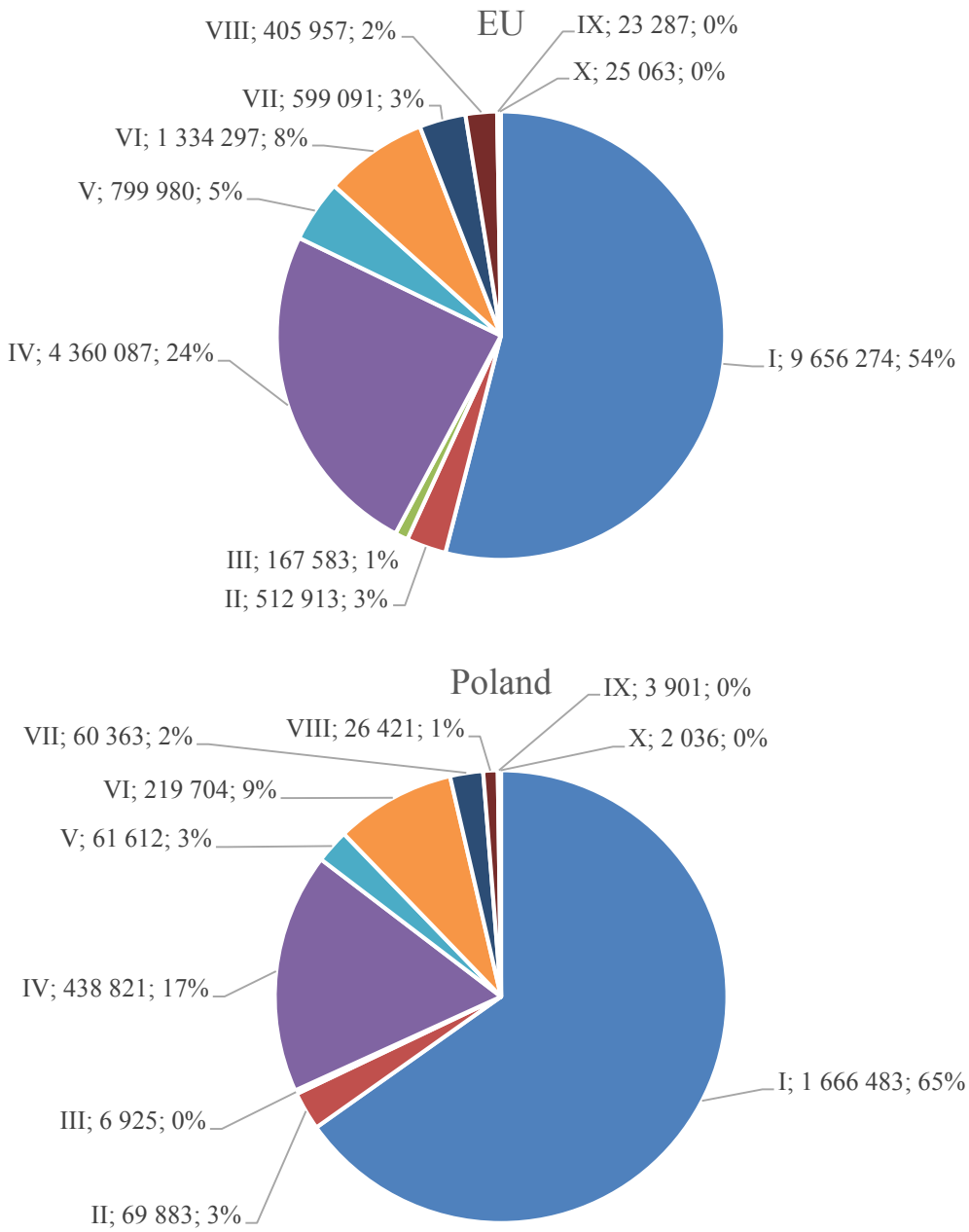


Figure 1. Size and structure of employment in bioeconomy sectors in the European Union and in Poland in 2010-2021.

Source: Authors' elaboration based on the Data-Modelling platform of resource economics.

Labour productivity is one of the major measures of labour factor utilisation efficiency. Figure 2 shows the average labour productivity in individual bioeconomy sectors in Poland and the average level in the EU during the 2010-2021 period. The average labour productivity in the EU, measured by the added value generated in the whole bioeconomy per one employee in all sectors of biomass production and processing, was EUR 33,219. The labour factor utilisation was less efficient in Poland. The overall average labour productivity in the bioeconomy in Poland was 2.5 times lower than the EU average (EUR 12,552 per employee).

A comparative analysis between Poland and the EU revealed significant differences in labour productivity within the bioeconomy overall and across its individual sectors. Notably, the electric bioenergy sector proved to be the most productive when measured against labour input. While labour productivity in Poland reached a high of EUR 107 thousand per employee, it is important to note that this figure was nearly half that of the EU average in the sector. Furthermore, high labour productivity was also evident in the EU's chemicals of biological origin sector (EUR 140,026) and the liquid biofuels sector (EUR 133,869). In Poland, the chemical sector occupied second place, with a productivity value of EUR 42,635 per employee, which represented just one-third of the EU average for this sector. Additionally, the paper production sector showed a productivity level of EUR 38,397, equating to 55% of the EU average, while the liquid biofuels sector recorded EUR 35,136, which is merely 26% of the EU average. These discrepancies, particularly in the biofuel and chemical sectors, indicate that their potential is not being fully utilised in Poland. In contrast, agriculture emerged as the least productive sector during the analysed period, with the average employee in Poland generating added value of only EUR 6268, which is one-third of the EU average.

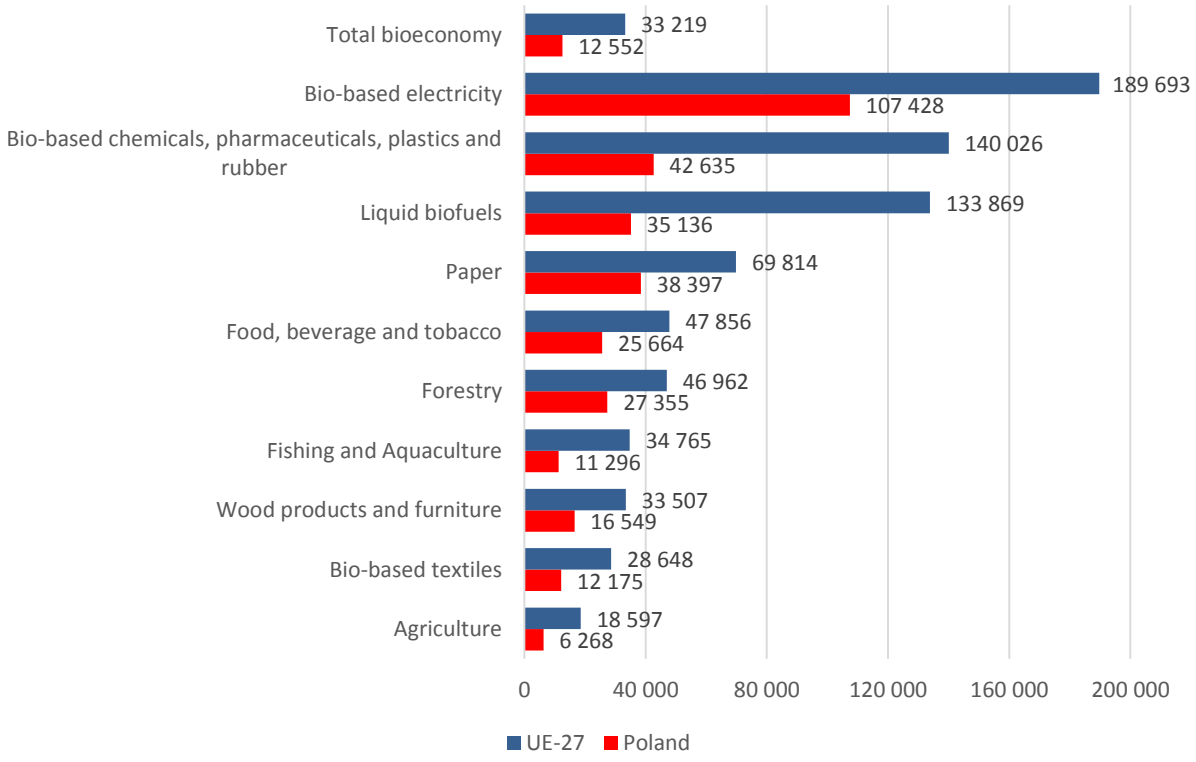


Figure 2. Productivity of labour in bioeconomy sectors in the European Union and in Poland in 2010-2021, average in EUR/employee.

Source: Authors' elaboration based on the Data-Modelling platform of resource economics.

