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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 41 papers.

The papers presented in the number concentrate on many topics connected with organization and management. There are in the number papers about: Smart Cities, economics, strategic management, customer management, production management, healthcare management, leadership, human resource management, supply chain management, the implementation of AI in management, innovation management, energy management, Lean Management, entrepreneurship, logistics, sustainability and greenwashing.

Radosław Wolniak

PERSONAL INNOVATIVENESS AS MODERATOR OF THE ACCEPTANCE OF SMART TRANSPORTATION SOLUTIONS

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Purpose: The primary objective of this study is to examine the acceptance of smart transportation solutions within urban areas, with a specific focus on the moderating role of personal innovativeness. The research aims to identify and analyze the determinants that influence residents' behavioral intentions to adopt such technologies. By utilizing the Unified Theory of Acceptance and Use of Technology (UTAUT2) framework, the study seeks to fill the gap in the literature regarding the interplay between individual traits and the adoption of innovative transportation systems in Polish cities.

Design/methodology/approach: The study employs a quantitative research design, utilizing the Computer-Assisted Web Interviewing (CAWI) method to gather primary data. A total of 471 responses were collected from residents of major Polish cities with populations exceeding 200,000. The survey instrument was developed based on established scales from the UTAUT2 framework and included measures for personal innovativeness, perceived usefulness, perceived ease of use, hedonic motivation, social influence, perceived costs, and intention to use smart transportation solutions. The collected data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the proposed hypotheses and determine the relationships between the variables.

Findings: The analysis revealed that perceived usefulness, perceived ease of use, and hedonic motivation positively influence the intention to adopt smart transportation solutions. Perceived costs were found to have a negative impact. Among these factors, perceived ease of use emerged as the strongest predictor. The study also demonstrated that personal innovativeness moderates the relationship between perceived costs and the intention to use, indicating that highly innovative individuals are less discouraged by higher perceived costs. Surprisingly, social influence did not significantly affect the intention to adopt smart transportation solutions, suggesting a context-specific deviation from typical UTAUT2 findings.

Practical implications: The results of this study offer valuable insights for policymakers, urban planners, and technology developers seeking to promote smart transportation systems. Strategies should focus on enhancing the perceived ease of use and usefulness of such systems while addressing cost-related concerns. Targeting early adopters with high personal innovativeness can create a bandwagon effect, encouraging broader adoption. Additionally,

the findings suggest the need to tailor promotional efforts that emphasize individual benefits rather than relying heavily on social influence.

Originality/value: This research contributes to the growing body of literature on technology acceptance by integrating the UTAUT2 framework with personal innovativeness in the context of smart transportation solutions. The study provides novel insights into how individual traits influence the adoption process, particularly in urban environments. Its findings offer practical guidance for enhancing the implementation and acceptance of smart transportation technologies, underscoring the importance of personalized strategies in fostering innovation adoption.

Keywords: personal innovativeness; UTAUT 2; smart transportation; innovativeness; smart mobility.

Category of the paper: Research paper.

1. Introduction

Smart transportation solutions are integral part of the “smart city concept”, embracing a wide range of advanced technologies to optimize mobility and reduce environmental pressures in urban areas. Fast adoption of such systems by urban populations is a crucial aspect of successful implementation of such solutions. As by 2050 two- thirds of the global population is expected to live in cities, there is a growing need for sustainable and efficient transportation solutions worldwide. The aim of this study is to investigate the determinants of the adoption of the smart transportation solutions among residents of Polish urban areas. Understanding these determinants is critical for successful implementation of smart transportation solutions, which often constitute a significant and risky investment for cities. Despite growing body of research on smart transportation adoption, the knowledge of factors promoting or inhibiting this process is still limited. In particular, the role of internal factors, such as individual differences is still not well understood. This study builds on the extended Unified Theory of Acceptance and Use of Technology (UTAUT 2) framework, enhanced with personal innovativeness, to provide a more in- depth understanding how personal traits impact technology adoption. This study contributes to the field by providing insight into the relationships between technology acceptance determinants and user characteristics.

2. Literature review

2.1. Personal innovativeness

Within extensive literature on determinants of technology acceptance, one identifies two main research streams. The first one focuses on external stimuli, such as perceived usefulness or ease of use, the second focuses on personal traits and social influences as determinants of adoption. Some studies suggest that the latter ones could potentially be more important factors behind adoption decisions (Lu, Yao, Yu, 2005). Individual's innovativeness has been long recognized as important factor driving individuals' behavior in the context of novel technologies and solutions (Lu, Yao, Yu, 2005). Highly innovative individuals are more likely to actively search for information, and are better accommodating for higher risk levels associated with the adoption of new products (Rogers, 1995). The general conclusions resulting from the diffusion of innovation research is that the innovative people tend to be quicker and more eager to try new technologies and solutions appearing on the market. Personal innovativeness is an individual trait, and is defined as adaptation of individuals to innovation sooner than others (Rogers, 1995) or eagerness to try any new technology (Agarwal, Prasad, 1998), and is antecedent for novel technologies acceptance behavior (Donmez-Turan, Zehir, 2021). As personal trait, it originates from the differences in cognitive styles (Lu, 2014). Innovative behavior is derived from conscious cognitive activity which implies shifting from habitual to active thinking, and is determined by novelty, discrepancy and deliberate conditions (Louis, Sutton, 1991). Individuals with higher levels of innovativeness should perceive novelty or discrepancy easier and have stronger inclination to use new technologies or solutions. In the literature, personal innovativeness is often related to risk – taking behaviors, with highly innovative individuals better accommodating for risk related to adoption of any innovative technologies (Chang, Huang, Fu, Hsu, 2017). Additionally, innovative individuals hold more positive beliefs towards innovative technologies (Lewis, Agarwal, Sambamurthy, 2003), and perceive them to be more useful (Mao, Srite, Thatcher, Yaprak, 2005). Numerous studies found personal innovativeness as a major determinant of intention to use new technologies (Donmez-Turan, Zehir, 2021). In the context of consumer behavior, personal innovativeness is understood as a predisposition to buy new and different products or brands, rather than relying on previous choices (Steenkamp, Hofstede, Wedel, 1999) or propensity to adopt new offerings or ideas earlier than others.

There is no agreement whether personal innovativeness is an antecedent or a direct moderator of behavioral intentions, and the role of individual innovativeness is theorized differently (Kwon, Choi, Kim, 2007; Yi, Fiedler, Park, 2006). Innovativeness can be measured both from internal and external perspectives, that is based on individual's internal characteristics or external actions (Menod, Jablokow, Purzer, Ferguson, Ohland, 2014). Generally, the first perspective (assessing attributes) and focusing on cognitive styles and affect

tend to dominate in the research, especially when consumers' reactions to novelties are investigated. Although studies of personal traits in the context of innovation diffusion has been conducted from the late 1990s, only few integrated them into technology acceptance models and studied its impact on intentions to adopt innovations (Lu, Yao, Yu, 2005).

2.2. The Unified Theory of Acceptance and Use of Technology and acceptance of smart transportation solutions

In the literature, several models have been proposed to investigate the factors influencing the acceptance of new technologies. The most influential include: the theory of planned behavior (TPB), technology acceptance model (TAM), theory of reasoned action (TRA), and the unified theory of acceptance and use of technology (UTAUT). The latter one, proposed by Venkatesh et al. (Venkatesh, Morris, David, Davis, 2003), and later extended into UTAUT 2 (Venkatesh, Thong, Xu, 2012), has become particularly popular over the recent years. UTAUT and UTAUT 2 synthesize eight important models of technology acceptance, have high predictive value, and are applicable to consumer research. The UTAUT incorporates four factors influencing technology acceptance: performance expectancy (confidence in the new technology to deliver positive effects or consumer's belief that using technology allows for better task performance), effort expectancy (perceived ease of use of technology), social influence (the perceived degree of social environment's influence on individual's adoption), and facilitating conditions (individual's belief of the existence of the adequate support when adopting the new technology). UTAUT 2 was extended with additional variables: hedonic motivation (perception of technology as pleasant or fun to use), price value (beliefs about the value of the new technology), and habit (the extent to which an individual believes their behavior to be habitual). Additionally, the model includes moderators such gender, age, willingness to use the new technology, and experience. UTAUT and UTAUT 2 have been validated in various contexts, and provide comprehensive framework to investigate behavioral intentions to adopt and use new technologies (Harris, Mills, Fawson, Johnson, 2018).

There is still limited body of knowledge regarding the factors determining consumers' intentions to use smart city technologies, with majority of them focusing primarily on general acceptance of such solutions or intention to use particular technologies, for example mobile applications. Considerable number of published studies utilize UTAUT or UTAUT 2 frameworks, aiming to locate factors crucial for implementation of such technologies. Notable studies include investigation of determinants of the acceptance of IT technologies in public safety domain by Oliveria and Santos (Oliveira, Santos, 2019), who found perceived ease to use and social influence to be important determinants. Research of factors influencing acceptance of smart city communication technologies by Popova and Zagulova (Popova, Zagulova, 2022) found performance expectancy, effort expectancy, social influence, facilitating conditions, and attitude towards the use of applications to have positive impact on the behavioral intention to use such technologies. Similar results were reported by Teng, Bai and

Apuke (Teng, Bai, Apuke, 2024), who additionally found privacy concerns to be negatively correlated to intention to use smart city services. High performance expectancy, facilitating condition, low effort expectancy, and social influence were found to impact positively behavioral intentions to adopt sustainability- oriented smart city services by Bestepe and Yildirim (2022), one of few studies that included personal innovativeness. They found personal innovativeness to be a significant determinant of use intention- more innovative individuals exhibited higher propensity to adopt focal technologies. Incorporating personal innovativeness to technology adoption studies is relevant for several reasons. As more innovative individuals should perceive any new technologies or solutions as less complex, this can have positive impact on effort expectancy, behavioral intention to use and performance expectancy. Further, one can expect lower impact of social influence on intention to adopt new technologies, but also higher expectations regarding the benefits of adoption.

Smart transportation solutions are part of the concept of the smart city. Both are conceptual and practical answers to demands of urban environments that result from growing populations, road congestion, and environmental pressures. It is estimated that by 2050, 68% of the global population, forecasted to reach ten Billion, will reside in urban areas (United Nations, 2024). Smart transportation systems are intelligent ones, defined as “(...) sets of tools that facilitate integrated, automated, and connected transportation systems, that are information-intensive to better serve users and be responsive to the needs of travelers and system operators” (U.S. Department of Transportation, 2015). Smart transportation systems utilize growing number of technologies, allowing more flexible, efficient and sustainable travelling and transportation. Smart cities worldwide adopt these sophisticated and intelligent systems, aiming at reduction of road congestion, limiting pollution and travelling optimization. Technologies that are employed in this area include, among others AI, Internet of Things, blockchain, sensors, communications technologies and the big data. Equipped with management strategies into cohesive and integrated frameworks, they aim to enhance efficiency and safety of transportation of both people and goods. Popular intelligent technologies have already been introduced to enhance urban mobility and include, among others, intelligent timetables for public transport, shared urban bicycles, park & ride facilities, mobile application ticketing systems, free parking space indicators, traffic light countdown displays, mobile parking payment systems, and city travel time displays. All these examples can be considered to be practical and tangible facets of smart transportation systems, which not only require considerable investment, but also- and foremost - acceptance of urban populations. There is still limited body of research of determinants of consumers’ intentions to use smart transportation solutions. Understanding what drives their fast and efficient adoption is crucial for their successful implementation. Knowledge of such factors can be instrumental to promoting benefits of such systems and encouraging their use by citizens, which, in turn, would allow their roader social and environmental goals to be achieved.

3. Method

The aim of this study is to investigate the determinants of the intention to use smart transportation solutions (ST, henceforth), with particular focus on the moderating role of personal innovativeness. To achieve this, the authors employed UTAUT 2 model. Based on literature review, a research model was developed (Fig. 1).

The following hypotheses were formulated:

H1: Perceived usefulness of ST positively influences intention to use ST solutions.

H2: perceived ease of use positively influences intention to use ST solutions.

H3: Social influence positively influences intention to use ST solutions.

H4: Hedonic motivation positively influences intention to use ST solutions.

H5: Perceived costs negatively influence intention to use ST solutions.

Based on analysis of the available literature, the following hypotheses, aiming to verify the moderating effects of personal innovativeness were formulated:

H6a: Personal innovativeness moderates the influence of the perceived usefulness on the intention to use ST solutions.

H6b: Personal innovativeness moderates the impact of the perceived ease of use on intention to use ST solutions.

H6c: Personal innovativeness moderates the impact of social influence on intention to use ST solutions.

H6d: Personal innovativeness moderates the impact of hedonic motivation on intention to use ST solutions.

H6e: Personal innovativeness moderates the impact of the perceived cost on intention to use ST solutions.

To verify the above hypotheses, the primary data was collected with CAWI method, to reach nation- wide population of respondents living in the major cities (with population above 200,000 residents) with smart transportation solutions already implemented. The authors aimed to investigate the acceptance of smart transportation solutions, and the role of personal innovativeness in this process. The questionnaire design was based on analysis of literature, and included scales measuring UTAUT 2 variables and personal innovativeness. Respondents answered with 5-point Likert scale, where 1 meant “strongly disagree”, and was scale’s minimum, and 5 meant “strongly agree”, and was scale’s maximum. To measure the perceived ease of use the scale proposed by Choi (Choi, 2022) was used. The scale for social influence was adapted from Nusir, Alshirah & Alghsoon (2024) and Lee (2023). The perceived usefulness was assessed with the scale proposed by Lee (2023). To measure hedonic motivation, the scale was developed based on the scales proposed by Debesa, Gelashvili, Martines-Navalon & Saura (2023) and Venkatesh, Thong & Xu (2012). For personal innovativeness the scale proposed by Alkodour et al. (2023) was applied. Weisstein, Kukar-Kinney and Monore scale was used to

measure perceived costs (2016). The use intent was measured with the scale proposed by Bestepe and Yildirim (2022). A pilot study of 25 respondents was conducted to secure the quality of the research instrument. The data collection took place from May to June 2024. A random sample of 1460 respondents from the Biostat Opinion Research Panel was selected. The sample was controlled for gender, location and use of smart transportation solutions. 600 respondents took part in the survey, out of which, after validation, 471 qualified for further analysis. Sample's characteristics are presented in table 1.

Table 1.
Sample's characteristics

Variable		%
Gender	Male	43.7
	Female	56.3
Age	18-30	33.5
	31-40	31.9
	≥40	34.6
Place of residence	City, 201,000-500,000 residents	43.7
	City, over 501,000 residents	56.3
Use of car	Yes	77.5
	No	22.5
Household role	Dependent	6.8
	One of the breadwinners	69.4
	Sole breadwinner	23.8

Source: Own calculations.

The analysis of the data was carried out with SmartPLS4 software. First, PLS-SEM algorithm was calculated. Since the model was based on reflective indicators, their internal consistency, convergent validity, and discriminant validity were estimated. The results of this stage are presented in table 2.

Table 2.
Reliability and validity indicators

Latent variable	Cronbach alpha	Composite reliability rho_c	Composite reliability rho_a	Average variance extracted (AVC)
Perceived usefulness	0.837	0.853	0.891	0.672
Perceived ease of use	0.903	0.909	0.939	0.837
Social influence	0.872	0.970	0.901	0.646
Hedonic motivation	0.850	0.938	0.905	0.760
Perceived costs	0.924	0.947	0.946	0.813
Personal innovativeness	0.879	0.948	0.920	0.794
Intention to use	0.920	0.923	0.949	0.862

Source: Own calculations.

Discriminant validity ratios for the constructs included into the study are presented in table 3.

Table 3.

Heterotrait-monotrait (HTMT) ratios- discriminant validity

Latent variable	Perceived usefulness	Perceived ease of use	Social influence	Hedonic motivation	Perceived costs	Personal innovativeness	Intention to use
Perceives usefulness							
Perceives ease of use	0.586						
Social influence	0.599	0.119					
Hedonic motivation	0.656	0.426	0.523				
Perceived costs	0.064	0.157	0.225	0.052			
Personal innovativeness	0.518	0.400	0.456	0.654	0.089		
Intention to use	0.700	0.704	0.245	0.517	0.193	0.374	

Source: Own calculations.

The measurement model was verified positively with the assessment of collinearity (variance inflation factor), predictive power (determination coefficients, R^2), and the significance of attrition coefficients. To estimate R^2 values, model fit indices, and path coefficients, PLS- SEM algorithm was used.

4. Results

Figure 1 presents results estimated with the PLS-SEM algorithm.

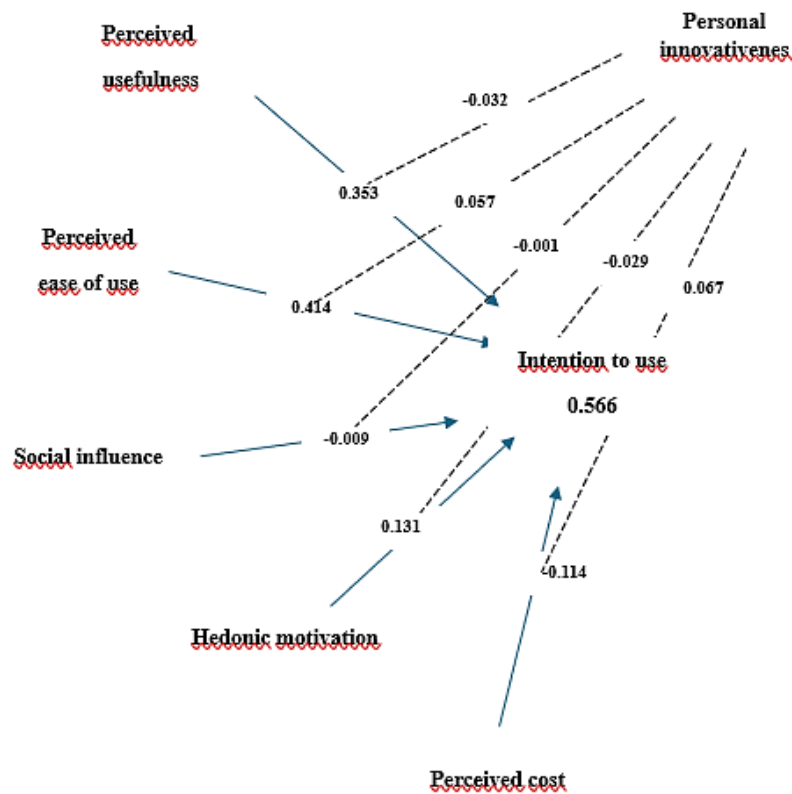


Figure 1. Path model estimated with the PLS-SEM algorithm.