Apart from examining labour productivity in individual bioeconomy sectors, an analysis of the importance of the labour factor in the Polish bioeconomy should also determine the position of Poland compared with the other EU countries. Figure 3 shows a list of EU countries ranked

by the average labour productivity in the bioeconomy during the 2010-2021 period. The average labour productivity in the EU bioeconomy amounted to EUR 33,219 per employee. This index varies from one EU country to another. The top ranking is held by the Irish economy, which boasts an average labour productivity of EUR 90,976, nearly three times higher than the EU average. Labour productivity in the Polish bioeconomy was EUR 12,552, accounting for a mere 38% of the EU average and placing Poland in the 25th position among 27 member states. A lower index level was found only in Romania and Bulgaria, with the added value of EUR 5025 and EUR 4823, respectively, i.e. approximately 1/7 of the EU average. It is noteworthy that 13 out of the 27 member states achieved labour productivity above the EU average, 12 of which were "old" EU member states. On the other hand, the lower half of the ranking (with labour productivity levels below the EU average) mainly included countries that joined the EU in 2004 or later, i.e. "new" EU countries.

A horizontal analysis shows that labour productivity increased in all EU member states in 2021 compared to the analysis baseline, i.e. the year 2010 (cf. Fig. 3). The average added value per employee in the EU bioeconomy increased from EUR 26,775 in 2010 to EUR 42,371 in 2021, i.e. by 58%. The highest change dynamics were found in countries in the lower half of the ranking, i.e. those with labour productivity below the EU average. This group also included the Polish bioeconomy, where labour productivity increased from EUR 9,261 in 2010 to EUR 16,480 in 2021, which is a growth of 78%. In contrast, the growth rate of the index in countries with above-average labour productivity was lower than the EU average.

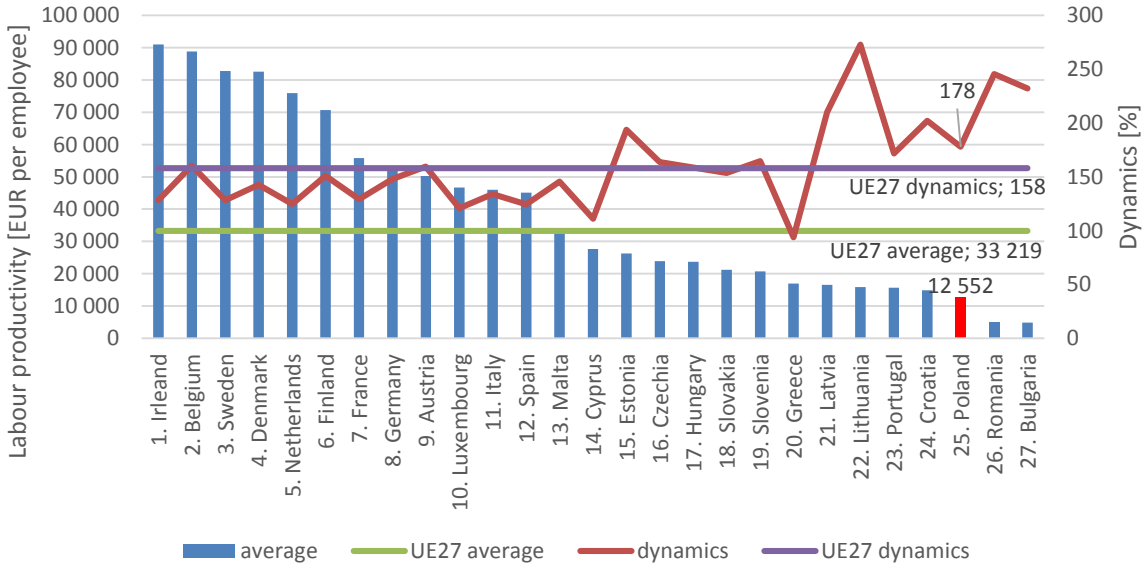


Figure 3. Labour productivity in the bioeconomy in EU member states in 2010-2021, average (EUR/employee) and change dynamics (%).

Source: Authors' elaboration based on the Data-Modelling platform of resource economics.

Figure 4 illustrates an attempt to classify EU member states based on relative measures of average labour productivity in the bioeconomy and the dynamics of its changes from 2010 to 2021. Their values calculated for 27 EU countries were taken as the reference point

(the reference value for EU27 = 1.00). The analysis identified five groups of countries: "leaders", "saturated", "catching up" countries, "tail", and "average" countries. The first group includes "leaders" in terms of labour productivity in the bioeconomy, in which the index and the dynamics of change are above average. These criteria were met by two countries during the period under analysis: Belgium (BE) and Austria (AT). The group of countries "saturated" in terms of labour productivity includes countries with high levels of productivity but where the growth dynamics are below the EU average. Ten countries are included in this group: Ireland (IE), Denmark (DK), Sweden (SE), The Netherlands (NL), Finland (FI), France (FR), Germany (DE), Luxembourg (LU), Italy (IT) and Spain (ES). It is noteworthy that both of these groups are comprised of only old EU countries. The group of "catching-up" countries consists mainly of new EU states. It includes countries with low labour productivity in the bioeconomy but with an above-average growth rate. The group of "catching up" countries during the 2010-2021 period included Estonia (EE), Czechia (CZ), Hungary (HU), Slovenia (SI), Latvia (LV), Lithuania (LT), Portugal (PT), Croatia (HR), Poland (PL), Romania (RO) and Bulgaria (BG). The group referred to as the "tail" comprises countries with both low labour productivity and low growth rates. This group was comprised of three countries: Cyprus (CY), Slovakia (SK), and Greece (EL). The last group includes "average" countries, in which labour productivity and its change dynamics are close to the EU average. This group includes Malta (MT).

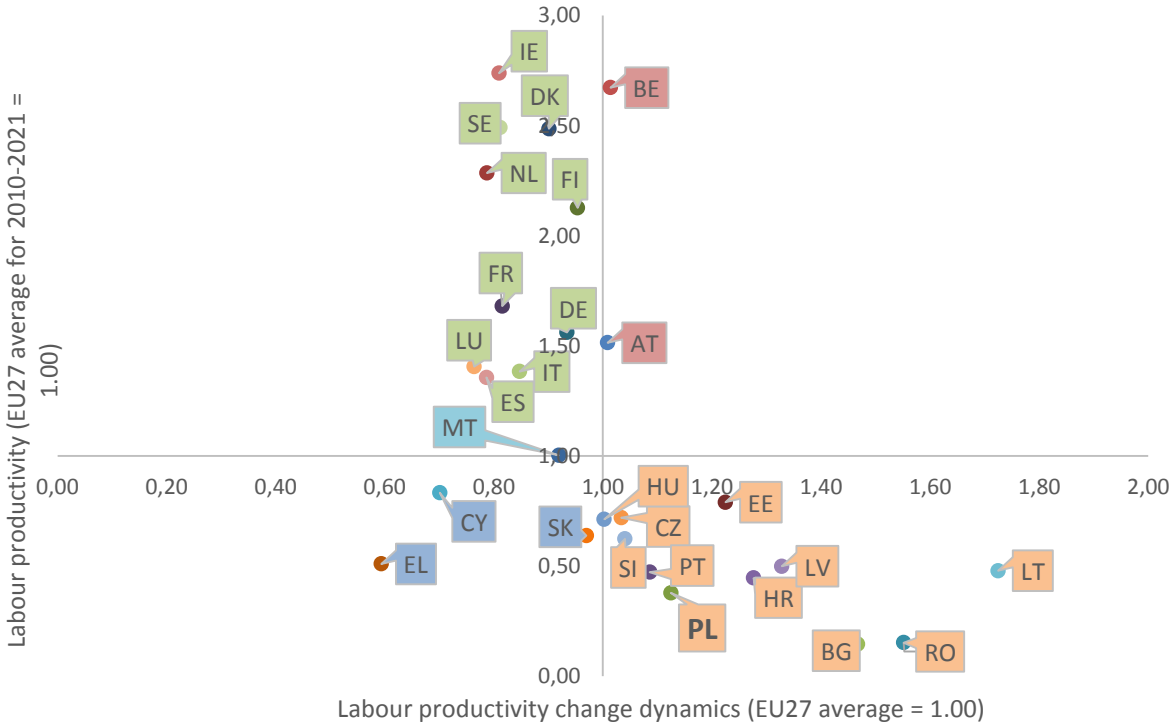


Figure 4. Classification of EU member states according to relative measures of average labour productivity in the bioeconomy and the dynamics of its change in 2010-2021.

Source: Authors' elaboration based on the Data-Modelling platform of resource economics.

4. Discussion

The current study identified agriculture as the sector of the bioeconomy with the lowest labour productivity, both in Poland and in the EU. The low productivity of agriculture in Poland results largely from a high employment level (Zakrzewska, Nowak, 2024). Although this decreased by about 25% during the period under study, an increase in labour productivity in this sector was a consequence mainly of the growing amount of equipment owned by farmers (Kubik, Zakrzewska, 2024).

This analysis showed significant differences in labour productivity between individual sectors of the bioeconomy. Similar results were obtained by Ronzon et al. (2020), who analysed the 2015-2017 period. Differences in labour productivity between individual EU countries were noted by Nowak, Kobiałka and Krukowski (2021) and Ronzon, Iost and Philippidis (2022).

An attempt at classifying EU member states according to relative measures of average labour productivity in the bioeconomy and the dynamics of its change in 2010-2021 indicated the existence of beta convergence. In it, economies with a lower initial revenue are characterised by higher growth dynamics compared with better-developed economies of rich countries. In effect, it leads to gradual equalisation of the income per capita in the groups of economies under study (Baer-Nawrocka, Markiewicz, 2012).

5. Summary

The objective of this study was to assess the use of the labour factor in bioeconomy sectors in Poland compared with other European Union countries in 2010-2021.

Poland has the largest human labour resources among EU countries. Although this results in low labour productivity, it could also be viewed as a potential competitive advantage. Transformations in the sectoral employment structure, particularly "moving" employees from low-productivity sectors to high-productivity sectors, can bring benefits in a longer-term perspective or in cases of labour force shortage caused, for example, by a disadvantageous demographic structure. The period under study saw a gradual decrease in employment in agriculture, with an increase in other sectors, i.e. food processing and the manufacturing of products from wood and furniture.

The average labour productivity in the bioeconomy in Poland in 2010-2021 amounted to EUR 12,552 per employee, which was 2.5 times lower than the EU average and shows that labour factor utilisation in Poland is less effective.

The analysis also found considerable differences in the average productivity between individual bioeconomy sectors. In Poland, it was the highest in the electric bioenergy sector, and yet its level was about half of that achieved in the EU. Unused potential was also observed in the liquid biofuel sector and in the field of chemicals of biological origin. Agriculture proved to be the weakest link in terms of utilisation of the labour factor. Although it provides the largest number of jobs of all the bioeconomy sectors, its high employment level has an adverse impact on labour productivity. This amounted to a mere EUR 6268 per employee in agriculture in Poland, which was 1/3 of the EU average. The distance to the EU average can be reduced by increasing productivity in sectors with a high potential and by optimising the employment structure, particularly by an outflow of excessive employees from agriculture.

The current study also confirmed the diverse utilisation of labour in the bioeconomy of different EU countries. The highest productivity was achieved by Ireland (more than seven times higher than Poland), and most "old" EU countries exceeded the EU average (EUR 33,219). Poland was ranked 25th in terms of labour productivity in the bioeconomy, surpassing only Romania and Bulgaria. An increase in labour productivity in the period under analysis of 78% is a positive aspect. Like other "new" EU countries, Poland is growing faster than the richer economies, which suggests a gradual decrease in differences in productivity. However, investments in technologies and innovations to improve labour productivity in bioeconomy sectors are necessary to catch up with countries where it is higher.

This analysis revealed certain limitations, which can also offer a basis for future research. The key methodological limitations identified in the analysis concern data availability, both temporal and cross-sectional. The latest available data are from 2021, i.e. they do not fully reflect the consequences of the COVID-19 pandemic or the Russian invasion of Ukraine in the context of the efficiency of the labour factor utilisation in bioeconomy sectors in EU countries, including Poland. Another limitation is posed by the range of available data for the bioeconomy of individual countries, which covers only the number of employed, added value and the turnover generated by individual bioeconomy sectors. A broader range of data, such as revenue from sales or the value of fixed assets, would make it possible to conduct a causal analysis of labour factor utilisation and to develop a synthetic measure allowing for a comprehensive assessment of its importance. Therefore, this analysis should be regarded as a preliminary study which should be continued.

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SILENCE IN AN ORGANIZATION AND TRUST IN AN ORGANIZATION – THE ROLE OF THE EMPLOYEE'S GENDER

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Purpose: The purpose of the work is to analyze the relationship between silence in the organization and trust in the organization, considering the differentiation of silence in the organization and the role of gender employees.
Design/methodology/approach: The empirical material was obtained through a questionnaire survey. The survey was conducted in 2021 in the West Pomeranian province, Poland, and 426 questionnaires were analyzed.
Findings: Research confirmed the conditions Polish attempts to research, which shows that growing trust in the organization is a factor contributing to the reduction scale silence of employees. Research confirms the significance of statistical compounds mentioned in the scope For silence consenting in both gender groups, for silence defensive, and in the group men. Research highlights the importance of the analysis in the context of silencing opportunistic (in both geneder groups). The power of those examined dependencies is generally relatively bigger in the group of men.
Research limitations/implications: The analysis is based on respondents' subjective declarations.
Practical implications: Research shows that to limit silence in the organization, you should undertake any possible Actions to build trust in organizations, leaders, and co-workers. You should also undertake Actions dedicated to gender-specific employees.
Originality/value: The tests they consider in the analyses often skip the category of silence opportunistic. They focus too on issues and gender differences in shaping their analyzed relations. They enter this in the identified gaps research.
Keywords: silence in organization, trust in organization.
Category of the paper: research paper.

1. Introduction

Organizational relationships should be established based on trust. Trust in the organization is a prerequisite for communication and cooperation. In conditions of mutual trust, individuals are willing to take risks that can bring positive results, such as increased satisfaction or commitment or reduced turnover. People working in environments with high trust and feeling

more comfortable communicating their thoughts or feelings. Trust is a factor that significantly reduces the risk of an employee speaking out. An increase in trust in the organization is, therefore, able to limit the scale of silence in the organization for various reasons. This relationship has been examined in quite a thorough manner in a simple scheme. In this respect, the research conclusions are unambiguous. A negative relationship is identified between the variables mentioned, although the literature on the subject emphasizes its moderate strength - e.g. (Fard, Karimi, 2015). The conclusions from studies considering a wide range of employees' motives for silence are more ambiguous. In this respect, they are not so unambiguous. Therefore, there is a need for further research in this area. In addition, the research conducted does not consider gender differences in the studied area. The research presented in the work fills the above gap. In addition, such research was not conducted on a Polish sample - in this respect, the presented research is pioneering.

The work is of a theoretical and empirical nature. The work aims to analyze the relationship between silence in the organization and trust in the organization, considering the differentiation of the motives for silence in the organization and the role of the employee's gender. In part, the theoretical foundation is presented, the issues of silence and trust in the organization are presented, and a review of research on the relationships between the analyzed variables is also made. Then, the results of survey studies conducted on a Polish research sample of respondents from the West Pomeranian Voivodeship focusing on implementing the work's goal are presented. The work ends with a discussion of the results.

2. Theoretical aspects

The classic understanding of organizational silence stemming from Milliken and Morrison (2000) reflects this construct as a homogeneous category, a collective phenomenon not directly determined by individual choices. Instead, it is a product of forces within the organization originating from managers' fear of negative feedback and hidden beliefs that managers, not untrustworthy employees, can decipher the meaning of most organizational issues. Specific structural and managerial solutions follow this approach of managers in the organization. They determine a specific climate of silence. When such a climate exists in the organization, silence dominates, not voice (Kunasz, 2022).

At the same time, approaches that reduce silence to individual decisions of employees have appeared in the literature (Pinder, Harlos, 2001; van Dyne, Ang, Botero, 2003). In such an approach, silence (of employees, not organizational) cannot be a homogeneous category. The motives for silence may be different. In works focusing on this approach, attempts were made to specify these motives (Kunasz, 2024). van Dyne, Ang, Botero (2003) drew attention to three motives for silence: resignation, fear and orientation towards others, distinguishing

adequate categories of silence: acquiescent, defensive and prosocial. Knoll, van Dick (2013) supplemented this strongly emphasized in the literature classification of the typology of employee silence with a fourth component - opportunistic silence. He also proposed a scale for measuring employee silence based on the four motives for silence mentioned above. In the empirical part, this analytical approach and measurement scale were borrowed (discussed in more detail in the methodological part of the work). It can be assumed that there is an opposition between organizational silence and employee silence in the literature. The second approach is represented in this work, although the author uses the neutral category of "silence in the organization".

Second element of the cause-effect relationships examined in the work-trust in the organization are also not a homogeneous category. In individual analyses, the authors refer to different conceptual categories connected by the concept of trust. Following Mayer et al. (1995), institutional and interpersonal trust should be distinguished. Institutional trust refers to the employee's faith in the position of institutional structures in striving for success and creating one's future (Mcknight, Cummings, Chervany, 1998). This type of trust focuses on the organization as a whole. The individual assumes that the organization will act to their advantage or at least not act in a way that harms them (Saglam, 2016). Interpersonal trust refers to individual relationships between employees. In this case, horizontal trust (to co-workers) and vertical trust (to managers and leaders) should be distinguished (Ellonen, Blomqvist, Puumalainen, 2008).