Source: Own calculations.

The R^2 values for the intention to use smart transportation explained by the independent variables although moderate, are satisfying. Statistical significance of the path coefficients was assessed with the bootstrap analysis of a sample of 5,000. The results for the path coefficients and t- values are presented in the table 4.

Table 4.
Path coefficients and t- values

Path	(STDEV)	t-Value	p-Value
Hedonic motivation → Intention to use	0.047	2.782	0.005
Perceived usefulness → Intention to use	0.056	6.324	0.000
Perceived ease of use → Intention to use	0.050	8.349	0.000
Personal innovativeness → Intention to use	0.045	0.526	0.599
Perceived costs → Intention to use	0.034	3.375	0.001
Social influence → Intention to use	0.041	0.216	0.829
Personal innovativeness x Perceived ease of use → Intention to use	0.060	0.945	0.345
Personal innovativeness x Social influence → Intention to use	0.041	0.026	0.979
Personal innovativeness x Perceived usefulness → Intention to use	0.058	0.548	0.584
Personal innovativeness x Perceived costs → Intention to use	0.031	2.170	0.030
Personal innovativeness x Hedonic motivation → Intention to use	0.044	0.662	0.508

Source: Own calculations.

Table 5 presents summary results of hypotheses' verification.

Table 5.
Summary of hypotheses' verification

Hypothesis	Influence direction	Estimate	p-Value	Verification
H1: Perceived usefulness → Intention to use	+	0.353	0.000	Supported
H2: Perceived ease of use → Intention to use	+	0.413	0.000	Supported
H3: Social influence → Intention to use	+	-0.009	0.825	Not supported
H4: Hedonic motivation → Intention to use	+	0.131	0.006	Supported
H5: Perceived costs → Intention to use	-	-0.013	0.001	Supported
H6a: Personal innovativeness x Perceived usefulness → Intention to use	+-	-0.032	0.577	Not supported
H6b: Personal innovativeness x Perceived ease of use → Intention to use	+-	0.057	0.339	Not supported
H6c: Personal innovativeness x Social influence → Intention to use	+-	-0.001	0.975	Not supported
H6d: Personal innovativeness x Hedonic motivation → Intention to use	+-	-0.028	0.520	Not supported
Personal innovativeness x Perceived costs → Intention to use	+-	0.067	0.027	Supported

Source: Own calculations.

With the exception of H3, all hypotheses formulated for this study were accepted. Perceived usefulness of smart transportation, its perceived ease of use, and hedonic motivation were found to positively impact the intention to use smart transportation solutions. The perceived ease of use was found to have the strongest impact on the intent to use smart transportation (0.414, $p < 0.001$). The intention to use smart transportation was negatively impacted by the perceived cost. When it comes to the social influence – the positive impact was not confirmed. As for the personal innovativeness, it moderates the impact of the perceived costs on the intention to use the strongest. The higher perceived costs, the lower intention to use, but higher personal innovativeness offsets this effect (Figure 2).

Figure 2 presents moderating effect of personal innovativeness on relationship between perceived cost and intention to use smart transportation.

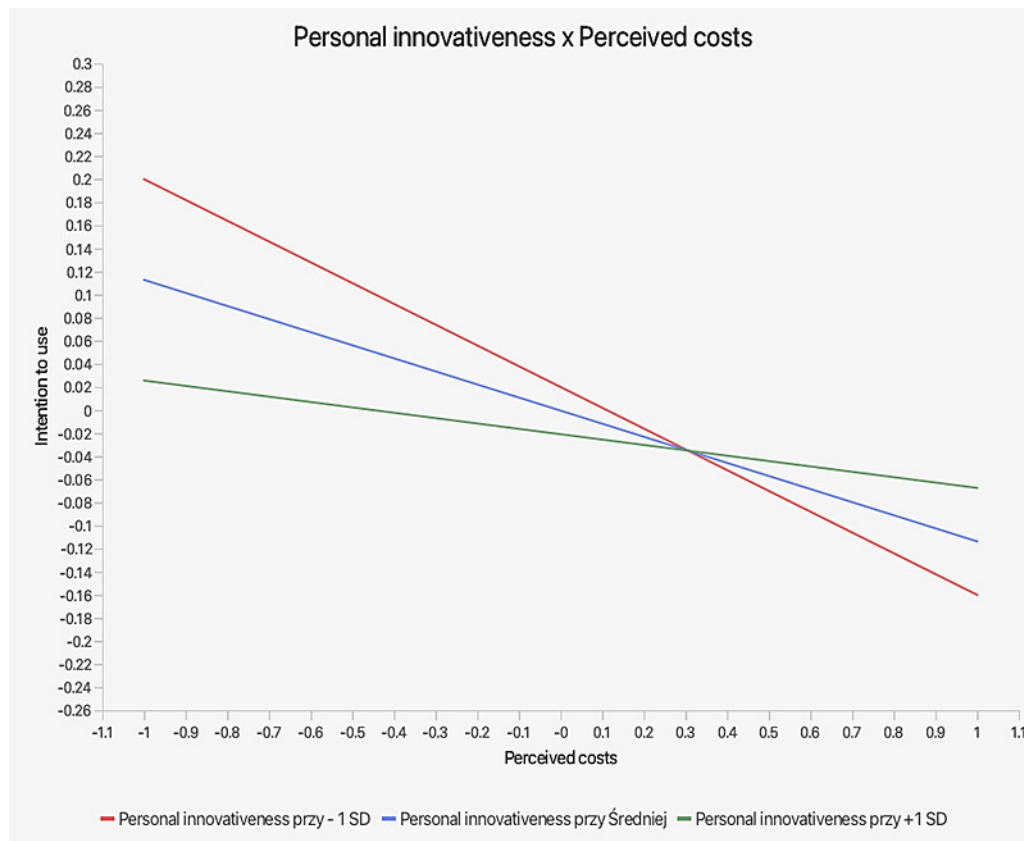


Figure 2. Personal innovativeness, perceived cost and intention to use smart transportation.

Source: Own calculations.

5. Discussion

This study sheds light on the UTAUT2 factors that impact the intention to adopt smart transportation solutions. The results of the analysis indicate that the perceived usefulness of such solutions ($\beta = 0.353$, $p < 0.001$) and perceived ease of use ($\beta = 0.414$, $p < 0.001$) significantly impact the behavioral intention to use smart transportation, which confirms their importance for the eventual adoption of such technology. Surprisingly, the results do not confirm the impact of the social influence ($\beta = -0.009$, $p = 0.825$) on the intention to use. One can hypothesize, that the insignificance of the peer pressure is context – dependent (for example culture or technology itself). The perceived costs ($\beta = -0.113$, $p = 0.001$) and hedonic motivation ($\beta = 0.131$, $p = 0.006$) influence the intention to use smart transportation- respectively negatively and positively.

The strongest determinant of the intention to use smart transportation was its perceived ease of use ($\beta = 0, 414$, $p < 0.001$). This suggest that individuals finding smart transportation solutions user- friendly are more likely to adopt them. The perceived simplicity and user-friendliness might reduce the risks perceived with technology adoption and thus, encourage to

use new solutions available. This finding is consistent with previous researches based on UTAUT framework, which suggest that technologies perceived as easy to use are adopted faster (Recskó, Aranyosy, 2024).

Similarly, the perceived usefulness was found to have significant impact on the behavioral intention. This confirms previous studies, which identified the relationship between the perceived benefits and adoption of technology. Individuals who understand smart transportation as reducing their costs and enhancing their life quality or performance have higher propensity to adopt such solutions. This study did not confirm previous research results regarding the impact of social influence on the intention to use smart transportation. This could result from stronger emphasis users of smart transportation place here on their personal benefits or practical consideration. Another possible explanation, which may require further research, is that peer pressure may not be so relevant in the specific context of urban transportation. Further, the likely impact of sample's cultural characteristic (individualism versus collectivism) could be investigated, too. Hedonic motivation was found to positively impact the intention to use smart transportation solutions. One can assume that individuals deriving fun or pleasure from using technology are more likely to use or continue to use it. The negative impact of the perceived costs on the intention to use was not a surprise. This finding confirms previous studies, which suggest that the perception of higher costs of using technology can discourage its adoption. Personal innovativeness proved to moderate this relationship. Highly innovative individuals were found to be less discouraged by costs, suggesting their stronger intention to adopt new technologies regardless the perceived financial costs. The focal point of this study was the moderating role of the personal innovativeness on the relationships between the investigated UTAUT 2 factors and respondents' intention to use smart transportation solutions. Among all the analyzed interactions, only the one between personal innovativeness and the perceived costs was found to be statistically significant. One can hypothesize that more innovative individuals are less cost sensitive when adoption of smart transportation solutions is considered. This finding confirms propositions present in the literature, that personal traits can impact adoption of technology. As innovative individuals are more likely to actively engage in information search, they may have either better knowledge or understanding of the actual or potential costs incurred in using new technology. Additionally, they may perceived greater value in the new technology, which decreases the perceived costs. For other relationships investigated in this study, moderating effects of personal innovativeness were not significant. This suggests that while it moderates the relationship between costs perceptions and technology adoptions, it does not have uniform effect on relationships between other factors and the intention to use smart transportation solutions.

6. Limitations to study and further research

The limitations to this study result primarily from the CAWI method used, which did not allow to reach all segments of urban populations. This limitation is inherent to this method. The quantitative nature of this method did not allow for more in-depth inquiry into motivations and behaviors of respondents. Additional qualitative investigation, for example Focus Group Interviews, could be conducted to accommodate for the complexity of the topic. Also, longitudinal studies could be employed to investigate dynamics and patterns of technology acceptance. A cross analysis of different demographic segments of urban populations could provide more practical insights to formulate promotional and educational policies. Another area of further investigation is comparison between regions to better understand the likely impact of local cultural contexts on the acceptance of smart transportation solutions. This study focused on the moderating role of personal innovativeness, contributing to understanding of the role of personal traits on technology acceptance. Other personal characteristics could be investigated, to better understand their role in processes of technology adoption.

7. Conclusions

Based on responses from 471 individuals, this study presents an inquiry into the moderating role of personal innovativeness on UTAUT 2 factors influencing the intention to use smart transportation by the large urban populations in Poland. Personal innovativeness was found to moderate the relationship between the perceived costs and the intention to use smart transportation ($\beta = 0.067$, $p = 0.027$), suggesting that more innovative individuals are less discouraged by costs to adopt new technology. No significant moderating effects between personal innovativeness and other factors of smart transportation adoption were found. The significant role of personal innovativeness in the context of cost perception suggest that when promoting smart transportation solutions, early adopters should be targeted primarily. This can create a bandwagon effect, accelerating the adoption among less innovative segments of the urban population. The main contribution of this study is exploration and validation of the moderating role of personal innovativeness in the context of UTAUT 2 factors in urban populations in Poland. This study provides insights how intention to use smart transportation is determined by its perceived usefulness, ease of use, perceived costs, hedonic motivation, and social influence. The findings regarding the role of personal innovativeness contribute to fundamental discussion of the role of personal traits in technology adoption process.

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DETERMINANTS OF THE ECONOMIC DEVELOPMENT OF THE VISEGRAD GROUP COUNTRIES

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Purpose: The research purpose of this article was to identify selected variables that influence the overall level of economic development of the Visegrad Group countries.

Design/methodology/approach: The article uses qualitative and quantitative research methods. A review of Polish and foreign literature on the subject was conducted, and secondary data (desk research) was analyzed based on public statistical data presented in time series (Eurostat, OECD, The World Bank) covering the period 2017-2024. To indicate the relationships between variables, a statistical analysis was performed using linear regression using the Stepwise method.

Findings: The article presents selected macroeconomic factors that affect the level of economic development of the Visegrad Group countries. The analysis of the interdependencies between these factors allowed for a deeper understanding of the relationships between variables.

Originality/value: The influence of selected macroeconomic factors conditioning the economic development of the Visegrad Group countries was verified using linear regression analysis. The literature review allowed the author to diagnose the research gap in the scope of the indicated determinants of the economic development of the V4 Group countries.

Keywords: Visegrad Group, economic development, GDP, minimum wages, Annual Enterprise Statistics for Special Aggregates of Activities, unemployment, mobile students, graduates.

Category of the paper: research paper.

1. Economic development

The level of economic development is an essential factor influencing the quality of life of a society. In highly developed economies, the situation in the labor market is generally stable, the population's average income level is high, and the financial crisis of households is good (Pastuszka, 2020). Economic development is a long-term process encompassing changes in the economy. Economic development encompasses qualitative changes (including changes in the organization of societies). Economic development is analyzed in three areas. First, in the substantive aspect, which is expressed, for example, in the faster growth of the

processing industry than the mining industry or the faster growth of the consumer services sector compared to the growth of the entire sphere of material production. Secondly, economic development can be analyzed in terms of ownership, expressed in the emergence of state and municipal ownership, in the growing share of large corporations in the total capital stock, e.g., in the emergence of an increasing number of international corporations. Thirdly, economic development is considered through the institutional prism (related to the growing role of state institutions, the state budget, and the banking system and capital market in the functioning of the national economy) (Chojnacka, 2020).

The main indicators of the level of economic development include:

- 1) GDP and national income per capita,
- 2) production of the main types of products per capita (electricity, basic foodstuffs - grain, milk, meat, sugar, potatoes, etc.),
- 3) sectoral structure of the national economy: relationships between national economic sectors of material and non-material production,
- 4) the level and quality of life of the population (analysis of the consumption basket, subsistence minimum),
- 5) indicators of economic efficiency of production (Khudoyarov et al., 2024).

It should be noted that the most common indicator that determines the level of economic development and is used in international comparisons is the gross domestic product per capita (GDP). This is a measure defining the value of goods and services produced in the economy of a given country in a given time (e.g., during a year), divided by the number of its inhabitants (per capita) (Knapińska et al., 2024).

The level of economic development between countries and even regions is significantly different (Wojtyna, 2007). These results, among other things, stem from the availability of production factors, which, in the theory of classical economics, can be divided into three main categories: land, capital, and labor (Hollander, 2005). Also in the context of the definition of economics, the essence of which is the management of limited resources (Samuelson, Nordhaus, 2012), it can be noticed that the barrier to unlimited economic development is the limited resources, which makes it impossible to satisfy all needs to the same extent (Żylicz, 2004; Grzelak, Matuszczak, 2011; Genstwa, 2022).

2. Visegrad Group Countries

The Visegrad Group is an informal regional cooperation associated with four Central and Eastern European countries: Poland, the Czech Republic, Slovakia, and Hungary (Braun, 2020). It was established on 15 February 1991 in the Hungarian castle in Visegrad, during a meeting of three representatives from each country (Olszyk, 2024). The V4 Community is a platform

for the integration of countries with similar geopolitical conditions, shared history, tradition, culture, and values characterized by a comparable level of socio-economic development. The V4 Group is a platform for creating initiatives and conducting activities in such areas as political and economic cooperation, security and defense, cultural and educational cooperation, and regional and cross-border cooperation (Jasiecki, 2020).

The Visegrad Group countries also focus on the constant transfer of values in the areas of culture, education, and science between the countries of the group (Sobczak et al., 2021). The Visegrad Group (Đurović Todorović et al., 2024) aims to contribute to building European security based on cooperation and coordination within existing European and transatlantic institutions (Visegrad Group, 2023). These economies are considered an example of a successful transition from a centrally planned economy to a market economy (Bieszk-Stolorz, Dmytrów, 2020).

From the Polish perspective, the Visegrad Group was one of the most important arenas of regional cooperation, although this significance changed radically after the Ukraine war outbreak. This was a consequence of Hungary presenting a radically different vision (from the other three) regarding the course, assessment, and postulated end of the Russian aggression against Ukraine. During the Slovak (2022/2023) and Czech (2023/2024) presidencies in the Visegrad Group, the frequency of organizing summits at higher political levels decreased significantly (Héjj, 2023).

3. Analysis of selected macroeconomic factors

Due to the numerous socio-cultural similarities and similar geopolitical situation of Poland, the Czech Republic, Slovakia, and Hungary, it was justified for the Author to conduct an analysis of the relationship between the level of GDP per capita and selected macroeconomic factors for the V4 countries. In this study, the Author focused on seven factors such as:

- Gross Domestic Product (GDP) – is one of the most important indicators used to measure the level of economic development of a given country, constituting a useful point of reference in determining the production capacity and efficiency of the economy (Watanabe et al., 2018; Ramzan et al., 2019).
- Minimum wage – „Minimum wages have been defined as the minimum amount of remuneration that an employer is required to pay wage earners for the work performed during a given period, which cannot be reduced by collective agreement or an individual contract” (International Labour Organization, 2024).
- Annual Enterprise Statistics for Special Aggregates of Activities (AES-AG) – the term „refers to a dataset and methodology used within the framework of Structural Business Statistics (SBS) in the European Union. It includes detailed annual data on enterprise

characteristics such as the number of enterprises, turnover, employment, and investment across various industries classified under the NACE (Statistical Classification of Economic Activities) system”. These statistics are essential for analyzing different economic sectors' structure, performance, and dynamics, excluding agriculture and largely non-market services such as education and health (European Union, 2024).