Trust should be viewed as a positive psychological process (Turner, Barling, Zacharatos, 2002) based on positive expectations about the intentions or behaviors of other individuals. When trusting another, individuals are more willing to take risks that may bring positive results (for example, it may reduce the intensity of silence in the organization). Destructive relationships are associated with distrust, inducing negative perceptions by the employees of the environment and members of the organization (Lazarus, 1995).

The distinct areas of building trust in an organization are mutually intertwined. Trust in the leader or co-workers builds trust and commitment throughout the organization. When employees trust the leader, this trust is reflected in the entire organization, as the leader is perceived as its key representative. Hence, the leader plays a key role in creating an atmosphere of mutual trust in the organization (Kim et al., 2019).

The author uses the universal semantic category of "trust in the organization" in the empirical analyses.

Identifying the relationship between organizational silence and organizational trust (regardless of the specific generic forms of individual categories considered in the analyses) is the subject of numerous studies. In most cases, a negative relationship is identified. Therefore, an increase in organizational trust is a factor that reduces the intensity of organizational silence. Usually, a statistically significant relationship is identified in this respect, although many studies point to its moderate strength (Fard, Karimi, 2015; Demet, Cevat, 2017; Akar, 2018a;

Akar, 2018b; Jurek, 2019). An exception in this respect should be the study by Saglam (2016), which indicates a positive, statistically significant relationship between organizational silence and organizational trust.

The subject of the analyses is also the identification of relationships in which constructs reflecting silence undertaken with a diverse spectrum of motives are cast as variables. The literature usually indicates the existence of such relationships in the context of defensive and acquiescent silence. Dedahanov, Rhee (2015) conducted analyses in the aforementioned area separately for the constructs of trust in the organization and trust in the leader. In the first area, a negative relationship was identified with acquiescent silence, while in the second area – it was also identified with defensive silence. Ozen Kutanis et al. (2014) indicate a lack of statistical significance of the relationship between trust in the superior and defensive silence. Schlosser, Zolin (2012) indicate a negative relationship between defensive silence and trust in coworkers. Saglam (2016) indicates a lack of statistical significance in the relationship between acquiescent and defensive silence and organizational trust. This author indicates a statistically significant but positive relationship between organizational trust and prosocial silence.

To sum up this part of the considerations, it should be stated that the conclusions from the above-mentioned studies on the relationships between silence in the organization and trust in the organization are pretty ambiguous, both at the level of silence in the organization in general and after taking into account the specific motives of employee silence. Studies at the second of the above-mentioned levels usually do not take into account the fourth category of employee silence (opportunistic silence) introduced to the discussion in 2013 by Knoll, van Dick (2013). The present discussion fits into this research gap. Moreover, previous studies do not take into account the aspects of gender differences in the formation of the relationship between silence in the organization and trust in the organization. This work also fits into this research gap. In this context, the research can be described as original and pioneering in the national literature.

3. Method

The study investigated the cause-effect relationships between silence in the organization (explained variable) and trust in the organization (explanatory variable). The research was conducted in a quasi-experimental design (independent, simple measurement). The classification variable considered was gender. Differences between groups of women and men were examined.

The explained variable was analyzed in general and subcategories reflecting silence from four motives (resignation, fear, orientation towards others, and opportunism). When introducing the division of the explained variables, the measurement scale proposed by Knoll, van Dick (2013) accepted in the literature was used. These authors constructed

a measurement instrument comprising 20 statements beginning with a common root, "I am silent in the organization ...". Based on the results of confirmatory factor analysis, the creators of the measurement tool indicated questions differentiating individual categories of employee silence. For each of the analytical categories, three differentiating questions were indicated. Therefore, a total of 12 questions differentiating four constructs can be indicated. Answers to only these questions were subjected to analysis. Respondents referred to the presented statements on a five-element Likert scale with extreme cases: 1 – complete disagreement with the statement and 5 – complete agreement with the statement. The average value of the respondent's attitudes to the appropriate differentiating questions was calculated when creating adequate constructs. For the overall silence construct, the mean value of the respondent's indications in response to the 12 differential questions from the questionnaire (Knoll, van Dick, 2013) was calculated.

Trust in the organization was considered in the analyses as a homogeneous construct using a six-item measurement scale. All statements were positively oriented; hence, there was no need to use reverse procedures. Respondents could also refer to the statements using a five-item Likert scale with adequate extreme statements for the intensity of reaction to the statements presented. A synthetic measure for this construct was also created for each respondent by averaging selected partial ratings. Therefore, a total of 6 constructs were considered in the analyses. Cronbach's alpha coefficient was calculated for individual constructs. Data in this respect are presented in Table 1.

Table 1.
Cronbach's alpha coefficients for the studied constructs

Construct	Cronbach's alfa
silence generally	0,833
defensive silence	0,599
prosocial silence	0,699
opportunistic silence	0,595
acquiescent silence	0,735
trust in organization	0,698

Source: own study based on the conducted research.

The values of this measure are generally within the norm (> 0.6). For defensive and opportunistic silence, Cronbach's alpha balances on the border of the norm. Therefore, it can be assumed that the scales are reliable.

A single-variable regression instrument was used to analyze the causal relationships investigated. A total of 15 models were estimated (five for the entire sample and the subgroups of women and men – due to the consideration of 5 explained variables). Model parameters were estimated using the classic least squares method. To assess the quality of the model fit, the following were calculated for each of them: R square, the sum of squared residuals, and the logarithm of likelihood. Appropriate calculations were performed using the Gretl package.

The average of synthetic measures calculated for individual respondents reflected the average level of intensity of a given feature within a given construct. These measures were also analyzed to find differences in the respondents' declarations in groups distinguished by gender. To verify whether these differences were statistically significant, the Student's t-test was used (as differences were examined in two groups). Appropriate calculations were performed in the Statistica package.

In econometric modeling and statistical inference, the strength of the relationship was differentiated with respect to the assumed limiting probability level. Three levels were adopted: p = 0.1*; p = 0.05**; p = 0.01***.

The study was conducted on a sample of 426 respondents from the West Pomeranian Voivodeship. The material was collected in September-October 2021 using the PAPSI method (via a paper questionnaire). The survey questionnaire was submitted to respondents in Polish.

Like every research, also these May own limitations:

- Research have partial not complete character.
- You should return attention to subjectivism declaration respondents in response to questions survey.
- Range spatial research limits them to a regional dimension (voivodeship West Pomeranian Voivodeship), not national.
- Research presented static picture of reality, dynamics changes, and they could reflect tests oblong research.

4. Research results

At the beginning, an analysis of differences in the declarations of respondents of both sexes was conducted at the level of the constructs considered in the work. The opinions of respondents on silence in the organization were examined, taking into account a diverse spectrum of motives in accordance with the classification (Knoll, van Dick, 2013). A measure reflecting the general construct of employee silence and a uniform construct of trust in the organization were also examined. The data are presented in Table 2. In addition to the average measures of the intensity of the examined feature within a given synthetic measure (construct), the result of the Student's t-test was presented, reflecting the statistical significance of the identified differences in the analyzed groups of respondents.

Table 2.
Differences in declarations respondents due to gender on the level under consideration constructs

construct	mean		t-test	p-value
	women	men		
silence generally	2,29	2,29	-0,02	0,985
defensive silence	**2,40**	**1,97**	**3,41**	**0,001*** **
prosocial silence	2,48	2,52	-0,34	0,736
opportunistic silence	**2,02**	**2,32**	**-2,70**	**0,007*** **
acquiescent silence	2,25	2,33	-0,63	0,527
trust in organization	3,12	3,27	-0,91	0,365

Source: own study based on the conducted research.

The organizational reality is dominated by silence from a prosocial motive in both groups of respondents (no statistically significant differences were noted in the declarations of women and men – very high p-value). The lowest average measure of silence from the selected motive was noted among women for opportunistic silence while among men – for defensive silence. Therefore, representatives of the individual groups of respondents are silent the least often from these motives. For these motives of silence in the organization, statistically significant differences were identified in the respondents' declarations, which is emphasized by the very low level of p-value. At the level of analyses of the measure synthetically reflecting the construct of employee silence, practically no differences were identified in the declarations of respondents from both gender groups (the measure of the average level of silence intensity was shaped in both groups at the level of 2.29 - p-value 0.985). Also, no statistically significant differences can be noted in the opinions of women and men regarding the level of trust in the organization. However, the average measure was slightly higher for this construct among men.

Similar analyses were conducted at the level of partial measures (questions from the survey). For measures of employee silence from selected motives, responses to three dedicated questions were analyzed (the average response to all questions from this category was used to construct the overall measure). The explained variable was reduced to the construct level based on respondents' responses to 6 questions in Table 3.

Table 3.
Differences in declarations respondents due to gender in relation to variables partial

acronym	question	mean		t-test	p-value
		women	men		
explained variables **- silence in organization – I'm silent ...**					
qs1	**for fear of negative consequences**	**2,55**	**2,02**	**3,48**	**0,001*** **
qs2	**because I fear disadvantages from speaking up**	**2,33**	**1,88**	**3,08**	**0,002*** **
qs3	**to not make me vulnerable in the face of colleagues or superiors**	**2,34**	**2,04**	**1,98**	**0,049** **
ps1	because I do not want to hurt the feelings of my colleagues or superiors	2,40	2,47	-0,40	0,691
ps2	because I don't want to embarrass others	2,13	2,28	-0,93	0,352
ps3	because I don't want others to get into trouble because of me	2,90	2,82	0,47	0,642
os1	**not to give away knowledge advantage**	**2,06**	**2,33**	**-1,67**	**0,095***

Cont. table 3.

os2	because of concerns that others could take an advantage of my ideas	2,11	2,34	-1,46	0,146
os3	**because it would mean having to do avoidable additional work**	**1,88**	**2,30**	**-2,68**	**0,008*** **
as1	because my opinions will not fall on fertile ground anyway	2,20	2,23	-0,20	0,840
as2	because my superiors are not open to proposals or solutions	2,27	2,43	-1,00	0,318
as3	because nothing will change anyway	2,28	2,33	-0,31	0,759
explanatory variable: trust in organization					
z1	I believe my employer is highly honest	3,21	3,34	-0,61	0,545
z2	I fully trust my employer	3,06	3,08	-0,13	0,900
z3	My employer is open and honest with me	3,25	3,33	-0,39	0,700
z4	I can expect my employer to treat me in a consistent and predictable manner	3,06	3,37	-1,56	0,122
z5	My employer is always honest and truthful	3,14	3,17	-0,12	0,905
z6	**Generally, I believe that the motives and intentions of my employer are good**	**3,06**	**3,41**	**-1,73**	**0,086***

Source: own study based on the conducted research.

The data again indicate areas in which statistically significant differences in the declarations of respondents from both gender groups are revealed. These differences are revealed to the greatest extent in the case of partial variables referring to defensive silence (in the case of answers to each of the three questions), statistically significant differences were noted in the declarations of respondents from both gender groups. For questions differentiating silence for an opportunistic motive, these differences are mainly revealed in the answer to subquestion os3 (I am silent in the because it would mean having to do avoidable additional work) - such a lack of voice activity is indicated more often by men. Statistically significant differences in the declarations of respondents were noted for subquestion os1. However, it should be noted that these differences are on the border of the lowest probability threshold adopted from the point of view of statistical significance of relationships, $p = 0.1$.

The least significant differences in the declarations of respondents of both sexes in the case of the explained variables were noted in the answers to the questions constituting partial measures for the construct of acquiescent silence (as1 and as3). In the case of the explanatory variable (trust in the organization), the least significant differences in the distinguished groups of respondents were noted for statement z5 (My employer is always honest and truthful). One of the partial statements for the explanatory variable - z6 (Generally, I believe that the motives and intentions of my employer are good) can be placed on the border of statistical significance. This question, therefore, significantly differentiates the opinions of women and men.

The next step of the analysis examined the relationship between silence in the organization (including several constructs reflecting the spectrum of motives for silence – explained variable) and trust in the organization (explanatory variable). The direction and strength of this relationship were identified based on the estimated univariate regression models. Analyses were conducted in general and in groups of women and men. Five econometric models were

estimated in each category (total, women, men). Data are presented in Table 4. The third column presents the coefficient estimate for the explained variable together with the estimated standard error, the fourth column presents the p-value level for the variable.

Table 4.
Model estimation results

model no.	explained variables	coefficient (standard error)	p-value
TOGETHER			
1	**silence generally**	**-0,17 (0,05)**	**0,001*** **
2	defensive silence	-0,11 (0,07)	0,136
3	prosocial silence	-0,04 (0,08)	0,637
4	**opportunistic silence**	**-0,21 (0,06)**	**0,002*** **
5	**acquiescent silence**	**-0,33 (0,07)**	**0,000*** **
WOMEN			
6	**silence generally**	**-0,14 (0,08)**	**0,073***
7	defensive silence	0,01 (0,12)	0,921
8	prosocial silence	-0,14 (0,12)	0,220
9	**opportunistic silence**	**-0,17 (0,08)**	**0,036** **
10	**acquiescent silence**	**-0,25 (0,11)**	**0,028** **
MEN			
11	**silence generally**	**-0,20 (0,06)**	**0,003*** **
12	**defensive silence**	**-0,18 (0,08)**	**0,032** **
13	prosocial silence	0,06 (0,11)	0,603
14	**opportunistic silence**	**-0,26 (0,09)**	**0,007*** **
15	**acquiescent silence**	**-0,41 (0,09)**	**0,000*** **

Source: own study based on the conducted research.

In most cases, the relationships were consistent with those identified in the literature – negative. Growing trust in the organization reduces the scope of silence in the organization.

Analyzing the entire research sample, it is necessary to identify a statistically significant relationship with trust in the organization of silence in general. When analyzing silence for specific reasons in a similar scope, attention should be paid to acquiescent and opportunistic silence. Here, statistically significant relationships were noted between the variables considered. An increase in trust in the organization by one unit contributes to a decrease of 0.33 units in the intensity of acquiescent silence and by 0.21 units – in the intensity of opportunistic silence.

Analyzing the relevant data in the groups of women and men, one can notice a greater strength of the studied relationship in the group of men. In general, an increase of one unit of trust in the organization reduces the intensity of silence by 0.20 among men and by 0.14 units in the subsample of women. Additionally, in the case of analyses for forms of silence, where statistically significant relationships were noted for the entire sample (acquiescent and opportunistic silence), the strength of the identified relationship is greater. In the group of men, a statistically significant relationship was also identified in the studies on the relationship between defensive silence and trust in the organization. In the group of women, the coefficient in the model for this explained variable oscillates around zero. Only in the case of the prosocial silence variable (where the generally lowest strength of the studied relationship was noted) can

we assume that increasing trust in the organization reduces silence for such reasons practically only among women (in the group of men, the relevant coefficient oscillates around zero, although formally it takes positive values – therefore, we observe a statistically insignificant positive relationship).

The quality of individual models' estimates was assessed using R square, the sum of squared residuals, and log-likelihood. Table 5 presents data for individual models in the analyzed groups of respondents.

Table 5.
Modelling quality assessment measures

model no.	R^2	sum of squared residuals	logarithm of likelihood
TOGETHER			
1	0,065	81,6	-182,1
2	0,013	170,1	-246,7
3	0,001	211,5	-265,9
4	0,054	144,1	-232,2
5	0,110	177,1	-250,3
WOMEN			
6	0,047	34,4	-73,9
7	0,000	85,7	-105,4
8	0,022	78,9	-102,5
9	0,064	39,0	-78,2
10	0,070	74,1	-100,4
MEN			
11	0,080	47,0	-107,9
12	0,043	73,3	-131,6
13	0,003	130,2	-162,3
14	0,066	98,1	-147,2
15	0,149	101,3	-148,9

Source: own study based on the conducted research.

In each of the analyzed groups of respondents, the best-fitting model, considering the R square criterion, is the last model in a given category (5, 10, and 15, respectively – related to acquiescent silence). The level of this measure oscillates between 0.07 and 0.14 (for men). At the general level, model 3 (focused on prosocial silence) should be assessed the worst, taking into account the analyzed measure. A similar position can be indicated for the appropriate model in the group of men. In the group of women, a zero R square was noted for model 7 (where the explained variable was defensive silence).

When analyzing another measure of fit, generally, the models estimated in the group of women should be assessed best in this point of view. In each of the analyzed groups of respondents, the fit of models focused on silence in general (adequate models 1, 6, and 11) can be assessed best. At the opposite end, however, in individual groups of respondents, the models focused on prosocial silence can be indicated as the least fitted to the actual data in the entire sample and in the group of men, while in the group of women – on defensive silence. The above-mentioned models can be indicated in extreme positions (indicating the best and worst quality of fit) in the case of the third considered measure of estimated model assessment (log-likelihood).

5. Discussion

The conducted research confirmed in the conditions of the Polish research sample that growing trust in the organization is a factor contributing to the reduction of the scale of employee silence. Similar conclusions can be drawn from the studies presented in the theoretical part (Akar, 2018a). However, as previously mentioned in the literature, some studies identify a positive relationship between the analyzed constructs (Saglam, 2016). Most studies indicate a moderate strength of the studied relationship – e.g. (Fard, Karimi, 2015). Such conclusions cannot be drawn from the presented studies. These studies confirm the statistical significance of the considered relationship in the groups of respondents distinguished according to gender (although the strength of this relationship is more significant in the group of men).