- Unemployment – „Unemployment rates represent unemployed persons as a percentage of the labor force. The labor force is the total number of people employed and unemployed” (Eurostat, 2024).
- Population total - population is the number of people that live in a country. It counts the resident population, defined as all nationals present in, or temporarily absent from the country, and aliens permanently settled in the country (OECD, 2024).
- Share of mobile students from abroad enrolled by education level, sex and country of origin, tertiary education, sex total in %.
- Graduates by education level, program orientation, completion, sex, and age: total, tertiary education (% of population total).

Table 1 presents selected macroeconomic factors determining the economic development of the Visegrad Group countries. Statistical data are presented in time series (2017-2024).

Table 1.

Selected indicators characterizing the Visegrad Group countries in 2017-2024

Country	Time							
	2017	2018	2019	2020	2021	2022	2023	2024
Slovakia								
GDP per capita (current US\$)	17585,2	19486,39	19383,48	19545,74	21391,93	21258,1	24470,2	bd
Minimum wages (Euro)	435	480	520	580	623	646	700	750
Population total	5439232	5446771	5454147	5458827	5447247	5473197	5518055	5506760
AES-AG*	471691	493636	512082	518497	bd	bd	bd	bd
Unemployment (% of total labor force)	8,13	6,54	5,75	6,69	6,83	6,14	5,8	bd
Share of mobile students from abroad enrolled by education level, tertiary education, sex total in %	4,4	4,5	4,6	4,8	4,6	4,8	bd	bd
Graduates by education level, program orientation, completion, sex and age: total, tertiary education	50622	44467	40324	38548	39514	37420	bd	bd

Cont. table 1.

Poland	2017	2018	2019	2020	2021	2022	2023	2024
GDP per capita (current US\$)	13815,62	15504,58	15699,91	15816,99	17999,91	18321,3	22112,9	bd
Minimum wages (Euro)	464	502,75	523,09	610,79	614,08	654,79	745,60	977,53
Population total	37974826	37974750	37965475	37899070	37747124	38385739	38762,844	38539201
AES-AG*	1 744 285	1 960 361	2 022 248	2 066 209	bd	bd	bd	bd
Unemployment (% of total labor force)	4,89	3,85	3,28	3,16	3,36	2,88	2,90	bd
Share of mobile students from abroad enrolled by education level, tertiary education, sex total in %	0,5	0,4	0,4	0,4	0,5	0,5	bd	bd
Graduates by education level, program orientation, completion, sex, and age: total, tertiary education	517305	469992	452628	411534	403602	400168	bd	bd
Hungary	2017	2018	2019	2020	2021	2022	2023	2024
GDP per capita (current US\$)	14621,24	16425,1	16782,95	16120,99	18728,12	18463,2	22147,2	bd
Minimum wages (Euro)	412,91	444,69	464,2	487,1	442,44	541,73	578,74	696,97
Population total	9787966	9775564	9771141	9750149	9709891	9684306	9686463	9676135
AES-AG*	570005	599547	647091	668796	bd	bd	bd	bd
Unemployment (% of total labor force)	4,16	3,71	3,42	4,25	4,05	3,60	4,1	bd
Share of mobile students from abroad enrolled by education level, tertiary education, sex total in %	3,9	3,9	4	4	3,6	3,9	bd	bd
Graduates by education level, program orientation, completion, sex, and age: total, tertiary education	63109	65079	62715	177972	71480	59471	bd	bd
Czech republic	2017	2018	2019	2020	2021	2022	2023	2024
GDP per capita (current US\$)	20636,2	23424,48	23664,85	22992,88	26821,25	27638,4	30427,4	bd
Minimum wages (Euro)	407,00	477,78	518,97	574,62	579,22	651,70	717,37	764,44
Population total	10594438	10629928	10671870	10697858	10505772	10673213	10809716	10735859
AES-AG*	1 019 773	1 043 330	1 058 776	1 068 446	bd	bd	bd	bd
Unemployment (% of total labor force)	2,89	2,24	2,01	2,55	2,81	2,22	2,60	bd
Share of mobile students from abroad enrolled by education level, tertiary education, sex total in %	7,3	7,7	8	8	7,8	7,6	bd	bd
Graduates by education level, program orientation, completion, sex, and age: total, tertiary education	87131	76158	72714	70119	67367	66746	bd	bd

bd – no data available.

„**” - Annual enterprise statistics for special aggregates of activities

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/data/database>, OECD <https://data.oecd.org/>, The World Bank, <https://data.worldbank.org/>, 28.11.2024.

Table 2 presents the dynamics of changes in the values of indicators year-on-year for the Visegrad Group countries. The list was prepared in percentage terms, assuming that the same period of the previous year = 100.

Table 2.

Dynamics of changes in indicator values for the Visegrad Group countries in 2017-2024 (%), the same period of the previous year = 100

Country	y/y	2018/2017	2019/2018	2020/2019	2021/2020	2022/2021	2023/2022	2024/2023
Slovakia	GDP per capita	110,81	99,47	100,83	109,44	99,37	115,11	bd
	Minimum wages	110,34	108,33	111,53	107,41	103,69	108,35	107,14
	Population total	100,13	100,13	100,08	99,78	99,78	100,81	99,79
	AES-AG	104,65	103,73	101,25	bd	bd	bd	bd
	Unemployment	80,44	87,92	116,35	102,09	89,90	94,46	bd
	Share of mobile students from abroad (%)	102,27	102,22	104,34	95,83	104,34	bd	bd
	Graduates, tertiary education	87,84	90,68	95,59	102,50	94,70	bd	bd
Poland	GDP per capita	112,22	101,26	100,75	113,80	101,79	120,69	bd
	Minimum wages	108,35	104,04	116,76	100,53	106,62	113,86	131,10
	Population total	99,99	99,97	99,82	99,59	101,69	100,98	99,42
	AES-AG	112,38	103,15	102,17	bd	bd	bd	bd
	Unemployment	78,73	85,19	96,34	106,32	85,71	100,69	bd
	Share of mobile students from abroad (%)	80	100	100	125	100	bd	bd
	Graduates, tertiary education	90,85	96,30	90,92	98,0	99,14	bd	bd
Hungary	GDP per capita	112,33	102,17	96,05	116,17	98,58	119,95	bd
	Minimum wages	107,69	104,38	104,93	90,83	122,44	106,83	120,42
	Population total	99,87	99,95	99,78	99,58	99,73	100,02	99,89
	AES-AG	105,18	107,92	103,35	bd	bd	bd	bd
	Unemployment	89,18	92,18	124,27	95,29	88,88	113,88	bd
	Share of mobile students from abroad (%)	100	102,56	100	90	108,33	bd	bd
	Graduates, tertiary education	103,12	96,36	283,78	40,16	83,19	bd	bd

Cont. table 2.

Czech Republic	GDP per capita	113,51	101,02	97,16	116,65	103,04	110,09	Bd
	Minimum wages	117,39	108,62	110,72	100,80	112,51	110,07	106,56
	Population total	100,33	100,39	100,24	98,20	101,59	101,27	99,31
	AES-AG	102,31	101,48	100,91	bd	bd	bd	bd
	Unemployment	77,50	89,73	126,86	110,19	79,00	117,11	bd
	Share of mobile students from abroad (%)	105,47	103,89	100	97,5	97,43	bd	bd
	Graduates, tertiary education	87,40	95,47	96,43	96,07	99,07	bd	bd

bd – no data available.

Source: own study based on Eurostat, <https://ec.europa.eu/eurostat/data/database>, OECD <https://data.oecd.org/>, The World Bank, <https://data.worldbank.org/>, 28.11.2024.

Among the four Visegrad Group countries (2017-2024 y/y), the GDP per capita dynamics indicator showed an upward trend in all periods only in Poland, ranging from 100.75% to 120.69%. A decline in the GDP per capita dynamics was noticeable in 2020/2019 in Hungary (96.05%) and the Czech Republic (97.16%), while in 2022/2021, only Hungary (98.58%) and Slovakia (99.37%) noted a downward trend in this indicator. The year 2023 ended with the following results for the Czech Republic: 30427.4, Slovakia 24470.2, Hungary 22147.2, and Poland 22112.9 GDP per capita (current US\$). In 2023, a negative natural increase was recorded in all the countries analyzed.

The minimum wage dynamics index in three V4 countries – Poland, Slovakia, and the Czech Republic – continuously showed an upward trend in the period (2017-2024 y/y), while in the 2021/2020 perspective, a negative value of the minimum wage dynamics index was recorded only in Hungary (90.83%). The total population dynamics index in the Visegrad Group countries (2017-2021 y/y) was a constant downward trend only in Poland and Hungary. In the Czech Republic and Slovakia, in the period (2017-2020 y/y), a minimal upward trend of this index was observed; however, in both countries in 2021, this trend changed towards a negative natural increase.

The AES-AG dynamics indicator in four V4 countries in the period (2017-2020 y/y) reached a positive value. However, a slight slowdown in this upward trend is observed in all countries. The unemployment dynamics indicator in all V4 countries (2017-2024 y/y) fluctuated, reaching an upward and downward trend. The lowest unemployment in 2023 was recorded in the Czech Republic and Poland. It is worth noting that over the 8 years counted from 2017, the unemployment rate in all Visegrad Group countries remained moderate.

The share of mobile students from abroad (%) in the analyzed period is an upward trend, except for the Czech Republic in 2021-2022 (fluctuations from 97.5 to 97.43%).

The graduates in tertiary education indicator were in a downward trend for the Czech Republic (2020-2022). The most considerable fluctuations in the indicator were recorded in Hungary, in 2019-2020, where in 2019/2020 it increased to 283.78%, and in the next period 2020/2021 it dropped to 40.16%.

The analysis of the dynamics of selected indicators for the Visegrad Group countries (Table 2) does not include a detailed discussion of the causes of their variability due to the variety of micro- and macroeconomic conditions. The COVID-19 pandemic, which affected the V4 countries in 2020, and the specificity of the socio-economic policy pursued at that time undoubtedly had a significant impact on the values of these indicators. The dynamics of economic transformations towards energy transformation (Jonek-Kowalska, 2024) in the V4 group towards a zero-emission economy (Łacka et al., 2024) also determines socio-economic development. However, these topics require separate, more in-depth studies to understand their significance fully.

4. Methods

The research objective of this article was to identify selected variables that affect the overall level of economic development of the Visegrad Group countries. Qualitative and quantitative research methods were used to achieve the objective. A review of Polish and foreign literature on the subject was conducted. Secondary data (desk research) was analyzed based on public statistical data (Eurostat, OECD, The World Bank) covering the period 2017-2024. In order to verify the impact of the group of factors determining economic development (GDP per capita current US\$), a dependency analysis was conducted using the linear regression function.

The regression function (Ali, 2021) is a tool for studying the relationships between variables. The regression function is an analytical expression of assigning the mean values of a dependent variable to specific values of an independent variable. Linear regression assumes the relationship between the dependent and explanatory variables is linear. In linear regression, it is assumed that an increase or decrease in the other variable accompanies an increase in one predictor variable. Mathematically, the simplest form of linear regression is described by the equation $Y = \beta_0 + \beta_1 X + \epsilon$, where Y is the dependent variable, X is the independent variable, β_0 is the intercept, β_1 is the regression coefficient, and ϵ is the random error. Regression uses methods such as least squares to minimize the deviations between data points and a linear model. A regression function is a mathematical function of a specific form that approximates the actual relationship between variables. The form of the function is determined based on the observed values (x_i, y_i) (Stanisz, 2006, 2007).

The author conducted a regression analysis using independent variables such as:

- minimum wages (Euro),
- population total,
- Annual Enterprise Statistics for Special Aggregates of Activities (AES-AG) about population total (the indicator was created at the stage of statistical calculations in order to enable comparison between countries),
- unemployment, total (% of total labor force),
- share of mobile students from abroad enrolled by education level, sex and country of origin, tertiary education, sex total, in % - after estimation,
- graduates in tertiary education (% of population total – the indicator was created at the stage of statistical calculations in order to enable comparison between countries).

In order to indicate the relationship between variables, an analysis was carried out using the stepwise linear regression method (Hayes, 2022) (Stepwise method). The focus was on explaining the percentage of variability of the dependent variable (dependent variable), which is explained by the variability of the predictor. The linear regression analysis aimed to calculate such coefficients so that the model would best predict the value of the dependent variable, and the estimation error was as small as possible. Regression analysis fits such a straight line to the subjects, creating a linear relationship to burden the model with the slightest possible random error. The stepwise method was used, which is a variety of regression analysis in which only statistically significant variables, called predictors, are introduced to the model, improving the built model's quality. The GDP per capita indicator (current US\$) was assumed as the dependent variable.

5. Results

In order to verify the influence of the group of factors conditioning economic development (GDP per capita), a dependency analysis was conducted. The results of the linear regression analysis are presented in Table 3, where the model's fit to the data is visible, and in Table 4, where the analysis of variance and regression coefficients are visible (Table 5). Four models were obtained. Predictors were introduced to each of them. Their statistical significance was checked.

Table 3.
Model fitting to the data

Model	R	*R Square (R ²)	Adjusted *R Square	Std. Error of the Estimate	Durbin-Watson
Predictors: (Constant), % - Annual enterprise statistics for special aggregates of activities/population total, unemployment, total (% of the total labor force) (modeled ILO estimate), minimum wages (EURO), the share of mobile students from abroad enrolled by education level, sex, and country of origin (tertiary education), sex total in % - after estimation	,967	0,935	0,922	1025,565264372120	
Predictors: (Constant), unemployment, total (% of the total labor force) (modeled ILO estimate), minimum wages (EURO), the share of mobile students from abroad enrolled by education level, sex, and country of origin (tertiary education), sex total in % - after estimation	,964	0,930	0,919	1039,743735283530	
Predictors: (Constant), minimum wages (EURO), the share of mobile students from abroad enrolled by education level, sex and country of origin (tertiary education), sex total in % - after estimation	,959	0,920	0,913	1081,788079437530	
Predictors: (Constant), minimum wages (EURO), the share of mobile students from abroad enrolled by education level, sex and country of origin (tertiary education), sex total in % - after estimation, %, graduates % of population total	,968	0,938	0,928	981,345227751106	2,113

*R² is a measure of the quality of model fit. It is a measure of what percentage of the variability in the dependent (explained) variable is explained by the independent variable (factor, explanatory variable, predictor) or the statistical model.

Source: own study.

Table 4.
Analysis of variance – Anova

Model	Sum of Squares	df	Mean Square	F*	p-value	
1	Regression	288653779,740	4	72163444,935	68,611	<,001
	Residual	19983898,118	19	1051784,111		
	Total	308637677,858	23			
2	Regression	287016337,157	3	95672112,386	88,498	<,001
	Residual	21621340,701	20	1081067,035		
	Total	308637677,858	23			
3	Regression	284062103,433	2	142031051,717	121,367	<,001
	Residual	24575574,425	21	1170265,449		
	Total	308637677,858	23			
4	Regression	289376908,738	3	96458969,579	100,161	<,001
	Residual	19260769,121	20	963038,456		
	Total	308637677,858	23			

*ANOVA – analysis of variance

Source: own study.

Table 5.
Regression coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value***	
	B*	Std. Error	Beta**			
1	(Constant)	2981,864	1643,299		1,815	0,085
	% - Annual enterprise statistics for special aggregates of activities/population total	525,590	421,238	0,288	1,248	0,227
	Unemployment, total (% of total labor force) (modeled ILO estimate)	-397,923	194,729	-0,183	-2,043	0,055
	Minimum wages (EURO)	20,670	3,706	0,442	5,578	0,000
	Share of mobile students from abroad enrolled by education level, sex, and country of origin (tertiary education, sex total, d - definition differs (see metadata), in % - after estimation	743,197	312,843	0,540	2,376	0,028
2	(Constant)	3047,390	1665,167		1,830	0,082
	Unemployment, total (% of total labor force) (modeled ILO estimate)	-215,381	130,290	-0,099	-1,653	0,114
	Minimum wages (EURO)	23,783	2,778	0,508	8,560	0,000
	Share of mobile students from abroad enrolled by education level, sex, and country of origin (tertiary education, sex total, d - definition differs (see metadata), in % - after estimation	1120,098	82,514	0,814	13,575	0,000
3	(Constant)	1906,235	1576,612		1,209	0,240
	Minimum wages (EURO)	24,098	2,884	0,515	8,356	0,000
	Share of mobile students from abroad enrolled by education level, sex, and country of origin (tertiary education, sex total, d - definition differs (see metadata), in % - after estimation	1141,088	84,828	0,829	13,452	0,000
4	(Constant)	-1485,357	2032,206		-0,731	0,473
	Minimum wages (EURO)	23,121	2,649	0,494	8,728	0,000
	Share of mobile students from abroad enrolled by education level, sex, and country of origin (tertiary education, sex total, d - definition differs (see metadata), in % - after estimation	1372,007	124,835	0,997	10,991	0,000
	% - graduates % of population total	3507,979	1493,259	0,215	2,349	0,029

a. Dependent Variable: GDP per capita (current US\$).

* Coefficient B – unstandardized regression coefficient.

** Coefficient Beta – standardized regression coefficient.

*** If the statistical significance of the F statistic is less than the generally accepted 0.05, it can be assumed that the model fits the data well.

Source: own study.

As a result of the analysis, four models were obtained. Each is well-fitted to the data, as indicated by the R2 coefficient (Table 3).

The first model is well-fitted to the data ($R^2 = 0.935$). It is built from predictors such as *Annual enterprise statistics for special aggregates of activity* about the *total population*, *unemployment* about the total labor force, *minimum wage* expressed in Euro, the percentage *share of mobility of students from abroad by higher education level*, *gender and country*, and the dependent variable which is *GDP per capita* (current US\$) $F(4, 23) = 68.611$ $p < 0.001$. Based on the regression coefficients (Table 3), it can be concluded that the increase in *Annual enterprise statistics for special aggregates of activity* ($\beta = 0.288$, $p < 0.227$), the decrease in the *unemployment level* ($\beta = -0.183$, $p < 0.055$), the increase in the *minimum wage (EURO)* ($\beta = 0.442$, $p < 0.000$) and the increase in the *mobility of students in higher education* ($\beta = 0.540$, $p < 0.028$) increase the overall economic growth of the country. The obtained model explains 93% of the variability of economic development, which means that based on the model, it is possible to predict what factors shape the country's economic development. The regression equation has been written in the following form:

$$Y = 2981,864 + 525,590 * X_{\text{Annual enterprise statistics for special aggregates of activity}} - 397,923 * X_{\text{Unemployment}} + 20,670 * X_{\text{Minimum wages}} + 743,197 * X_{\text{Share of mobile students}}$$

The second model was built with predictors such as *unemployment*, *minimum wage*, and student mobility, and the dependent variable, which is *GDP per capita* (current US\$) $F(3, 23) = 88.498$, $p < 0.001$. This model fits the data well ($R^2 = 0.930$). Based on the regression coefficients (Table 3), it can be stated that the decrease in *unemployment* ($\beta = -0.099$, $p < 0.114$), the increase in the *minimum wage (EURO)* ($\beta = 0.508$, $p < 0.000$), and the increase in *student mobility* in higher education ($\beta = 0.814$, $p < 0.000$) increase the overall economic growth of the country. The obtained model explains 93% of the variability of economic development, which means that based on the model, it is possible to predict what factors shape the country's economic development. The regression equation was written in the following form:

$$Y = 3047,390 - 215,38 * X_{\text{Unemployment}} + 23,783 * X_{\text{Minimum wage}} + 1120,098 * X_{\text{Share of mobile students}}$$

The third model was built with predictors such as *minimum wage* expressed in Euro, percentage share of international student mobility by higher education level, *gender*, and *country*, and the dependent variable, which is *GDP per capita* (current US\$), $F(2, 23) = 121.367$, $p < 0.001$. This model fits the data well ($R^2 = 0.920$), and all variables are statistically significant. Based on the regression coefficients (Table 3), it can be stated that the increase in *student mobility* in higher education ($\beta = 0.829$, $p < 0.000$) and the increase in the *minimum wage* ($\beta = 0.515$, $p < 0.000$) increases the overall economic growth of the country. The obtained model explains 92% of the variability of economic development, which means that based on the model, it is possible to predict what factors shape the country's economic development. The regression equation was written in the following form:

$$Y = 1906,235 + 24,098 * X_{\text{minimum wages}} + 1141,088 * X_{\text{Share of mobile students}}$$

The fourth model was built with the predictors of the *minimum wage* expressed in Euro, the percentage of international *student mobility* by higher education level, gender and country, and the percentage of *graduates*. The dependent variable in the model is *GDP per capita* (current US\$) $F(1,100) = 100.161$, $p < 0.001$. This model fits the data well ($R^2 = 0.935$). All variables in the model are statistically significant. Based on the regression coefficients (Table 3), it can be concluded that the increase in the *minimum wage* (EURO) (beta = 0.494, $p < 0.000$), the increase in *student mobility* in higher education (beta = 0.997, $p < 0.000$), and the increase in the percentage of *graduates* (beta = 0.215, $p < 0.029$) increase the overall economic growth of the country. The obtained model explains 93% of the variability of economic development, which means that the model can be used to predict what factors shape the country's economic development. The regression equation was written in the following form:

$$Y = -1485,357 + 23,121 * X_{\text{Minimum wages}} + 1372,007 * X_{\text{Share of mobile students}} + 3507,979 * X_{\text{Graduates}}$$

6. Discussion

The article examines the influence of selected variables on the economic development of the Visegrad Group countries. Using regression analysis, it was checked which independent variables significantly influence the explained variable (GDP per capita). The conducted research shows that the economic development of the Visegrad Group countries is influenced by: *minimum wage (Euro)*, *annual enterprise statistics for special aggregates of activities*, *unemployment, total (% of total labor force)*, *population total*, *share of mobile students from abroad enrolled by education level, sex and country of origin*, *tertiary education*, *graduates in tertiary education*.

The Visegrad Group (V4), which includes Poland, the Czech Republic, Slovakia, and Hungary, has undergone a significant economic transformation since the 1990s, characterized by dynamic economic growth, reduced unemployment, and an increase in the standard of living of its inhabitants. Analysis of indicators such as GDP per capita, unemployment rate, minimum wage, share of international students, number of university graduates, total population, and number of enterprises allows for a better understanding of the mechanisms of economic development in the region.

GDP per capita in the V4 countries is growing steadily, approaching the EU average, although the differences between countries remain clear. The Czech Republic has the highest GDP per capita in the region, which indicates greater economic efficiency compared to other countries in the group. The unemployment rate has gradually decreased in recent decades, and the Czech Republic has the lowest rate in the EU. The increase in the minimum wage

indicates an improvement in living conditions, but it is still lower than in Western EU countries, which attracts investors looking for cheaper labor.

The share of international students in the region is growing, especially in Poland and Hungary, possibly due to competitive costs and quality of education. The number of university graduates indicates an increase in human capital, although there is still a need for better integration of graduates into the labor market. The number of enterprises in the region is growing, indicating an improved investment climate and increased entrepreneurial activity. The total population plays a key role in determining the size of the domestic market, although in some V4 countries low population growth and labour emigration remain a challenge.

7. Summary

GDP growth per capita is the essential measure of economic development, but its dynamics in the V4 countries results not only from the economy's efficiency, but also from transfers of EU funds and investment strategies. Decreasing unemployment results from the inflow of foreign investments and relatively low labor costs, which supports the development of the industrial sector but may limit innovation and the transition to a knowledge-based economy.

The minimum wage serves two functions: it increases household incomes, but it can also limit the region's price competitiveness in the future. The growth in the number of international students and university graduates is an opportunity to increase human capital, but it is necessary to strengthen the mechanisms for retaining talent in the region to prevent brain drain. The population and number of enterprises determine the scale of the economy, with the development of the SME (small and medium-sized enterprise) sector in the V4 remaining crucial to increasing innovation and diversifying the economy. Labor emigration and an aging population can limit the growth potential, which is why demographic and migration policies should be a priority.

The economic development of the Visegrad Group is based on the synergy between improving living conditions, education, entrepreneurship, and investment. Key challenges include reducing regional inequalities, integrating the economy with global trends, and ensuring sustainable growth through investment in innovation and human capital. The issues raised in this article provide prospects for conducting extended research in this area, which will be the subject of further research by the Author.

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STANDARDS STRATEGIC AND OPERATIONAL DIRECTIONS OF TOURISM AND RECREATION DEVELOPMENT ON THE EXAMPLE OF A RURAL COMMUNE

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Purpose: The aim of the work was to learn the importance of tourism in the socio-economic development of rural communes based on strategic documents.

Design/methodology/approach: The authors analyzed the current strategic documents of the commune. A detailed analysis of selected studies was made, i.e. chapters on strategic and operational goals and SWOT/TOWS analyses.

Findings: The article presents considerations related to the development of tourism in rural areas, based on the literature on the subject and the results of research.

Practical implications: The study concerned the objectives and elements of the SWOT/TOWST analysis, which were directly related to the development of tourism in the analyzed commune.

Originality/value: Analysis based on existing data, SWOT and TOWS analyses, analyzes of the Development Strategy of the examined commune, as well as the mission and vision of the commune's development outlined on this basis, allowed us to determine the hierarchical structure of five groups of strategic, operational and detailed goals.

Keywords: logistics, tourism, local development, commune management.

Category of the paper: Research paper.

1. Introduction

Tourism is currently the fastest growing, and therefore the most profitable, sector of the economy. It is often called the key to development and prosperity. Regardless of what threats it brings, whether social or environmental, it is perceived as a kind of guarantor of the socio-economic development of regions (Dogru, Bulut, 2018). This belief in the beneficial role of tourism in socio-economic development is also common at the local and regional level, including in Poland.

Undoubtedly, the tourism sector stimulates the economic development of regions (Bosiacki, 2016; Szwacka-Mokrzycka, 2012; Kozak, 2010). However, the process of developing the tourism function must be properly planned, taking into account social, environmental, regional and cultural issues (Skubis et al., 2023). One of the main tools for long-term development planning of local governments in our country are development strategies, i.e. the so-called documents defining strategic development goals, specifying directions of action in the form of operational goals and tasks, and indicating the necessary financial resources, resources and sources. Implements established goals and tasks (Kłodziński, 2009) and provides information on the perception of the commune itself and its resources, identifying opportunities and threats, strengths and weaknesses as part of the SWOT analysis. Although these are not mandatory documents and no law obliges local governments to develop them, carefully prepared development strategies, taking into account the participation of the local community, are a very useful tool in the administration of regional units. The latest nationwide scientific publications include many studies on the role of municipalities and strategic documents in the socio-economic development of regional units.

Strategic documents of Polish municipalities - According to research A. Pawlikowskiej-Piechotki (2013) approximately 80% of municipalities recognize tourism as the main or additional direction of socio-economic development. Most municipalities have a valid development strategy, so the authors of the article set themselves the goal of checking how local governments perceive tourism and what importance they attach to the tourism sector in planning long-term development in their regional units.

2. Literature review

2.1. The commune as a region developed for tourism and recreation

In order to achieve efficient and effective development of the commune and, above all, improve the lives of its inhabitants, a number of actions should be taken. Local development is a complex process of changes including quantitative and qualitative growth and encompassing both economic and social determinants (Hajdys, 2018; Skubis et al.). Social aspects of local development are manifested in the need to obtain social acceptance for the actions of the authorities, participatory management mode, i.e. democratization of the decision-making process, taking into account the participation of many entities/stakeholders of the local environment in municipal management (Kumara, Binoy, 2017). Economic aspects include, among others, stimulating or at least maintaining economic activity and employment levels at the existing level (Albrechts, Balducci, 2013; Brzozowska et al.).

In connection with the above, the management of the commune is based on harmonized and systematic action of the local community, local authorities and other entities operating in the municipality aimed at creating new and improving the existing utility values of the commune (Bąkowska-Morawska, 2014; Subis, Wodarski, 2023). The actions taken should improve the living and economic conditions, as well as the competitiveness of the municipality (Kogut-Jaworska, 2011; Łukomska-Szarek et al.). It can be said that in some areas administrative units behave like quasi-enterprises (Landre, Peeters, 2011). Similarities in the activities of local government units and enterprises include:

- operating in competitive conditions,
- focus on increasing operational efficiency,
- customer orientation,
- creating products (services) to meet the customer's needs,
- using similar techniques and tools to influence customers.

The competitiveness of each area is determined by a certain set of features, its strengths and weaknesses, its advantages and disadvantages. Their type and number determine whether we are dealing with a strong or weak region (Paliś, Przenzak, 2022). When an area's strengths dominate over its weaknesses, we talk about the region's high competitiveness, and when the opposite happens, it is low. Strong units, thanks to the accumulation of positive values in the hands of local government authorities, achieve a competitive advantage over weak regions and thus increase the distance between them.

The examined commune is a strong administrative unit with many strengths in the economic, social, cultural and, above all, tourist areas. Tourism is part of the market and ranks second in the global economy after the electronics and computer industries, ahead of the petrochemical and automotive industries. The tourism industry occupies an important place in the economy of most regions. In recreationally developed countries, tourism and recreation activities provide almost 50% of all budget revenues. The tourist attractions of the commune are:

- afforestation of the area (approx. 40% afforestation of the commune),
- retention reservoir with an area of approximately 40 ha,
- proximity of the Silesian and Częstochowa agglomerations,
- good access - good road network,
- hospitality and kindness of residents.

It should be emphasized that some of the most important determinants of the commune's development that improve the lives of residents and increase the commune's competitiveness include: the creation, introduction and application of a tourism development strategy and related long-term promotional activities.

2.2. Development of local tourism – benefits for the commune

Nowadays, municipalities perceive tourism "as an important factor of economic activation, an increase in local budget revenues, a factor that revitalizes the local labor market, and as an element shaping the social development of a town or region". In the process of local tourism development, local natural resources, human and institutional resources should be used in line with sustainable development and social responsibility (Gajewska, 2009). Local development is not autarkic. It is influenced by processes taking place in the closer (region) and further environment (country, abroad) (Witkowski, 2022). The local economy is entangled in a network of complex relationships with the environment, which is why municipal resources are constantly evolving and subject to changes resulting from economic, legal, environmental, technological and social determinants. The diagnosis of the issues discussed is therefore important due to the dynamically changing political and economic reality, technology development, and the role of resources in increasing the efficiency of management of a municipal government unit, and thus stimulating local tourism development (Abbas, Mubeen, Iorember, Raza, Mamirkulova, 2021).

Thanks to the development of tourist and recreational infrastructure, the area will become increasingly saturated with various forms of economic activity, which is related to the growing demand for land and real estate. The development of local tourism will also have a positive impact on the economic situation. This will translate into greater employment opportunities. The universal benefit of developing tourism in the region is the maximization of social well-being (Hall, Scott, Gössling, 2020).

The development of tourism will bring benefits in terms of urbanization and location (Pilis et al., 2022). As a result, the tax base will be expanded, allowing for a more complete satisfaction of social needs and improving the area's competitive position in the economy. (Orchiston, Prayag, Brown, 2016). There will be an improvement in the real, spatial and temporal accessibility of service facilities of various categories.

The benefits of developing local tourism include primarily the maximization of population income and local government income. The level and quantity of municipal services and the spectrum of activities stimulating economic activity depend on the wealth and condition of local finances (Kuščer, Eichelberger, Peters, 2021). There is a feedback loop between the income of the population - taxpayers - and the amount of budget revenues, and between the state of the local budget and the level of living conditions of the population and the conditions for running a business. The number of goods and services offered on the market will expand. The purchasing power of the population will also increase, as will the development of the economic sphere.

Undoubtedly, the benefits will accrue to representatives and members of local authorities, whose political position will be strengthened and improved. As positive trends in municipal tourism develop, leading to local development, local authorities will be increasingly better

perceived by both local society and higher levels of government. The success accompanying the tourist development of a given area is a ticket for local politicians to higher levels of political career, and for officials to further professional career. For many of them (especially senior officials), this creates opportunities to move to the private sector.

3. Methodology

The concept of local tourism development of the studied commune obliges it, as a local government unit, to create a coherent tourism policy, taking into account the current state of regional tourism and the forecast development. The tourism development concept of the studied commune refers to the development strategy and takes into account the spatial development plan. The general objectives of the research area's tourism policy include:

- development of services in the field of research and development,
- observation of the socio-economic effects of tourism development,
- diversification of the local economy, including the development of regional products,
- combining service providers into local structures,
- expansion of tourist infrastructure,
- supporting the development of tourism in rural areas,
- increasing employment,
- creating legal, tax and financial solutions for the needs of tourism,
- cooperation with the external environment of the commune.

The process of sustainable and harmonious tourist development of the studied commune requires the local authorities and entities to be able to recognize threats, prevent them, eliminate disproportions in social and economic life and create satisfaction for the constantly growing needs. The implementation of the tourism development plan in the commune results from the formulated strategic plan, which specifies goals, programs and tasks.

Strategic goals, constituting the framework for the sustainable development of tourism in the commune, should ensure maximum economic efficiency, the highest possible level of living conditions and consumption, and the use of resources in such a way as to ensure the continuity of the commune's existence. Strategic goals are subordinated to operational goals, and these, in turn, are subordinated to specific goals (tasks).

4. Empirical results and discussion – SWOT/TOWS analysis for the research area

Appropriate and proper design of a development strategy is not possible without prior, full and proper familiarization and assessment of all one's own strengths and weaknesses, as well as opportunities and threats from the immediate and distant environment, which may play an important role in achieving the set goals. This challenge is taken up by the SWOT strategic analysis method. SWOT analysis is an integrated methodology for conducting strategic analysis from the moment of defining the place that a given institution occupies in the environment, to determining the development opportunities available and appropriate to its strategic position.

In order to develop effective action plans, a commune should know and understand its internal and external environment. For this purpose, it is appropriate to perform an internal analysis, which covers strengths and weaknesses, as well as an external analysis, which in its structure includes external threats and opportunities. The internal analysis will cover the commune's current activities and its development trends. Further development is built on the strengths. Weaknesses serve to correct the operation. The aim of the external analysis will be to identify the areas that should be "attacked" to make the environment more friendly to the commune. Such identification of threats is mainly intended to help avoid them or provide better protection against them. The SWOT analysis is built on a simple classification scheme of factors that influence the current and future position of the commune. It involves identifying and describing their influence on the development of the commune, as well as the possibilities it has to weaken or strengthen their influence. The analysis of opportunities and threats presents potential directions of development of the situation in the analyzed area of interests. This means that not all identified action options are opportunities and threats for a given commune. It depends mainly on the analysis of the commune's strengths and weaknesses. Appropriate juxtaposition and comparison of the results of both analyzes gives the opportunity to make a correct assessment of the strategic situation of the commune and draw conclusions on this basis, as presented in table 1.