The literature on the subject also includes studies relating to selected categories of silence in an organization (taking into account the diverse spectrum of motives that guide employees).

Studies in the aforementioned context mainly indicate the significant role of defensive silence - e.g. (Schlosser, Zolin, 2012) and acquiescent silence - e.g. (Dedahanov, Rhee, 2015). The conclusions from the studies cited in the theoretical part at this level of analysis are ambiguous. The studies presented in the paper confirm the statistical significance of the relationships in the aforementioned scope for acquiescent silence (here, the strongest relationships were noted both at the level of the entire sample and in both gender groups). For defensive silence, a negative statistically significant relationship between the studied variables was identified only in the group of men; in the model in the group of women, the analyzed coefficient oscillates around zero.

The presented research highlights the importance of opportunistic silence in the analyzed context (also in all considered groups of respondents).

It should also be noted that in the case of most models built for variables reflecting silence due to selected motives (except for the model taking into account prosocial silence), the strength of the relationship was relatively more significant in the group of men (in comparison with the group of women). Hence, it seems that in this gender group, actions promoting the growth of trust in the organization may bring slightly more significant effects on the male population.

Considering the utilitarian dimension of the presented research, it should be stated that to reduce the scale of silence in the organization, all possible actions should be taken to build trust in the organization, leaders, and co-workers. Dedicated actions should also be adjusted to the employee's gender (for example, actions aimed at men to reduce defensive silence).

Future studies in a similar scope could consider other characteristics of respondents (age, seniority, functions performed in the organization, etc.). Studies in a similar scope could also be carried out for the generic categories of trust distinguished in theoretical considerations (to the organization, leader, or co-workers). In the presented studies, trust in the organization was treated as a homogeneous category (while silence in the organization was considered a sum of lower-order constructs).

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WORK-LIFE INTERFACE. MAPPING KEY TOPICS IN SCOPING REVIEW

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Purpose: To examine the research interest in specific WORK-LIFE constructs in the literature through the number of publications on the topic, as well as to determine their relationships with other topics through the frequency of keywords.
Design/methodology/approach: A scoping review of publications on five work-life constructs from 1999 to 2024, and identification of their links to other topics through keyword frequencies using VOSviewer.
Findings: The most widely described construct is the work -life balance, while the others constitute only a small percentage of it. The analysis of the most frequently occurring keywords indicates that all constructs have one common area (occurring in all 5 constructs) and it is work-life balance. Other common areas with lower frequency of occurrence are burnout, human, job satisfaction, female and wellbeing.
Research limitations/implications: In practice, it is difficult to distinguish between the concepts. Despite the conceptual differences, there is a lack of efforts in the literature to confirm these differences.
Originality/value: This article brings together for the first time all the terms related to the work-life interface. The work-life interface goes beyond the traditional understanding of balance, focusing on the dynamic interaction of both spheres depending on the preceding term, which can be conflict, balance, integration, harmony, or enrichment.
Keywords: work-life conflict, work-life balance, work-life integration, work-life harmony, work-life enrichment.
Category of the paper: Research paper.

1. Introduction

Since the work-life interface includes social, affective, and behavioral dimensions (Morris, 2009), the lack of balance, harmony, or integration between work and private life can cause conflict in behaviors and emotions, which in turn can promote cognitive and emotional dissonance and burnout (Owens et al., 2018). The work-life interface goes beyond the traditional understanding of balance, focusing on the dynamic interaction of both spheres

depending on the preceding term, which can be conflict, balance, integration, harmony, or enrichment. However, the difference between the constructs is not entirely clear, and they are sometimes even used interchangeably, which does not seem to be correct. Given that the topic is a practical phenomenon, it seems important to review and determine the current state of research. This article presents a scoping review of publications on five work-life constructs from 1999 to 2024, and the main aim was to examine the research interest in specific WORK-LIFE constructs in the literature through the number of publications on the topic, as well as to determine their relationships with other topics through the frequency of keywords. The evidence was expected to be diverse and scattered. The review process was conducted by searching the Scopus database, using 10 keywords selected in the initial phase of the narrative. The results show a rapid evolution of the existing literature related to the construct of work-life balance. As for the other discussed constructs such as work-life conflict, work-life integration, work-life harmony or work-life enrichment, the evolution is rather low, but in 2021 it is uninterrupted for the first time.

2. Constructs of the work-life interface

The work-life interface encompasses the relationships that exist between professional and personal life (Griffin, Moorhead, 2010). Within these relationships, we can talk about the following constructs:

a) work-life conflict,
b) work-life balance,
c) work-life integration,
d) work-life harmony,
e) work-life enrichment.

Why is conflict mentioned in the first place? In all the constructs presented above, there are two levels - one is work and the other is private life. In principle, we often deal with conflict here, because personal and professional life influence each other, interpenetrate each other, and as a result - incompatible requirements occur between the performed professional and family roles, which makes participation in both roles difficult and may even cause conflicts.

Work-life conflict is understood as the negative or unbalanced combination of work with non-work activities (Godlewska-Bujok, 2019) . The conflict in this case consists of two separate, yet related concepts: work-family conflict and family-work conflict (Chang, McDonald, Burton, 2010), and its result is the overlap of the performed roles. It is considered that the role conflict is bidirectional here:

1. Work-family conflict occurs when work commitments and interests interfere with family life, e.g. irregular or inflexible working hours, work overload, stress, interpersonal conflict at work, unsupportive supervisor or organization (Unruh, Raffenaud, Fottler, 2016; Asiedu et al., 2018).
2. Work-family conflict occurs when family commitments interfere with work life, such as childcare or eldercare responsibilities, interpersonal conflict within the family, and unsupportive family members (Jahan Priyanka et al., 2024). The idea of overlap (interference) between home and work roles means that the challenges and expectations on one side are in some way contradictory (conflict-generating) to the other – a phenomenon that occurs because work and private life responsibilities compete for resources such as physical energy, psychological resources, time and others, which are limited (Greenhaus, Beutell, 1985). It becomes apparent that devoting resources to one domain is considered to take resources from the other, which leads to a constant dispute (Hill et al., 2007; Ong, Jeyaraj, 2014) . The role conflict described here is important for organizations and employees because it is often associated with negative consequences: burnout, stress and deterioration of health, organizational commitment and work performance (Amstad et al., 2011; Akkas, Hossain, Rhaman, 2015).

Work life balance

Work-life balance (WLB) focuses on equal division of time and energy between work and private life. The key goal is to separate these two spheres so that neither dominates the other. In practice, this means, for example, clearly defined working hours, after which the employee completely cuts off from professional duties to spend time with family, rest or devote themselves to their interests.

The concept of WLB has gained much attention in recent years due to the growing importance of flexible, family-friendly working hours (Small et al., 2011). It is usually defined as the extent to which people achieve equal levels of satisfaction with their work and life (Greenhaus, Powell, 2003) and the boundary theory views work and life as separate domains, each satisfying different needs.

A slightly different definition of WLB indicates that the balance is in line with individual values, meaning that it is defined by each individual at the individual level. It cannot therefore be defined as an equality between the domains of work, family, and life (Wayne et al., 2017), but as the desired balance between the domains at a given point in a person's life and career. As such, it represents a personal ideal that may or may not be actually achieved (Adkins, Premeaux, 2019).

Work-life integration

Work-life integration (WLI) focuses on the interpenetration of professional and private life in a flexible manner. In this approach, work and personal tasks are carried out in a schedule tailored to individual needs, e.g. remote work, dealing with personal matters during working hours or performing professional duties at non-standard times. The essence is efficiency and the ability to freely switch between professional and private roles.

This process has become particularly visible through the adoption of remote work at home, and is therefore, among other things, the result of technological changes, although considerations on this subject have appeared more widely since the pandemic, which forced work from home. From the employee's point of view, this type of integration may threaten their independence through the possibility of the employer deciding how the work is to be performed by the employee without observing the standards provided for in the national labor law system (Godlewska-Bujok, 2020). In practice, remote and hybrid work options may be beneficial to some extent, but this way of performing work may blur the boundaries between professional and private life.

Integrative behaviours refer to the actual ways in which an individual manages the boundaries between work and personal life (Foucreault, Ollier-Malaterre, Ménard, 2018).

Work life harmony

As some researchers point out, work and personal life can actually be complementary to each other (rather than competing) and then we can talk about harmony rather than conflict or the search for balance (Hill et al., 2007; McMillan, Morris, Atchley, 2011). The concept of work-life harmony (WLH) introduces the perception of these spheres as integrative rather than competitive elements and includes understanding and sharing the responsibilities related to roles (Ong, Jeyaraj, 2014).