Table 1.
SWOT analysis for the studied commune

The strengths of the examined commune include:	The opportunities of the commune include:
MS1 - good communication connection (0,2), MS2 - cultural and historical attractions (0.15), MS3 - social activity, striving for success (0.15), MS4 - favorable conditions for the development of tourism and recreation (0.3), MS5 - area reserves for various spatial development functions (0.3).	S1 - investments related to environmental protection (0.3), S2 - inflow of foreign capital (0.1), S3 - regional and supra-regional cooperation (0.15), S4 - dynamics of tourist growth (0.15), S5 - development of municipal infrastructure (0.3).

Cont. table 1.

The commune's weaknesses include:	The commune's threats include:
SS1 - low quality of tourist services (0.2), SS2 - no open cultural and tourist events (0.2), SS3 - difficulties with reclassifying typical farms into agritourism farms (0.1), SS4 - no advertising, poor ability to reach new customers (0.25), SS5 - no development conditions for agritourism (0.25). Z1 - little state aid in the field of pro-ecological activities (0.2),	Z2 - poor information flow (0.2), Z3 - imperfection and instability of regulations, legal restrictions on investments (0.2), Z4 - uncontrolled development of tourism (0.2), Z5 - lack of a common long-term development policy for the commune (0.2).

This means that not all identified action options are opportunities and threats for a given commune. It depends mainly on the analysis of the commune's strengths and weaknesses. Appropriate comparison and comparison of the results of both analyzes gives the opportunity to make a correct assessment of the strategic situation of the commune and draw conclusions on this basis.as presented in the crosstabs below from 2 to 9.

Table 2

SWOT: Will the identified strengths allow you to take advantage of the opportunities?

Strengths/ Chances Strong	Page strong 1	Page strong 2	Page strong 3	Page strong 4	Page strong 5	Scales	Number interaction	Product of weights and interactions	Rank
Chance 1	1	0	1	1	1	0,3	4	1,2	1/2
Chance 2	1	1	1	1	1	0,1	5	0,5	4
Chance 3	1	1	1	1	1	0,15	5	0,75	3
Chance 4	1	1	0	0	1	0,15	3	0,45	5
Chance 5	0	1	1	1	1	0,3	4	1,2	1/2
Scales	0,2	0,15	0,15	0,3	0,3				
Number of interactions	4	4	4	4	5				
Product of weights and interactions	0,8	0,6	0,6	1,2	1,5				
Rank	3	4/5	4/5	2	1				
The sum of interactions							42/2		
Sum of products								8,8	

Table 3*TOWS: Will opportunities magnify strengths?*

Opportunities/ Strengths	Chance 1	Chance 2	Chance 3	Chance 4	Chance 5	Scales	Number interaction	Product of weights and interactions	Rank
Page strong 1	1	1	1	1	1	0,2	5	1	2
Page strong 2	1	1	1	1	0	0,15	4	0,6	4/5
Page strong 3	1	0	1	1	1	0,15	4	0,6	4/5
Page strong 4	1	1	1	1	1	0,3	5	1,5	1
Page strong5	0	1	1	0	1	0,3	3	0,9	3
Scales	0,3	0,1	0,15	0,15	0,3	42/2		8,75	
Number of interactions	4	4	5	4	4				
Product of weights and interactions	1,2	0,4	0,75	0,6	1,2				
Rank	1/2	6	3	4	1/2				
The sum of interactions									
Sum of products									8,75

Table 4*SWOT: Will the identified strengths overcome the threats?*

Strengths/ Threats	Strong side 1	Strong side 2	Strong side 3	Strong side 4	Strong side 5	Scales	Number interaction	Product of weights and interactions	Rank
Threat 1	0	0	1	0	1	0,2	2	0,4	1/3
Threat 2	0	0	1	0	0	0,2	1	0,2	4/5
Threat 3	0	0	1	0	0	0,2	1	0,2	4/5
Threat 4	0	0	1	0	1	0,2	2	0,4	1/3
Threat 5	0	0	1	0	1	0,2	2	0,4	1/3
Scales	0,2	0,15	0,15	0,3	0,3	16/2		3,25	
Number of interactions	0	0	5	0	3				
Product of weights and interactions	0	0	0,75	0	0,9				
Rank	3/5	3/5	2	3/5	1				
The sum of interactions									
Sum of products									3,25

Table 5*TOWS: Will threats undermine strengths?*

Danger/ Strengths	Danger 1	Danger 2	Danger 3	Danger 4	Danger 5	Scales	Number interaction	Product of weights and interactions	Rank	
Strengths 1	0	1	0	0	0	0,2	1	0,2	4	
Strengths 2	0	0	0	0	0	0,15	0	0	5	
Strengths 3	1	1	1	0	0	0,15	3	0,45	3	
Strengths 4	1	1	1	1	1	0,3	5	1,5	1/2	
Strengths 5	1	1	1	1	1	0,3	5	1,5	1/2	
Scales	0,2	0,2	0,2	0,2	0,2					
Number of interactions	3	4	3	2	2					
Product of weights and interactions	0,6	0,8	0,6	0,4	0,4					
Rank	2/3	1	2/3	4/5	4/5					
The sum of interactions							28/2			
Sum of products									6,45	

Table 6*SWOT: Will the identified weaknesses prevent you from taking advantage of the opportunities?*

Weaknesses/ Opportunities	Weak page 1	Weak page 2	Weak page 3	Weak page 4	Weak page 5	Scales	Number interaction	Product of weights and interactions	Rank	
Chance 1	0	0	1	0	0	0,3	1	0,3	3/4	
Chance 2	0	0	0	0	0	0,1	0	0	5	
Chance 3	1	0	0	1	0	0,15	2	0,3	3/4	
Chance 4	1	1	1	1	1	0,15	5	0,75	2	
Chance 5	1	1	1	1	1	0,3	5	1,5	1	
Scales	0,2	0,2	0,1	0,25	0,25					
Number of interactions	3	2	3	3	2					
Product of weights and interactions	0,6	0,4	0,3	0,75	0,5					
Rank	2	4	5	1	3					
The sum of interactions							26/2			
Sum of products									5,40	

Table 7*TOWS: Will opportunities overcome weaknesses?*

Opportunities/ Weaknesses	Chance 1	Chance 2	Chance 3	Chance 4	Chance 5	Scales	Number interaction	Product of weights and interactions	Rank
Weak page 1	1	0	1	1	1	0,2	4	0,8	2
Weak page 2	0	0	1	1	1	0,2	3	0,6	3
Weak page 3	1	0	1	0	0	0,1	2	0,2	5
Weak page 4	0	0	1	0	1	0,25	2	0,5	4
Weak page 5	1	0	1	1	1	0,25	4	1	1
Scales	0,3	0,1	0,15	0,15	0,3	30/2		6,5	
Number of interactions	3	0	5	3	4				
Product of weights and interactions	0,9	0,1	0,75	0,45	1,2				
Rank	2	5	3	4	1				
The sum of interactions									
Sum of products									6,5

Table 8*Will the identified weaknesses strengthen the impact of threats?*

Weaknesses/ Threats	Weak page 1	Weak page 2	Weak page 3	Weak page 4	Weak page 5	Scales	Number interaction	Product of weights and interactions	Rank
Threat 1	0	0	0	0	0	0,2	0	0	3/4
Threat 2	1	0	0	1	0	0,2	2	0,4	5
Threat 3	0	0	0	0	0	0,2	0	0	3/4
Threat 4	1	1	1	1	1	0,2	5	1	1/2
Threat 5	1	1	1	1	1	0,2	5	1	1/2
Scales	0,2	0,2	0,1	0,15	0,15	22/2		4,35	
Number of interactions	3	2	2	3	2				
Product of weights and interactions	0,6	0,4	0,2	0,45	0,3				
Rank	1	3	5	2	4				
The sum of interactions									
Sum of products									4,35

Table 9*TOWS: Will threats magnify weaknesses?*

Threats/ Weaknesses	Threat 1	Threat 2	Threat 3	Threat 4	Threat 5	Scales	Number interaction	Product of weights and interactions	Rank
Weak page 1	1	0	0	1	0	0,2	2	0,4	2
Weak page 2	0	1	0	0	0	0,2	1	0,2	4
Weak page 3	0	0	1	1	1	0,1	3	0,3	3
Weak page 4	0	1	0	0	0	0,15	1	0,15	5
Weak page 5	1	0	1	1	1	0,15	4	0,6	1
Scales	0,2	0,2	0,2	0,2	0,2				
Number of interactions	2	2	2	3	2				
Product of weights and interactions	0,4	0,4	0,4	0,6	0,4				
Rank	2/5	2/5	2/5	1	2/5				
The sum of interactions	22/2								
Sum of products									3,85

It is known from the literature on the subject that the choice of strategy depends on the strength of connections between groups of SWOT/TOWS factors. The organization adopts a strategy:

- aggressive, if strengths and related opportunities prevail (the organization takes advantage of opportunities thanks to its strengths, there is dynamic development, strengths should be nurtured and opportunities should be used),
- conservative, if strengths and related threats predominate (the organization effectively eliminates threats thanks to its strengths, but this does not allow for dynamic development, the organization expects improvement in environmental conditions),
- competitive, if weaknesses and related opportunities predominate (the organization operates in a friendly environment, therefore, despite the weaknesses, it allows it to continue functioning, but it is not possible to take advantage of the opportunities, you should focus on eliminating the weaknesses),
- defensive, if weaknesses prevail and the threats associated with them (organization in the survival phase, risk of closure).

In the analyzed case, the commune should adopt an aggressive strategy. It is proposed to make maximum use of the relationship between its strengths and the opportunities provided by the environment, i.e. to use opportunities through strengths.

The examined commune is perceived positively by the society as a modern, economically managed commune, which is dynamically developing and constantly investing, thus improving the standard of living of its inhabitants. The presence of green areas, cultural and historical attractions and a clean natural environment favors the development of tourism in its area. Strengths combined with opportunities provide great development opportunities that the

commune can use in the near and distant future. The problems that the commune should pay attention to are the increasing level of unemployment, the lack of a well-developed recreational base and the lack of development conditions for agritourism.

5. Findings and Conclusions

Based on existing data, SWOT and TOWS analysis, analysis of the Development Strategy of the examined commune, as well as the mission and vision of the commune's development outlined on this basis, a hierarchical structure of five groups of strategic, operational and detailed goals was formulated.

Strategic goals are:

1. Increasing the availability of tourist facilities, education, upbringing and medical care and creating conditions for the development of human resources.
2. Active protection of the natural environment along with the improvement of technical, transport and IT infrastructure in accordance with sustainable development.
3. Revitalization of the former functions and layout of the commune and their protection along with the necessary functional and spatial development of the entire commune.
4. Development of tourism, sports and recreation along with the promotion of the commune.
5. Activation of the commune's social and economic functions.

The operational goals are:

1. Shaping awareness of environmental protection and the importance of tourism, adapting the educational and cultural base. Organization of free time for commune residents. Improving medical care and health protection.
2. Development of technical infrastructure and communication, raising ecological awareness, expansion of the recreational and tourist area by the water reservoir so that it meets the needs of tourists and constitutes a base for water recreation, elimination of emissions harmful to the environment.
3. Revitalization of the waterfront and the shore by the water reservoir, shaping an efficient road system in the commune, modernization of the existing commune development towards grouping service, commercial and tourist functions, increasing the supply of land for housing construction and investments on the outskirts of the commune, improving cross-border spatial and communication connections.
4. Development of tourism and sports, organization and development of recreational facilities, promotion of the commune.

5. Development of non-agricultural entrepreneurship, creating conditions stimulating the creation of new jobs, using the commune's location for the long-term development of the economy, increasing the mobility of the workforce.

The specific goals are:

1. Modernization and renovation of schools, construction and modernization of gymnasiums and sports fields, additional equipment for schools, adult education, improvement of medical services, improvement of social services.
2. Expansion of the sewage network, proper management of solid waste, gasification, change of the building heating system, development of alternative sources of energy production, elimination of noise sources and protection of the atmosphere and water, maintaining the sustainability of the use of resources and environmental values, ecological education of residents.
3. Expanding the functions of the waterfront of the recreational reservoir (boulevards, marinas, sports and recreation areas, water recreation equipment stations), spatial arrangement, defining spatial standards for new development, conditions for reconstruction and principles of operation of facilities intended for liquidation, maximizing the area of green areas, increasing parking possibilities passenger cars in the commune.
4. Development of sports clubs, adaptation of tourist products to market needs, demonstration of the specificity and regional identity offering an appropriate and attractive tourist product, creation of an appropriate system for the promotion and distribution of the region's tourist product, organization of an integrated network of tourist information and reservations, organization and development of agritourism farms, organization active tourism routes, promotion of tourism, increasing the cultural offer.
5. Reducing production costs on farms, adapting the production structure to market needs, developing the processing of local agricultural raw materials, activating the local labor market, actions to reduce unemployment, developing cooperation with cities adjacent to the commune.

When talking about the possibilities of using tourism for development and restructuring purposes, the conclusion comes to mind that tourism can be developed not only where there are natural and cultural resources supporting its development. These resources are neither necessary nor sufficient factors for tourism to develop. However, a necessary condition for the development of tourism is the existence of the necessary level of tourist development, creating conditions for spending time in an interesting way, in a standard that meets the expectations of tourists. A huge variety of motivations makes the preparation of tourist products easier. All this offers great opportunities for the development of tourism in almost any place, but it is necessary to create infrastructure and products. The above considerations on local development allow us to draw certain conclusions:

- the development of tourism in the commune is an autonomous process. The autonomy of development processes results from the fact that it follows the principles and rules relating to market mechanisms. It is also the subject of making sovereign decisions, within the entrusted competences and resources, by local government authorities which are the subject of development processes and policy;
- tourism development is empowered. This means that it is a specific process that brings effects and benefits to entities participating in the development of a given area. Tourist activity is the result of an agreement between various forces and actors operating in a local territorial unit. The result of the compromise is the sum of events stimulated by the forces taking part in the socio-economic and political life of a given territorial unit. The final effect depends on the level of awareness of individual entities regarding the need to pursue general interests regarding the functioning of the territorial unit as a whole, in comparison with the possibility of achieving particular goals and realizing individual profits;
- the development of local tourism takes place in conditions determined by the phenomena and processes taking place in its internal structures. On the other hand, it is influenced by all the events taking place in its environment. The condition for the success and durability of development processes is flexibility in the activities of economic units and local authorities. Economic units adapt their activities to market conditions, and local authorities adapt to the conditions resulting from the competition of territorial units operating in the changing legal and financial environment created by higher-level administrative units. Flexibility is therefore a guarantee of success and durability of development processes;
- tourism development is a long-term process, rooted in the historical conditions, production and cultural traditions of the commune's society. It depends largely on the attitudes of the local community;
- the development of local tourism in the commune is universal. It results from both socially acceptable values and the laws of the market economy. It becomes specific only when it concerns a separate area. They then materialize in the form of detailed goals and tasks related to the internal characteristics and processes taking place in a specific city or commune. They will therefore be different for different areas.

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FACTORS DRIVEN THE CLIENT'S SATISFACTION ON THE HOUSING LOANS MARKET. EVIDENCE FROM POLAND

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Purpose: The aim of the article is to assess the satisfaction of housing loan borrowers in banks. The authors seek to answer the research question of what factors influence the declared level of satisfaction with the housing loan, ancillary products, and the bank's products in general. The paper addresses the consumer's behavior toward banking services, outlining the need to deepen and complete a financial-banking education.

Design/methodology/approach: The analyses are based on information obtained through a survey questionnaire. The survey was conducted in June 2022 on a sample of approximately 1,000 borrowers in Poland, aged over 18, with a housing loan secured by a mortgage. Nonparametric tests, the Mann- Witney U test and the Kruskal-Wallis H test, were used to assess the relationships between the variables considered.

Findings: The borrowers surveyed were mainly characterized by positive attitudes toward their bank. Most respondents declared satisfaction with their home loan, as well as with the bank's products/services in general. Socio-demographic characteristics turned out to be variables significantly differentiating declared customer satisfaction, only with regard to satisfaction ratings with the bank's products in general.

Originality/value: The analyses carried out provide important conclusions about the factors determining the level of satisfaction among bank customers in Poland with regard to housing loans. This is because housing loans are the main form of financing housing needs by consumers. The obtained results also make it possible to assess whether there are differences in the opinions of the surveyed borrowers, considering satisfaction in terms of their additional products to the loan, as well as assessments in the context of the banks' products in general. In addition, the originality of the study stems from the research methods used, which are rarely used in consumer satisfaction research.

Keywords: client's satisfaction, housing loan market, the Kruskal-Wallis H test, the Mann-Witney U test.

Category of the paper: Research paper.

1. Introduction

The purpose of the article is to assess the satisfaction of housing loan borrowers in banks. The market for banking products and services is characterized by a high rate of change (Czechowska et al., 2020). A key role is played by bank customers, who have an ever-increasing array of financial solutions available to them. Investigating the financial needs and expectations of customers should be one of the main pillars for banks to strive for the satisfaction felt by the recipients of their products and services (Pettersen-Sobczyk, 2015; Skowron, 2011; Starzyńska, Kowańska, 2022). In this context, the role of adequate quality of banking products and services is emphasized. This quality can be considered differently from the point of view of banking entities and customers (Idzik, 2016). It is important for banks to place special emphasis on pro-quality measures (Giemza, Materna, 2015).

Customer satisfaction has become a key determinant of demand, reflecting consumers' perceptions of product quality, service levels, and overall experience. Research indicates that satisfied customers are more likely to become repeat buyers, leading to increased sales and improved brand loyalty (Czechowska et al., 2024; Das et al., 2024). The etymology of the word satisfaction comes from Latin *satisfactionem* (nominative *satisfactio*) "a satisfying of a creditor, "noun of action from past-participle stem of *satisfacere* "discharge fully, comply with, make amends," literally "to do enough" (Online Etymology Dictionary). Customer satisfaction also has an emotional dimension and is related to responses to shopping experiences, retail outlets, and even behavior patterns (Agustiansyah, Taufik, 2019). Unhappy customers may switch to another company and spread negative news to the public (Kaur et al., 2021; Supriyanto, Wiyono, Burhanuddin, 2021). Meanwhile, the satisfied can be a link in word-of-mouth advertising (Wulandari, 2022). Customer satisfaction refers to an attitude or evaluation formed by a customer comparing pre-purchase expectations of what they would receive from the product or service to their subjective perceptions of the performance they actually did receive (McDonald, Rundle-Thiele, 2008). Customer satisfaction measures concern consumer expectations towards the service provided, as well as to what extent it is close to ideal (McDonald, Rundle-Thiele, 2008). The relationship between customer trust, satisfaction and demand for products is the subject of research in various disciplines, with satisfaction being more important for loyalty in industries such as automotive or banks and insurance (Cohen, Gan, Hwa, Chong, 2006). Findings from multiple studies have identified a positive correlation between customer satisfaction and subsequent purchasing behavior, reinforcing the idea that satisfied customers drive more demand. For example, Anderson and Mittal (2000) suggest that companies that prioritize customer satisfaction can expect to see more loyal customers.

When it comes to the banking industry, the factors affecting customer satisfaction may be different than for other services. Chakrabarty (2006), based on research conducted among United Kingdom retail banking customers, indicated four factors that determined overall customer satisfaction. Such as (Chakrabarty, 2006):

- in-branch satisfaction (speed of service, staff helpfulness, privacy, opening hours),
- economic satisfaction (level of bank fees, overdraft interest rates),
- remote satisfaction (responsiveness and efficiency in dealing with remote enquiries),
- ATM satisfaction (ATM availability, ATM reliability).

Manrai and Manrai (2007), on the other hand, pointed to other factors weighted from the point of view of customer satisfaction, namely:

- personnel-related considerations (attitudes and behaviour of tellers and other staff, procedures for handling complaints, appearance of staff),
- financial considerations (interest earnings, interest payments),
- branch environment-related considerations (atmospherics),
- convenience-related considerations (ATMs, opening hours).

In order to achieve customer satisfaction in the banking industry, appropriate service standards are needed (Wulandari, 2022), with particular emphasis on the quality of service (Setiawan et al., 2019). In addition, customers make comparisons between the cost of the service and the resulting benefits (Parvati, 2022). However, as the authors emphasize, the goal that the bank wants to achieve is not customer satisfaction, but customer loyalty, which is expressed in long-term relationships (Li et al., 2021) and consistent purchase (Zikir, 2019; Supriyanto et al., 2021). Banks compete not only with each other but also with non-bank entities and other financial institutions (Cohen, Gan, Hwa, Chong, 2006). Since banking services are easy to follow, which means that they are very similar, they can only differ in price and quality. Therefore, customer retention is a potentially more effective tool to use to gain an advantage in a competitive market (Cohen, Gan, Hwa, Chong, 2006). The quality of service is a key element affecting the level of customer satisfaction in the banking industry. In banking, quality is a multidimensional concept that encompasses different types of amenities, reliability, service package, and staff that provides them (Ioanna, 2002). In addition, research has shown that customers with high knowledge of financial products are satisfied (Barbu et al., 2021; Reddy, Thanigan, 2023).

The literature highlights the roles of sociodemographic factors as important determinants of customer satisfaction (Rudawska, 2011; Skowron, 2017). In view of the considerations made in the context of existing research, the analyses undertaken will seek to determine answers to the following research questions. Do the demographic characteristics and credit profile of the Polish consumers differentiate their declared level of satisfaction with a housing loan, ancillary products and bank products in general?

2. Research method

Satisfaction among bank customers is a very important element in building positive attitudes and establishing long-term relationships (Al Qaisi, Alrosan, 2020; Chu et al., 2012; Geebren et al., 2021). Using the computer-assisted web interview method (CAWI), a survey of adult Poles was conducted to assess respondents' satisfaction with banks. This method of collecting quantitative data involves providing data using an online survey questionnaire. The survey was conducted in June 2022 and involved 993 respondents over 18 years of age, with a housing loan secured by a mortgage. The research sample was chosen considering the population of borrowers who have a mortgage-secured housing loan, taking into account the borrowers' age and gender, and utilizing information from Poland's Credit Information Bureau. Quota-based sampling was used. Respondents could use a 5-point Likert scale to rate their level of satisfaction, with 1 being "definitely dissatisfied" and 5 representing "definitely satisfied". The results were compiled using IBM SPSS Statistics software (version 29.0.1.0).

Using non-parametric tests such as the Mann-Whitney U test and the Kruskal-Wallis H test, the association between borrowers' satisfaction with housing loans and sociodemographic and credit profile information was evaluated. The search for differences in the context of sociodemographic characteristics of bank customers is visible in the subject literature (Dauda, Lee, 2016; Haron et al., 2020; Kaczmarek, 2019; Li et al., 2021; Pakurár et al., 2019; Waliszewski, Barankiewicz, 2023). The Mann-Whitney test is used to compare two independent samples when the data are stated on an ordinal scale or are measured on an interval scale but do not meet the t-test's normality assumptions. Whether the two medians are equal - as opposed to the two means in the t-test for independent samples - is the hypothesis under investigation (McCrum-Gardner, 2008; McKnight, Najab, 2010). The Kruskal-Wallis test ranks the initial data values, just like the Mann-Whitney test does. In other words, all data instances from the samples are gathered and ranked in ascending order. In the event that two scores are equal, the average of the two ranks is used (Nahm, 2016). The Kruskal-Wallis test examines whether the median values of three or more independent samples differ from each other (MacFarland, Yates, 2016; Mircioiu, Atkinson, 2017).

3. Results and Discussion

3.1. Respondent satisfaction with their housing loan

In the first step of the study, the declared satisfaction with the housing loan was verified and analyzed whether there is a relationship between the declared satisfaction with the housing loan and selected characteristics of the borrowers surveyed.

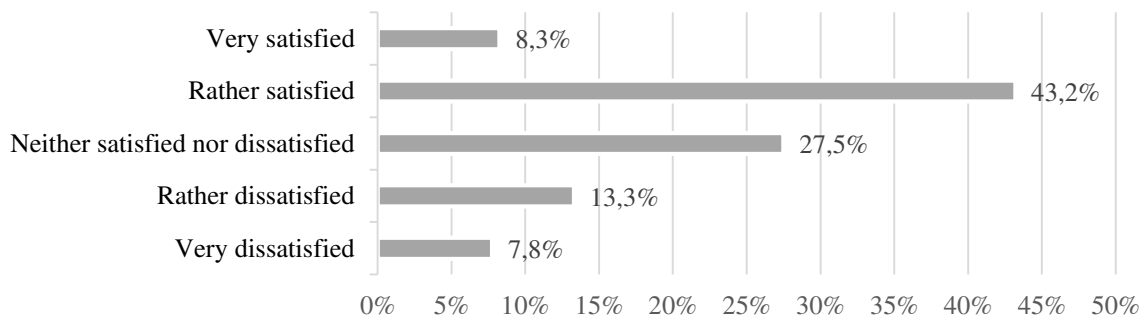


Figure 1. Declared satisfaction with housing loan (in %).

Source: own study.

Based on the results of the study (Figure 1), it should be stated that borrowers mainly declared satisfaction with their housing loan (more than half, i.e. 51.5% of the respondents, chose the option indicating satisfaction with the loan), with 43.2% of the respondents declaring the variant "rather satisfied" and 8.3% the variant "very satisfied". In general, 21.2% of the respondents were dissatisfied with the loan, indicating in 13.3% the variant "rather dissatisfied" and in 7.8% the variant "very dissatisfied". The remaining 27.5% of the respondents indicated an intermediate option, i.e., "neither satisfied nor dissatisfied".

Regarding the declared satisfaction with the housing loan, there were no significant differences between the respondents in terms of sociodemographic characteristics (i.e., gender, age, place of residence, educational level) and the amount of net income received (Table 1).

Table 1.

Results of the analysis of the relationship between declared satisfaction with the housing loan and selected variables from the profile of the surveyed borrowers

Independent variables	Test value*	Number of degrees of freedom (df)	Probability value (p)	Rejection of Hypothesis H ₀ (decision based on p value)	V-Cramer coefficient or Kendall tau-b rank correlation (p)
Gender	122819.500	-	0.923	No	0.050 (0.642)
Age	2.102	3	0.552	No	0.017 (0.0923)
Place of residence	6.582	4	0.160	No	-0.048 (0.067)
Educational level	3.114	3	0.374	No	-0.47 (0.093)
Net income	1.433	3	0.698	No	0.016 (0.556)
Type of bank**	9835.000	-	0.023	Yes	0.091* (0.023)
Borrowing year	10.657	3	0.014	Yes	0.049* (0.043)
Loan period	25.513	6	0.00	Yes	-0.112** (<0.010)
Amount of credit	1.966	3	0.579	No	-0.250 (0.362)
Share of the instalment in net income	87582.500	-	0.000	Yes	-0.128** (<0.01)
Currency of the loan	33.867	2	<0.001	Yes	0.200 (<0.001)

Note.

*F - Mann-Whitney U test or Kruskal-Wallis H-test (when comparing more than 2 subgroups).

** whether a commercial or cooperative bank.

Source: own study.

However, there were significant differences in satisfaction with a housing loan from the point of view of credit profile parameters, such as the type of bank, the year of loan takeout, the loan period, the share of the loan instalment in the borrower's net monthly income, and the loan currency (the probability value in the Mann-Whitney U or Kruskal-Wallis H test was below the cutoff value, i.e. $p = 0.05$). Borrowers who had a commitment in cooperative banks declared a higher level of satisfaction with their housing loan (mean rank 561.86) than commercial bank borrowers (mean rank 454.60). On the contrary, a significant but very weak relationship was found between satisfaction with the housing loan and the type of bank ($V = 0.091$).

From the point of view of the year of taking out a housing loan, using the post hoc test, differences were noted between borrowers who contracted liabilities until 2008 (i.e., before the financial crisis) and borrowers who did it in the period between 2009-2014, as well as between borrowers who took out a loan in 2015-2020. Borrowers who took out a loan before 2008, compared to the others listed here, on average declared a lower level of satisfaction with a housing loan. There was a weak positive relationship between the level of satisfaction with a housing loan and the year of borrowing the loan ($\tau\text{-}c = 0.049$). This result means that the level of satisfaction with the loan is higher the later the loan is taken out. Taking into account the loan period, using the post hoc test, significant differences were observed between borrowers who contracted a liability for up to 35 years and borrowers where the declared loan period was up to 25 years; as well as borrowers with a loan period of up to 15 years and up to 10 years. Borrowers with a liability for a period of up to 35 years, compared to the others listed here, on average declared a lower level of satisfaction with a housing loan. There was a weak negative relationship between the level of satisfaction with a housing loan and the loan period ($\tau\text{-}c = -0.112$). Such a result means that the level of satisfaction with the loan is lower the longer the loan period.

On average, borrowers who show a higher level of satisfaction with a housing loan are those for whom the loan instalment is less than half of their net income. A very weak relationship was observed between satisfaction with a housing loan and the share of the instalment in the borrowers' net income ($\tau\text{-}c = -0.128$). This means that as the share of instalments in net income increases, the declared satisfaction of borrowers with their liabilities decreases.

Taking into account the loan currency, significant differences were shown between borrowers with liabilities in Swiss francs and borrowers with loans in Polish zlotys. Borrowers with liabilities in Polish zlotys declared a relatively higher level of satisfaction with the loan than borrowers with liabilities in Swiss francs. Differences were also observed between borrowers with loans in Swiss francs and those with loans in euros. In the case of borrowers with a liability in euro, satisfaction is relatively higher than in the case of borrowers with a loan in Swiss francs. There was a weak relationship between currency and satisfaction with housing loans ($V = 0.300$).

3.2. Satisfaction with products additional to the loan

In the next step of the study, the declared satisfaction with housing loan ancillary products was verified and the relationship between the declared satisfaction with housing loan ancillary products and selected characteristics of the borrowers surveyed was analyzed.

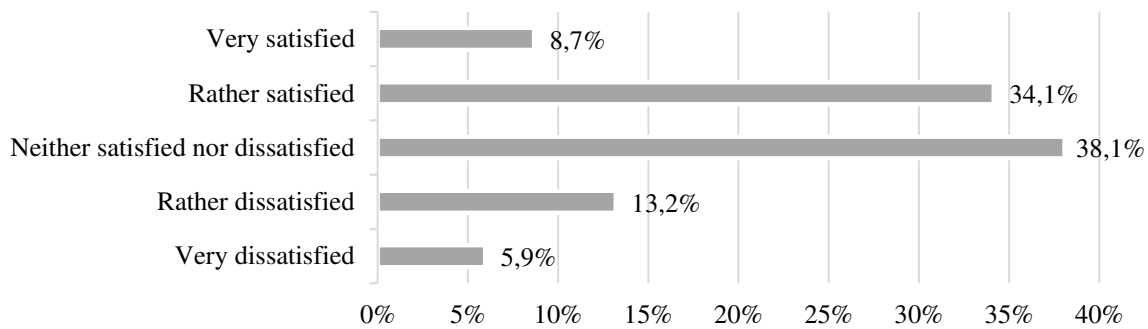


Figure 2. Declared satisfaction with housing loan ancillary products (%).

Source: own study.

In the case of assessing the satisfaction of borrowers with additional products to the housing loan (Figure 2), 38.1% of the respondents declared that the option was “neither satisfied nor dissatisfied”. Satisfaction with the additional products was expressed by a total of 42.8% of respondents, with 8.7% choosing the “very satisfied” option, and 34.1% choosing the “rather satisfied” option. Dissatisfaction was expressed by a total of 19.1% of respondents, of which 13.2% were “rather dissatisfied” and 5.9% chose the option “very dissatisfied”.

As for the declared satisfaction with products additional to the housing loan, there were no significant differences between the respondents in terms of socio-demographic characteristics (except for education), i.e., gender, age, place of residence, as well as the amount of net income received (Table 2).

Table 2.

Results of the analysis of the relationship between the declared satisfaction with additional products and selected variables in the scope of the profile of surveyed borrowers

Independent variables	Test value*	Number of degrees of freedom (<i>df</i>)	Probability value (<i>p</i>)	Rejection of the H_0 hypothesis (decision based on <i>p</i> value)	Cramer's V-coefficient (<i>p</i>) or Kendall's tau-b rank correlation (<i>p</i>)
Gender	4.656	4	0.324	No	0.068 (0.324)
Age	3.806	3	0.283	No	0.008 (0.765)
Place of residence	7.434	4	0.115	No	-0.043 (0.108)
Educational level	12.774	3	0.005	Yes	-0.093**(<0.001)
Net income	18.615	16	0.289	No	-0.052 (0.070)
Type of bank**	12829.500	-	0.989	No	0.030 (0.036)
Borrowing year	8.472	3	0.037	Yes	0.048* (0.047)
Loan period	23.896	6	<0.001	Yes	-0.082** (0.002)
Amount of credit	6.622	3	0.085	No	-0.053 (0.056)

Cont. table 2.

Share of the instalment in net income	94979.000	-	0.012	Yes	-0.073* (0.012)
Currency of the loan	22.373	2	<0.001	Yes	0.176 (<0.001)

Notes.

*F- Mann-Whitney U test or Kruskal-Wallis H-test (when comparing more than 2 subgroups).

** whether a commercial or cooperative bank.

Source: own study.

In the case of the level of education, the probability value in the Kruskal-Wallis H test was lower than the limit value ($p < 0.005$), which indicates that the expressed satisfaction with additional products of the housing loan differs significantly from the point of view of the borrower's education. Differences were observed between borrowers with higher education and those with secondary and/or postsecondary education. People with higher education, on average, declared a lower level of satisfaction with additional products. In this respect, a weak negative relationship was noted ($\tau\text{-c} = -0.093$), which means that the higher the level of education, the lower the satisfaction with additional products for the loan.

From the point of view of the parameters of the credit profile, differences were noted in terms of satisfaction with products additional to the loan, taking into account the year of taking out the loan, the loan period, the share of the loan instalment in monthly net income and the currency of the loan (probability value in the Mann-Whitney U test or H Kruskal-Wallis was below the cut-off value, i.e., 0.05). From the point of view of the year of taking out a housing loan, using the post hoc test, differences were noted between borrowers who took out a loan until 2008 (i.e. before the financial crisis) and borrowers who took out a loan in 2015-2020. Borrowers who took out a loan before 2008, on average, declared a lower level of satisfaction with additional products. There was a weak positive relationship between the declared level of satisfaction with additional products to the housing loan and the year of liability ($\tau\text{-c} = 0.048$). Such a result means that the level of satisfaction with the loan is higher, the later the loan is taken out.