Others view work-life harmony as the ability to combine work and life dimensions and as a harmonious arrangement of work and life roles that are integrated with each other (McMillan, Morris, Atchley, 2011). Harmony occurs when resources are successfully coordinated and utilized in both spheres and negotiation and sharing of responsibilities are practiced (Grzywacz, Carlson, 2007).

Hughes and Bozionelos (2007) point out that ensuring work-life harmony relies on "the ability of individuals, regardless of age or gender, to find a rhythm that allows them to combine work with responsibilities, activities and aspirations outside of work".

Using the concept of work life harmony gives employers and their employees greater opportunity to push boundaries as needed to effectively adjust work parameters and maintain employee life harmony. It is important to note that the boundaries between tasks, levels of authority, and other traditional constraints and an employee's life are not always as clear and reliable (Murphy, Manocha, 2024).

The advantage of using this concept is the emphasis on building an internal sense of balance and fulfillment, in which work and private life are perceived as mutually supporting elements. It is not about equal division of time, but about a sense of satisfaction and emotional balance. For example, a job that gives satisfaction can be a source of energy and motivation in personal life, instead of being a competition for free time. In this context, it is indicated that it is possible to achieve synergy between life and work. Consequently, for an employer, a higher level of work-life harmony among its employees may be associated with less frequent plans to leave the company (Lindfelt et al., 2018).

In this construct, a special role can be attributed to the phenomenon of mompreneurship, which describes female entrepreneurs who seek harmony between their professional and private lives, combining the roles of mothers and businesswomen, and thus putting family and full-time professional work first (Ekinsmyth, 2013).

Work-life enrichment

According to Friedman and Greenhaus (2000), balance is a flawed metaphor that assumes that employees must negotiate between work and the rest of their lives. Instead, the authors propose striving for a more satisfying goal than balance, namely enrichment, which is not related to trade-offs but to synergy, occurring when work and family help an individual cope better in other areas of life, such as work (Friedman, Greenhaus, 2000; Friedman, 2014).

The basic assumption behind the concept of work-life enrichment (WLE) is that both work and family provide individuals with resources (e.g., self-esteem, income, etc.) that can help them cope better in various areas of life (Carlson et al., 2006).

According to this approach, the work-life interface may be easier when involvement in one role spills over into another (Greenhaus, Powell, 2006). As an example, employees believe that their family/personal life has taught them, among other things, how to interact better with coworkers or how to multitask. Conversely, employees who learn conflict resolution techniques during training at work can use the knowledge to effectively resolve conflicts at home (Ruderman et al., 2002).

Interestingly, work-family conflict and enrichment are opposites (Allen, 2012). Family involvement may produce positive spillovers into the workplace, but these positive spillovers do not compensate for the conflict that the workplace introduces into the family, which contributes to lower job performance (Weer, Greenhaus, Linnehan, 2010).

The term WLE aims to focus the research field away from the conflicts and tensions that typically characterize other work-life constructs, towards the positive outcomes of participation in work and private life (Pitt-Catsouphes et al., 2004).

The key differences between the constructs discussed include:

- Work-Life Balance seeks to separate work and life, while Work-Life Integration brings them together into a coherent whole.
- Work-Life Balance is about time proportions, and Work-Life Integration is about the freedom to manage activities.
- Work-Life Harmony places greater emphasis on the subjective sense of fulfillment and synergy between different spheres of life.

3. Methodology

This article attempts to conduct a scoping review of the existing literature (Tricco et al., 2018) related to the WORK-LIFE interface to gain insight into the research interests in the individual WORK-LIFE constructs over the years and their relationships with other topics and each other. It was expected that the evidence would be diverse and scattered. The exclusion Criteria were as follows:

a) the search was performed using a combination of keywords containing the interfaces described at the beginning of the article, taking into account their different spellings: "WORK LIFE CONFLICT" OR "WORK-LIFE CONFLICT", "WORK LIFE BALANCE" OR "WORK-LIFE BALANCE", "WORK LIFE INTEGRATION" OR "WORK-LIFE INTEGRATION", "WORK LIFE HARMONY" OR "WORK-LIFE HARMONY", "WORK LIFE ENRICHMENT" OR "WORK-LIFE ENRICHMENT",
b) after identifying the key words, an international database was selected and a search was conducted in the Scopus database using the following fields: Article Title, Abstract, Keyword,
c) the review period was not time-limited in terms of the start of the scope - indexed documents were requested until 2024,
d) was used filters based in the Business, Management and Accounting knowledge discipline,
e) accepted OPEN ACCESS criterion,
f) documents written in a language other than English were excluded from the study,
g) from research disabled materials in press and note, short survey, erratum, letter, conference review, conference paper, editorial,
h) the decision was made to include the following document types: article, book, book chapter, review.

The bibliometric analysis was conducted using the preferred reporting items for systematic reviews and meta-analyses (PRISMA-ScR) guidelines (Tricco et al., 2018). PRISMA outlines essential steps for systematically reviewing scientific literature, including the selection of

indexed papers from bibliographical databases while excluding nonrelevant materials (Moher, 2009) . The results of searches and process of article selection are presented in the PRISMA diagram (Table 1) below.

Table 1.
Screening process

	WORK LIFE CONFLICT	WORK LIFE BALANCE	WORK LIFE INTEGRATION	WORK LIFE HARMONY	WORK LIFE ENRICHMENT	
IDENTYFICATION	6134	42 326	3530	259	292	
SCREENING	740	11 586	374	43	54	tems for Title, Abstract& Keyword screen
SCREENING	490	8968	276	33	22	excluded studies (as described above)
INCLUDED	250	2618	98	10	32	

Source: own study based on Moher, 2009, p. 264.

Following a preliminary literature review on the WOR-LIFE INTERFACE, the following research questions were identified:

1. Which of the constructs discussed is most widely described in the literature?
2. What key themes are associated with each construct?
3. What are the themes common to all constructs?

In accordance with the objectives, all data from the included sources will be presented in the form of graphs and a narrative summary. The results will be discussed in relation to the research questions.

4. Results

The WLB interface is most widely described in the literature, followed by WLC, WLI, and recently WLH and WLE (Fig. 1). Analysis of publication time reveals a general increase in WLB-related documents published since 1998, although five stages were identified: 1. weakly increasing growth from 1998 to 2004; 2. A sharp increase in 2005-2007; 3. a steadily increasing number of publications observed between 2012 and 2017; 4. A critical decline just before the pandemic in 2018; 5. A systematic, large increase since 2019.

For the remaining constructs, a significantly smaller number of documents were identified, however, starting from 2021, all topics have been continuously present in scientific publications, which was not the case before.

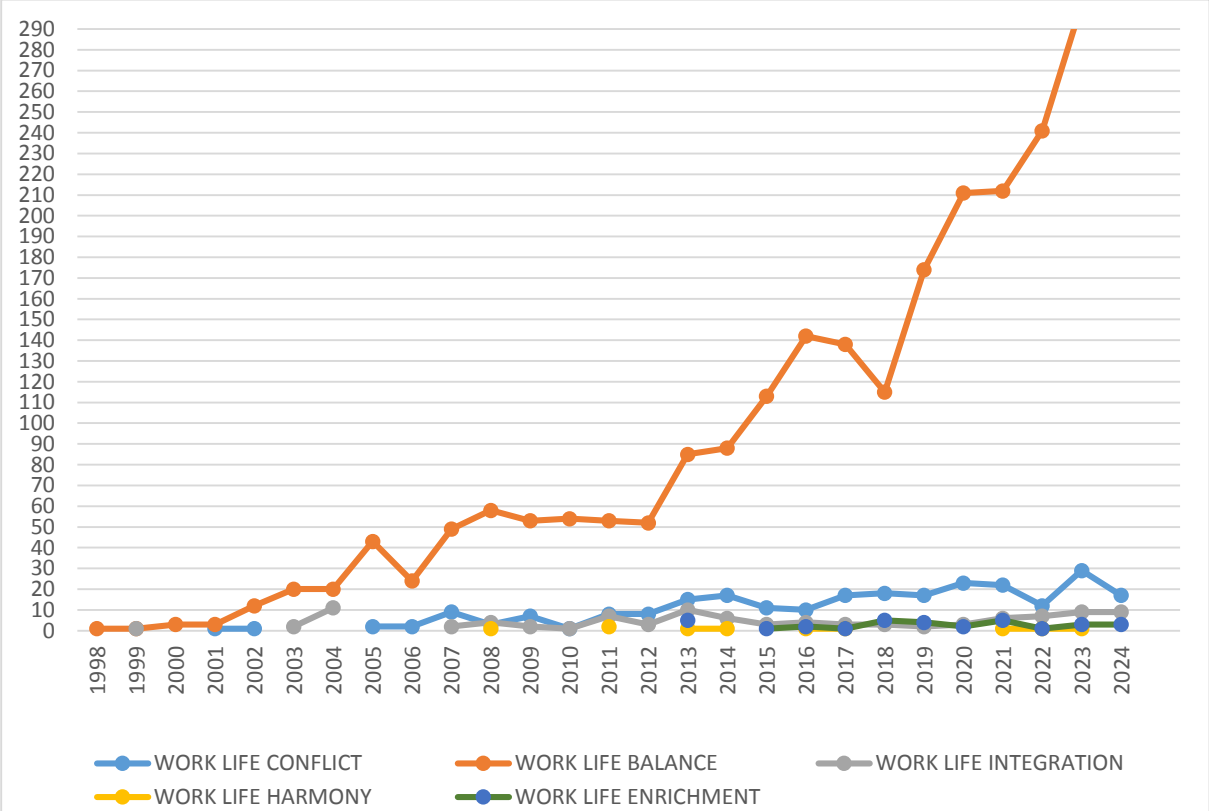


Figure 1. Total number of publications per year.