Taking into account the loan period, using the post hoc test, significant differences were noted between:

- borrowers who took out a liability for a period of over 35 years and borrowers where the declared loan period was up to 35 years, up to 25 years, up to 20 years, up to 15 years and up to 10 years. Borrowers with a liability for a period of more than 35 years, compared to the others listed here, on average declared a lower level of satisfaction with additional (accompanying) products;
- borrowers with liabilities for up to 35 years and borrowers with liabilities for up to 20 years,, up to 15 years and 10 years. Borrowers with a liability for a period of up to 35 years, compared to the others listed here, on average declared a lower level of satisfaction with additional (accompanying) products;

- borrowers with a loan term of up to 25 years and borrowers with a loan term of up to 10, 15 and 10 years. Borrowers with a liability for up to 25 years, compared to the others listed here, on average declared a lower level of satisfaction with additional (accompanying) products.

There was a very weak negative relationship between the declared level of satisfaction with additional products to the housing loan and the loan period ($\tau\text{-}c = -0.082$). Such a result means that the level of satisfaction with additional products to the loan is lower the longer the loan period is.

From the point of view of the share of the loan instalment in the monthly net income, borrowers for whom the loan instalment is less than half of the net income declared a higher level of satisfaction with additional products. A very weak negative relationship ($\tau\text{-}c = 0.073$) was observed in this respect. This means that as the share of instalments in net income increases, the declared satisfaction of borrowers with the products additional to the loan decreases (albeit to a small extent).

Taking into account the loan currency, significant differences were shown between borrowers with liabilities in Swiss francs and borrowers with loans in Polish zlotys. Borrowers with liabilities in Polish zlotys declared a relatively higher level of satisfaction with additional loan products than borrowers with liabilities in Swiss francs. There was a significant but weak relationship from the point of view of loan currency and satisfaction with additional products of the loan ($V = 0.176$).

3.3. Satisfaction with bank products in general

In the next step of the study, the declared satisfaction with the bank's products in general among the surveyed borrowers was verified, and the relationship between the declared satisfaction with the bank's products and selected characteristics of the surveyed borrowers was assessed.

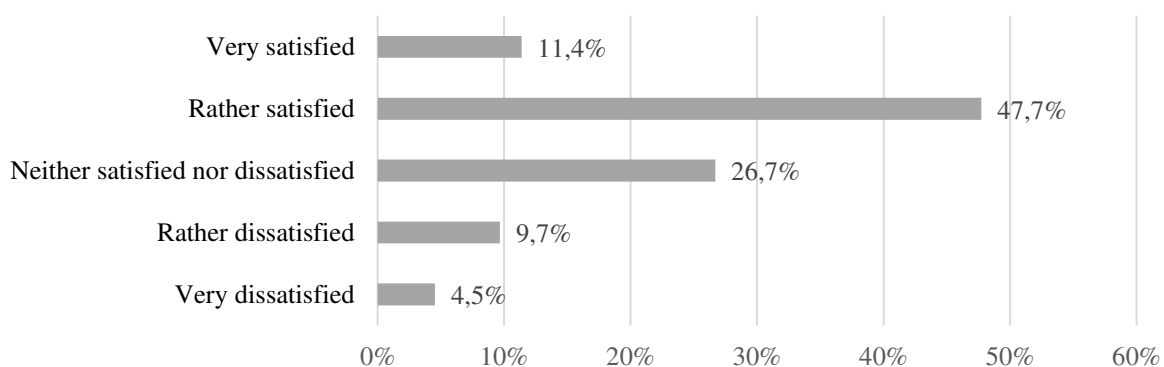


Figure 3. Declared satisfaction with bank products/services overall (%).

Source: own study.

Regarding satisfaction with the bank's products in general (Figure 3), satisfaction was expressed by 59.1% of respondents, with 11.4% selecting the option 'very satisfied /' and 47.7% selecting the option 'rather satisfied /'. Dissatisfaction was expressed by a total of 14.2% of respondents, 9.7% as "rather dissatisfied" and 4.5% selecting the option "very dissatisfied". An intermediate option, i.e., "neither satisfied nor dissatisfied", was declared by 26.7% of respondents.

As for the declared satisfaction with the bank's products in general, significant differences were noted between the respondents in terms of such sociodemographic characteristics as gender, age, and place of residence. In the case of the level of education and the amount of income obtained in net terms, no differences were shown (Table 3).

Table 3.

Results of the analysis of the relationship between the declared satisfaction with the bank's products in general and selected variables

Independent variables	Test value*	Number of degrees of freedom (df)	Probability value (p)	Rejection of the Ho hypothesis (decision based on p value)	Cramer's V-coefficient (p) or Kendall's tau-b rank correlation (p)
Gender	10.686	4	0.030	Yes	0.104* (0.030)
Age	9.412	3	0.024	No	0.017 (0.522)
Place of residence	17.559	4	0.002	No	-0.089** (<0.001)
Educational level	5.738	3	0.125	No	-0.049 (0.086)
Net income	9.215	16	0.904	No	0.003 (0.919)
Type of bank**	8867.000	-	0.002	Yes	0.111* (0.024)
Borrowing year	8.291	3	0.040	Yes	0.047 (0.085)
Loan period	14.649	6	0.023	Yes	-0.084** (0.002)
Amount of credit	3.466	3	0.325	No	-0.430 (0.124)
Share of the instalment in net income	90612.000	-	<0.001	Yes	-0.108** (<0.001)
Currency of the loan	22.682	2	<0.001	Yes	0.161* (<0.001)

Notes.

*F- Mann-Whitney U test or Kruskal-Wallis H-test (when comparing more than 2 subgroups).

** whether a commercial or cooperative bank.

Source: own study.

On average, men declared a higher level of satisfaction with the bank's products than women. In the case of age, using post hoc tests, differences were observed between 35 to 44-year-old borrowers and those aged over 55. On average, borrowers aged 55 and older assessed the level of their satisfaction with the bank's products relatively higher than borrowers aged between 35 to 44. Taking into account the place of residence, significant differences were observed between borrowers from cities with more than 500,000 inhabitants and borrowers living in cities with 11,000 to 100,000 inhabitants. Generally, people from cities of over 500 thousand inhabitants, rated their level of satisfaction with the bank's products relatively

lower. There is a negative but weak correlation between satisfaction with bank products in general and the size of the borrower's town ($\tau\text{-}c = -0.089$), which means that the level of satisfaction is lower the larger the borrower's town (calculated in the number of inhabitants).

Statistically significant differences were observed from the point of view of the credit profile, taking into account the type of bank, the year of taking out the loan, the loan period, the share of instalments in net income and the currency of the loan. Borrowers with liabilities in cooperative banks declared a higher level of satisfaction with the bank's products (average rank 595.24) than borrowers of commercial banks (average rank 453.51). However, a weak correlation was found between satisfaction with the bank's products in general and the type of bank ($V = 0.111$). From the point of view of the year of taking out a housing loan, using the post hoc test, significant differences were noted between borrowers who took out a loan until 2008 (i.e., before the financial crisis) and borrowers who took out a loan between 2015-2020. Borrowers who took out a loan before 2008, on average, declared a lower level of satisfaction with additional products compared to people who took out a loan in the period of 2015-2020.

Taking into account the loan period, differences were shown between borrowers who took out a liability for a period of up to 35 years and borrowers with the declared loan period of up to 30, 25, 20, 15 and 10 years. Borrowers with liabilities for a period of up to 35 years, compared to the others listed here, on average declared a lower level of satisfaction with the bank's products in general. There was a weak negative relationship between the level of satisfaction with the bank's products and the loan period ($\tau\text{-}c = -0.084$). Such a result means that the level of satisfaction with the bank's products is lower, the longer the loan period.

On average, borrowers for whom the loan instalment is less than half of their net income, declared a higher level of satisfaction. In this regard, a weak negative relationship ($V = -0.108$) was shown, which means that the higher the share of the instalment in net income, the lower the level of satisfaction with bank products.

Taking into account the loan currency, the differences were shown between borrowers with liabilities in Swiss francs and borrowers with loans in Polish zlotys. Borrowers with liabilities in Polish zlotys declared a relatively higher level of satisfaction with the bank's products than borrowers with liabilities in Swiss francs. A significant, although weak, relationship was observed from the point of view of loan currency and satisfaction with bank products ($V = 0.166$).

4. Summary

In the article, the adopted goal was pursued by presenting the current state of research on the importance of customer satisfaction with bank products and services, as well as performing an empirical analysis of factors affecting bank customers' satisfaction with their home loan,

ancillary products, and total bank products. The analysis shows that the majority of respondents declared satisfaction with their home loan, ancillary products, and the bank's products in general. More than half, that is, 51.5% of the respondents, chose the option indicating satisfaction with the loan. Satisfaction with the loan's accompanying products was expressed by a total of 42.8% of the respondents, while satisfaction with the bank's products in general was indicated by 59.1% of the respondents. Demographic characteristics (gender and age) did not significantly differentiate the declared level of satisfaction with the home loan and accompanying products. However, in the case of declared satisfaction with the bank's products in general, demographic characteristics (gender and age) significantly differentiated the respondents' level of satisfaction. On average, men declared a higher level of satisfaction with the bank's products than women. Higher levels of satisfaction were declared by older borrowers, i.e. over 55 years of age. The parameters of the credit profile, except for the amount of the loan, significantly differentiated satisfaction with the home loan. On the other hand, in the case of satisfaction with ancillary products and the bank's products in general, the amount of the loan and the type of bank proved to be non-significant parameters. The practical importance of the research was emphasized.

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APPLICATION OF THE METHOD OF MULTI-VALUED LOGIC TREES IN THE METHODOLOGY OF GEAR PUMP DESIGN

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Purpose: The aim of this article is to present a method of optimization of a discrete gear pump, using multi-valued logic trees (this is unique and original approach to this issue).

Design/methodology/approach: In this paper, we have presented the application of multi-valued decision logic in the design methodology of gear pumps. We are talking about the methodological process of „design - construction - optimization” beginning with the consideration of coupling relations between interacting assemblies, subassemblies and elements.

Findings: The developed methodology of multi-valued logic trees and parametric graphs in particular provides a new method for discrete optimization. The analytical description of the object speeds up finding the optimal solution and significantly reduces the cost of the optimization process.

Practical implications: The paper presents a methodology for designing gear pumps using multi-valued logic trees. The solutions obtained by means of the adopted methodology have been structurally supported by two patent applications and industrial implementation.

Originality/value: We have described the methodological cycle of application of multi-valued logic trees which resulted in development of a whole series of innovative new generation gear pumps. Finally, we introduced multi-valued weighting coefficients, which allowed us to develop innovative prototype pumps.

Keywords: design methodology, design method, graphs and trees, machine systems, design theory, multi-valued logic trees, gear pumps.

Category of the paper: Case study.

1. Introduction

Engineering practice requires a correct assessment of the mathematical model describing a given system by means of variables. Models describe a given system with different accuracy.

The analysis of design methodology, the structure of this process and the corresponding stages, show that methodological elaborations create the basis for the development of new design methods. Undoubtedly, the foundation for the creation of methods of design support has become heuristic procedures, which include all the rules and laws that help to solve the problem, but not always guarantee finding the best solution. The method of morphological analysis (Zwicky, 1969) and the method of solving invention tasks (Altszuller, 1972) should be mentioned here first of all. Morphological analysis is a creative problem-solving technique for systematically structuring and exploring all possible solutions to a multidimensional, complex problem and a powerful tool for generating creative ideas and designing new product and services. It is based on attribute analysis, generating alternatives for each attribute, creating new possibilities. Among other things, this work laid the foundation for algorithmic procedures based on logical inference.

Algorithmic design is based on determining the sequence of individual operations starting from the conceptualization stage ending with the creation of a task-based optimization criterion. This approach describes systems analysis. Rene Descartes' ideas in his Discourse on the Method (Descartes, 1637) greatly influenced design thinking: „divide every difficulty into as many parts as are possible and necessary for its adequate solution”. A reference work that should also be cited is the book (Jones, 1992) describing a set of tools and a theoretical framework to support design. The representation of the design process by (Maher, 1996) cited by (Cross, 2008) was based on abductive thinking associated with production (synthesis), while induction and deduction are associated with analysis. It is clear that in many situations the design process will depend primarily on the designer.

W. Gasparski in (Gasparski, 1979) wrote that on the grounds of design methodology (methodology of solving practical problems) the object of scientific search for solutions is the art of practicality. Searching is understood here as solving problems arising from practical situations. In turn, the search is made in connection with the theory of decisions as „... praxeology as a theoretical discipline is, or becomes, an optimization theory of action ...”, i.e. a discipline establishing optimization theories with an analytical basis in the form of decision theory. Therefore, the concept of design determined by the results of methodological studies so far was called praxeological-system concept.

The result of methodological observation of the ways of formulating hypothetical solutions-projects is the identification of two attitudes:

- the refining attitude,
- the idealizing attitude (the so-called projecting attitude),

which is schematically presented in Figure 1.

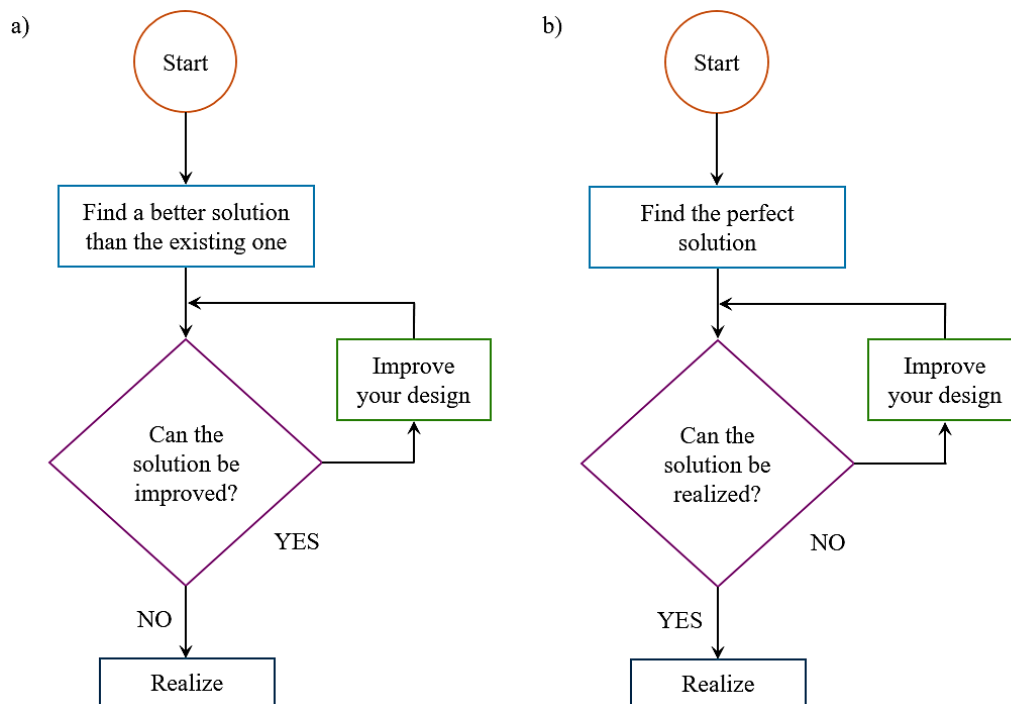


Figure 1. Two attitudes of formulating hypotheses to solve a design problem: a) the streamlining attitude, b) the designing attitude.

Source: Gasparski, 1979.

Analysis of the design process requires a precise definition of the essence of the process. The problem, „what is design?“ is not a new one. The design attitude is characterized by the modern concept of design, based primarily on the formulation of a hypothesis of a solution that the designer thinks is ideal. A system is defined by a set of variables, a set of possible states corresponding to each variable, and by some way of describing the meaning of the variables and their states in terms of attribute valence. Systems whose variables are divided into input variables (we) and output variables (out) are called directed systems. The problem to be addressed can be roughly described as follows: given a data system, determine the best representation of that system by a directed structural system whose elements correspond to subsets of the data system variables.

Nowadays, the design method based on the development of technical diagrams is a widely used method. A paper (Daalhuizen, 2021) presents ideas for a new understanding of methods in design. The authors proposed Method Content Theory as a very powerful „indicator method“ for education and practical applications along with the potential of useful insights in design methodology. A very important issue was addressed in (Ge, 2021), where the authors investigated emotions in design considering the preferences of experienced designers. They presented results showing how situated emotions mediate design work using a multi-level model analysis. This is extremely important primarily by considering the personality traits of the expert in risk assessment of innovative solutions in integrated decision support systems (Deptuła, Deptuła, 2017).

2. Literature review

Methodological thinking includes two aspects. The reflective aspect stems from a person's desire to understand and organize cognition from the perspective of its possible forms. The second aspect is a pragmatic orientation toward the practical solution of a particular problem. Thinking about method cannot be separated from thinking about logic. Virtually always the two concepts appear together in philosophy. The acceleration of the development of technology, taking place in the twentieth century, had a significant impact on the processes of preparation of practical actions taken by man. This acceleration resulted primarily from the complication of erected objects and their increasing scale. At the same time, a need arose to increase the efficiency of design, that is, to reduce its time, while achieving greater suitability of the designed object to the functional and economic requirements.

In other words, the need for project evaluation procedures has arisen. In recent years, the amount and degree of difficulty of design work have been growing faster than the capabilities of designers. This is especially true for machinery, equipment and production systems with complex applications, construction and operating principles. In this paper (Heiss, Kokshagina, 2021), the authors investigated the role of tactile co-design tools that enable interdisciplinary collaboration in complex healthcare environments. Specifically, they presented how the capabilities of tactile co-design tools can support equity in decision making, improve literacy in teams.