Source: own study.

To answer the remaining two research questions, a visualization map was used, which displays keywords in the data file based on clustering techniques available in VOSviewer. The approach is based on keyword mapping and clustering (van Eck, Waltman, 2010). For mapping the minimum number of keyword occurrences was assumed to be 5. Results are shown in figures 2-6.

As indicated by maps created with VOSviewer:

a) The WLC interface is most often related to the WLB topic, job satisfaction, gender and wellbeing (Fig. 2).
b) The WLB interface is most often associated with the job topic satisfaction, human, female, article, male and burnout (Fig. 3).
c) The WLI interface is most often associated with the work-life balance, human, female, article, burnout (Fig. 4).
d) The WLH interface is most often related to the topics of work-life balance, human, wellbeing and burnout (Fig. 5).
e) The WLE interface is most often associated with the WLB and WLC topic (Fig. 6).

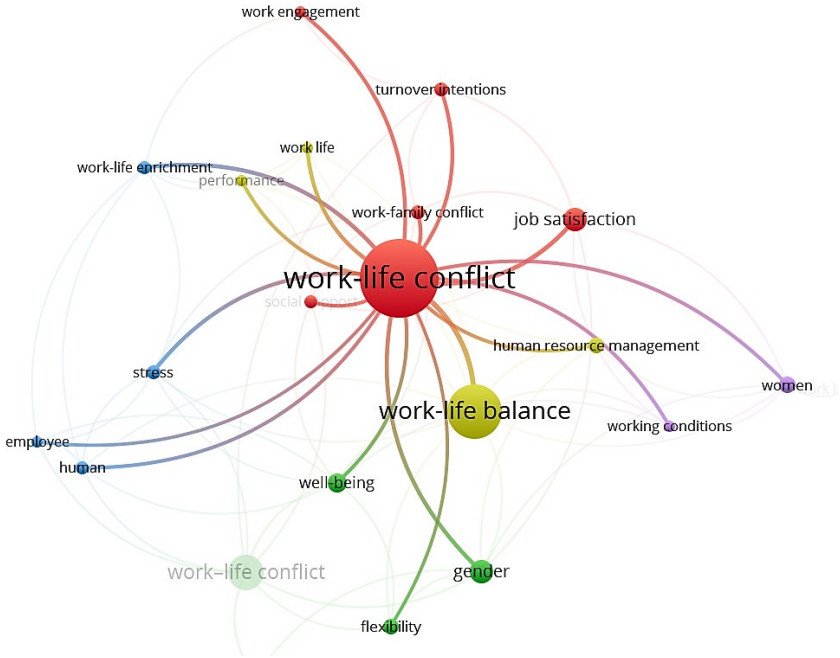


Figure 2. Work life conflict.

Source: own study by VOSviewer.

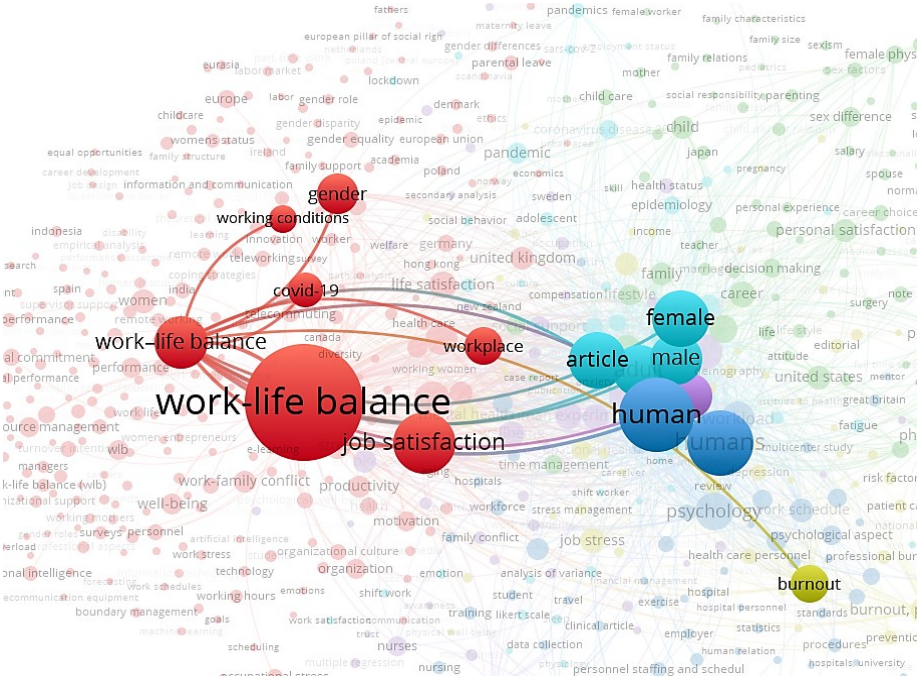


Figure 3. Work life balance.

Source: own study by VOSviewer.



Figure 4. Work life integration.

Source: own study by VOSviewer.



Figure 5. Work life harmony.

Source: own study by VOSviewer.

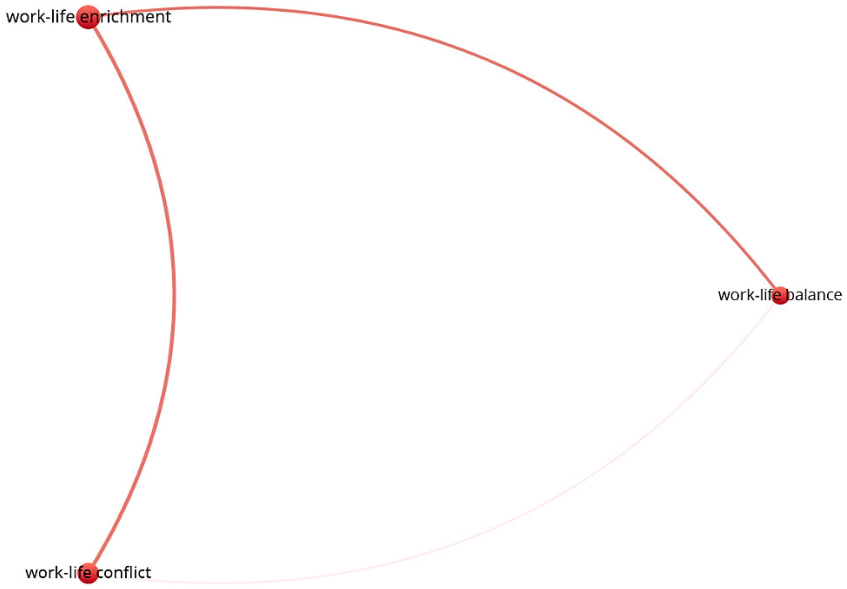


Figure 6. Work life enrichment.

Source: own study by VOSviewer.

The analysis of the most frequently occurring keywords indicates that all constructs have one common area (occurring in all 5 constructs) and it is work-life balance. Other common areas with lower frequency of occurrence are burnout, human, job satisfaction, female and wellbeing.

5. Summary

Each of the constructs discussed in the article responds to different needs and lifestyles, therefore their selection depends on individual preferences and the working and living conditions of an individual. In practice, it is difficult to distinguish between the concepts, although it is worth noting that all of these constructs, the distinctions of which are not always clear, express the mutual benefits of integrating work and family/personal life. Despite the conceptual differences, there is a lack of efforts in the literature to confirm these differences. Moreover, some previous studies often consider the above-mentioned terms as similar. This is confirmed by the results of the presented review, where a huge difference in the number of publications depending on the construct is visible. The most widely described construct is the work -life balance, while the others constitute only a small percentage of it. Interestingly, despite the differences in the names of the constructs, they often contain the same key words.

The lack of empirical evidence substantiating conceptual differences between constructs constitutes a significant research gap that requires further attention.

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