The need for the development and use of alternative design methods is caused not only by the increase in the requirements for machines and mechanical systems (interdisciplinarity, modularity, economy), but also by the weakness of the design process, which currently relies primarily on the experience, intuition of designers and often too much trust in computer programs and calculators, too little draws on the achievements of design methodology. Often, property modeling and optimization in mechanization and automation are not comprehensive.

In the design of machines and mechanisms, the object is a device composed of closely integrated parts that together realize the assumed (set) functions. An important feature of mechanical systems is the complex arrangement of geometric, technological and functional features. Small changes in the properties of the elements may cause large changes in the properties or manufacturing costs of the machine. Often, the designed device is an integral part of a larger system and must be properly matched. The task of the designer-constructor is to design a device performing strictly specified functions under many constraints.

In recent studies, diverse optimization techniques for gear pumps have been proposed. Zharkevich et al. (2023) presented a parametric optimization approach for gear pump casings using finite element analysis (FEA), achieving up to a 16% reduction in structure weight while maintaining structural integrity. Our study also applied FEA, yet we expanded upon this by

optimizing stress distribution to improve durability and resilience under dynamic loads. Similarly, Guerra et al. (2021) introduced a methodology for designing multistage gear pumps intended for dry sump systems, which included detailed structural analysis of the drive shaft and internal clearances. While we also performed structural analysis, our research incorporated novel gear profiles and clearance compensation mechanisms to achieve enhanced stability and performance efficiency. Dhote et al. (2022) explored the use of the Taguchi method to optimize parameters such as material hardness, outlet pressure, and rotational speed in order to minimize wear. Although our study also analyzed materials, we emphasized reducing cavitation and improving hydromechanical parameters through advanced structural optimization. Robison (2021) developed a multi-objective optimization technique tailored to gerotor geometry, with goals to reduce flow ripple and leakage while enhancing efficiency. Inspired by this approach, we applied a similar optimization framework within the context of gear pumps, ultimately producing prototype pumps with substantially improved flow stability. Another study by Nguyen et al. (2022) utilized CFD simulations and response surface methodology to optimize centrifugal pumps for slurry transport, successfully enhancing efficiency and reducing erosion. In our research, we also leveraged advanced CFD simulations, focusing specifically on optimizing gear pump designs to achieve significant noise and pulsation reductions.

Garcia and Patel (2022) conducted research on the use of magnetorheological fluids for dynamic sealing in gear pumps, which led to enhanced seal performance. Although we focused on conventional sealing methods, similar optimization principles were applied in our study to improve the overall seal tightness and efficiency. An analysis by Cinar et al. (2016) used FEA to investigate stress distribution within the pump casing, identifying high-risk zones for damage under various load conditions. In a similar vein, we applied FEA but implemented additional design modifications to reduce stress concentration and increase the durability of the pump. Smith and Jensen (2023) demonstrated that modifications to tooth profiles could lower noise levels in hydraulic pumps by up to 15%. Expanding on this, we incorporated clearance compensators, achieving even greater acoustic improvements—a crucial factor in noise reduction for industrial applications. In examining high-pressure gear pumps, Kim and Wei (2023) investigated strategies to reduce cavitation. Following their insights, we developed additional design solutions that both minimized cavitation and improved hydraulic efficiency.

Ivanović et al. (2021) focused on optimizing parameters of gerotor pumps to reduce wear and enhance efficiency. Building on this approach, our research aimed to achieve similar improvements in gear pumps through structural optimization and advanced materials. Further, Zharkevich et al. (2023) once again applied FEA to gear pump casings, achieving a 16% weight reduction while ensuring structural strength. In our research, we not only pursued weight reduction but also aimed to enhance efficiency and durability, thus broadening the impact of their findings.

Orlandi et al. (2023) developed a methodology for CFD simulation of gear pumps, accurately modeling the contact between gear teeth under actual operating conditions. Our study also employed CFD simulations, but with a distinct focus on flow optimization and reducing performance pulsations. Pourmostaghimi et al. (2023) used evolutionary optimization techniques for reverse-engineering helical gears, successfully determining critical design parameters. Although their research concentrated on gear shape reconstruction, we adapted similar techniques to enhance key performance parameters in gear pumps. In a related area, Peng et al. (2023) studied the influence of radial and end clearances on the efficiency of high-speed gear pumps, identifying optimal values to reduce internal leakage and frictional losses. In our study, clearance optimization was similarly addressed, but with a broader emphasis on durability and noise reduction. Cao et al. (2023) applied CFD alongside optimization methodologies to analyze internal flow characteristics in a guide vane centrifugal pump. While our focus remained on gear pumps, we applied a similar approach to flow modeling, leading to substantial performance gains. Wei Li et al. (2024) proposed a combined approach using response surface optimization and CFD to improve energy characteristics and flow states during pump startup, thereby enhancing transient efficiency. Although our scope was different, we also focused on optimizing dynamic parameters in gear pumps.

Finally, Dixit et al. (2023) introduced a multi-objective optimization method for designing spur gears, accounting for multiple failure modes. Our study builds upon this framework, particularly in optimizing structural strength and efficiency in hydraulic gear pumps.

Our study is unique in that it introduces multi-valued logic trees as a method for optimizing gear pumps. The “design - construction - optimization” process has been refined through the use of coupling relations between interacting assemblies, subassemblies, and components. By using multi-valued logic trees and parametric graphs, we were able to rapidly and effectively identify optimal solutions, accelerating the design process and significantly reducing costs. The developed methodology has resulted in two patent applications and has been implemented in industrial settings, emphasizing its practical significance.

The introduction of multi-valued weighting coefficients within the optimization process is another novel element, allowing us to develop innovative prototype gear pumps for the next generation. The contribution of our research to the scientific field includes expanding machine design theory and introducing new tools for analyzing and optimizing complex mechanical systems.

2.1. Graph-based decision - making models

Design decision support tools include decision trees, dendrites, tree classifiers, and graphs, among others. These tools are classified as so-called graphical decision support and decision making methods (Jones et al., 2001).

Often, a set of decisions (and the relationships between them) are written graphically from a mathematical model, which are the main implementation plane of the decision making process that a decision maker can use to solve any problem (Cheng et al., 2018). This usually refers to the stage in the early stages of the design process where schematics, sketches, and prototypes exist. In a paper (Segers et al., 2005), the authors effect of offering feedback to annotations by, among other things, presenting word graphs that contain the architect's annotations and semantic associations based on those words. The authors showed that the feedback provided by word graphs can stimulate design. The application of generating parametric trees for a given graph playing out parametrically for automatic transmissions is presented in (Deptuła, Kurmayev, 2021).

For decision support in optimization of mechanical systems, modeling of the overall process is required. The most commonly used graph models in the analysis of mechanical systems are graphs and decision trees (Cai, 2010). There are a number of publications in the literature on the applications of decision trees in decision making systems in the methodological design and construction process. This is mainly related to meta-design theory, considering parametric modeling using graph methods, among others. In a paper (Harding, Shepherd, 2017), the authors proposed a new approach called Meta-Parametric Design, combining graph-based parametric modeling with genetic programming. The advantages of this approach are demonstrated through the example of two real case study projects, which extend the exploration of the design while maintaining the benefits of graph representation.

In particular, multi-valued logical decision trees can be distinguished in design (Deptuła, 2020; Deptuła et al., 2019).

3. Multi-valued logic trees as graph models in machine systems analysis

3.1. The development of logical binary trees - Boolean algebra

The method of multi-valued logic trees is effectively used in discrete optimization of machine systems. When each design and/or performance parameter taking numerical values from a certain interval is labeled with a fixed binary or multi-valued logical variable, a discretization of such numerical intervals can be performed. The set of all numerical combinations forms a variant tree with a number of floors equal to the number of design and/or performance parameters, since in the case of a traditional logic tree, there can be only one logical variable on a single floor. The number of sub-branches of a given interval represents the number of branches in a single branch bundle, and the number of all paths from the bottom to the top of the logic tree corresponds exactly to the number of all combinations of discrete values of the considered intervals.

The method of multi-valued logic trees results from the development of logical decision trees and Boolean algebra (Béziau, 2012). Based on Boolean algebra, two important branches of mathematics like multiplicity theory and classical logic were defined. In this algebra, basic symbols, axioms and the set of theorems derived from them are defined. The set of axioms can be chosen arbitrarily. The use of multiplicity theory and Boolean algebra allows, among other things, to make descriptions of the design process based on the analysis and synthesis model. For example, in the work (Darke, 1979) the author proposed to develop the paradigm - conjecture analysis in order to create a model of the design process consisting of generator-concept - analysis. The methodology of multi-valued logic trees also allows a similar approach.

Figure 2 shows a logic tree that encodes a fixed Boolean function of three variables.

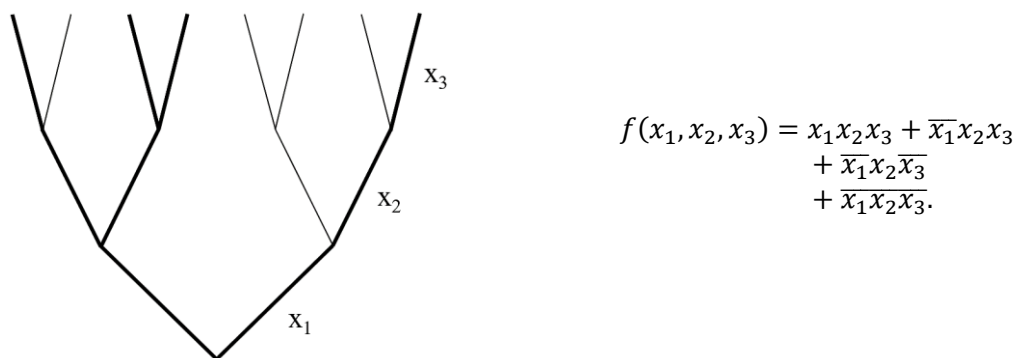


Figure 2. Boolean function of three variables encoded on a logic tree.

Source: based on own research analysis.

In the Quine - McCluskey algorithm, by simplifying the Boolean functions written in KAPN, the truncated alternative normal form (SAPN) and finally the minimum alternative normal form (MAPN) are obtained (Figure 3).

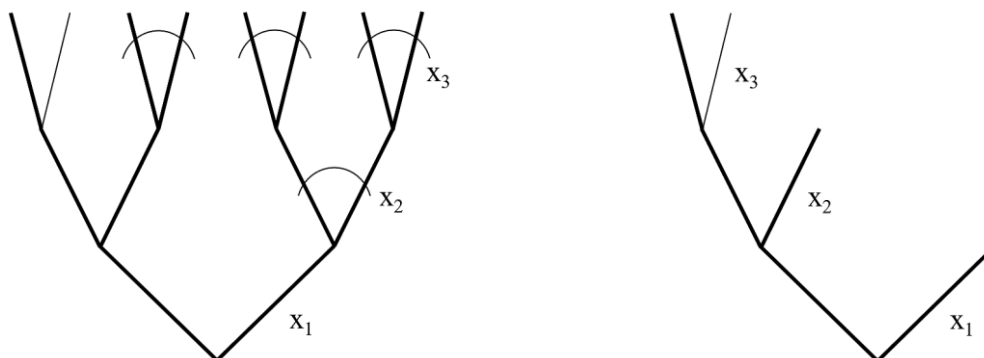


Figure 3. Logic tree and simplified logic tree.

Source: based on own research analysis.

The minimized form of the output function (with the minimum number of literals) is then obtained.

3.2. Quine - McCluskey algorithm for minimization of partial multi-valued logical functions

In the minimization considering multi-valued complete logic systems, the rank of importance of fixed variables, detailed analysis of realizable sub-solutions, etc. are determined. In the case of multi-valued Boolean functions, as in Boolean functions, the notions of incomplete gluing and elementary absorption, which are applied to the APN of a given Boolean function, play a fundamental role in the search for prime implicants.

The Quine - McCluskey algorithm makes it possible to find all prime implicants of a given logic function that is there is a shortened alternative normal form SAPN (Bhandaria et al., 2018). The terms of incomplete gluing and elementary absorption have the main role in the search of prime implicants and are used for the APN of a given logic function (Partyka, 1983, 1999). The following transformation is called the consensus operation:

$$Aj_0(x_r) + \dots + Aj_{m_r-1}(x_r) = A \quad (1)$$

where:

$$r = 1, \dots, n$$

A – a partial elementary product, the literals of which possess variables belonging to the set: $\{x_1, \dots, x_{r-i}, x_{r+i}, \dots, x_n\}$.

The following transformation is called the operation of reduction:

$$Aj_u(x_r) + A = A \quad (2)$$

where:

$$0 \leq u \leq m_r - 1; 1 \leq r \leq n,$$

A – a partial elementary product, the literals of which possess variables belonging to the set: $\{x_1, \dots, x_{r-1}, x_{r+1}, \dots, x_n\}$. If the above equation takes place, then A absorbs $Aj_u(x_r)$.

In the case of multi-valued weighting factors, we get:

$$\begin{aligned} w_0 Aj_0(x_r) + \dots + w_{m_r-1} Aj_{m_r-1}(x_r) &= \\ &= (\min\{w_0, \dots, w_{m_r-1}\}) \cdot A + \sum_{s=i_0, \dots, i_{m_r-2}} w_s \cdot A \cdot j_s(x_r) \end{aligned} \quad (3)$$

where w_i - polyvalent weighting factor.

For example using the formula:

$$\begin{aligned} Aj_0(x_r) + \dots + Aj_{m-1}(x_r) &= A, \\ Aj_u(x_r) + A &= A \end{aligned} \quad (4)$$

where:

$$A = A(x_1, \dots, x_{r-1}, x_{r+1}, \dots, x_n), \quad (5)$$

$$j_u(x_r) = \begin{cases} m-1, u = x_r \\ 0, u \neq x_r \end{cases} \quad 0 \leq u \leq m-1 \quad (6)$$

successive stages of the multi-valued logic function minimization: 020, 101, 200, 021, 111, 201, 210, 022, 121, 202, 211, 212, 221 can be presented in the following way (Table 1).

Table 1.

NAPN and MAPN of a given logical function

	020	200	101	021	201	210	111	022	121	202	211	212	221
02-	*			*				*					
20-		*			*					*			
1-1			*				*		*				
21-						*					*	*	
-21				*					*				*
2-1					*						*		*

Source: Partyka, 1983, 1999.

3.2.1. Consideration of multi-valued weighting factors for the Quine - McCluskey algorithm

As in the case of minimization of multi-valued Boolean functions without weighting coefficients, in the algorithm elementary products are written as numbers in appropriate positional systems. The author's algorithm for minimizing multi-valued Boolean functions with weighted coefficients is presented in the book (Deptuła, 2020). For the gluing operation of individual partial multi-valued logical functions with weighted coefficients, definitions of „pure” and „impure” gluing are introduced, where the gluing operation for canonical multi-valued elementary products is performed with respect to the weighted coefficient with the smallest value, i.e. $\min\{w_1, \dots, w_n\}$.

An impure gluing operation is a transformation:

$$\begin{aligned}
 & w_0 A_{j_0}(x_r) + \dots + w_{m_r-1} A_{j_{m_r-1}}(x_r) = \\
 & = (\min\{w_0, \dots, w_{m_r-1}\}) \cdot A + \sum_{s=i_0, \dots, i_{m_r-2}} w_s \cdot A \cdot j_s(x_r)
 \end{aligned} \tag{7}$$

where:

$$r = 1, \dots, n; w_s > \min\{w_0, \dots, w_{m_r-1}\},$$

A – elementary partial product whose variables of particular literals belong to the set $\{x_1, \dots, x_{r-1}, x_{r+i}, \dots, x_n\}$. In n variables (m_1, \dots, m_n) - value weighting factor before the partial canonical product takes values in the range $\langle w_1, \dots, w_n \rangle$, whereby $w_j = w_{j-1} + w_{j-2} + \dots + w_1$ where $j = 2, \dots, n$.

4. Gear pump design methodology using multi-valued logic trees

4.1. Gear pumps

Gear pump designs have been developed for over 400 years. The first descriptions of gear pump design appeared in works: *Hilaria mathematica* (1624), *Recreation mathematique, composee des plusieurs problemes plai sants et facetieux* (1626), whose authorship is attributed to Jean Leurechon (Beck, 1901).

The creator of the first gear unit was Johannes Kepler, who patented his solution in 1604. The initial application of the patented solution at that time was the pumping of water in dewatered mines (Abel, 1971; Stryczek, 2007). Valveless and self-priming gear construction resistant to numerous impurities present in water removed from shaft sumps very quickly displaced piston pumps used at that time and troublesome in operation. The author of the solution saw a wider application of his invention. He did not exclude the use of his idea for removing bilge water on ships, forcing the flow in the installation of park and garden fountains, but also for pumping air in the construction of blowers and exhaustors. Thus, as early as the 17th century, great importance was placed on maintaining proper dimensional tolerances of the mating displacement elements with the body.

Improving internal tightness is a direction that is associated with minimizing energy losses, increasing transmitted power, and increasing generator energy efficiency (Amman, 1926; Arai, 1968; Tilley, Burrows, 1995). The total efficiency of gear pumps produced today is about 80-90% (for nominal pressures up to 28 MPa). Such a large range is mainly associated with the adopted manufacturing tolerances. Due to the considerable difficulty of correlating in a simple way the effect of tolerances of individual elements on the energy efficiency of the produced pump.

Gear pumps are the most common power generators used in hydraulic power transmission systems, whose share is estimated at more than half of all pumps manufactured. The most important advantages of gear pumps are simple and compact design, reliability of operation, resistance to contamination of the working medium and high efficiency coefficient at the same time with small dimensions compared to other pumps. Figure 4 shows the division of gear pumps by application (Osiński, 2013).

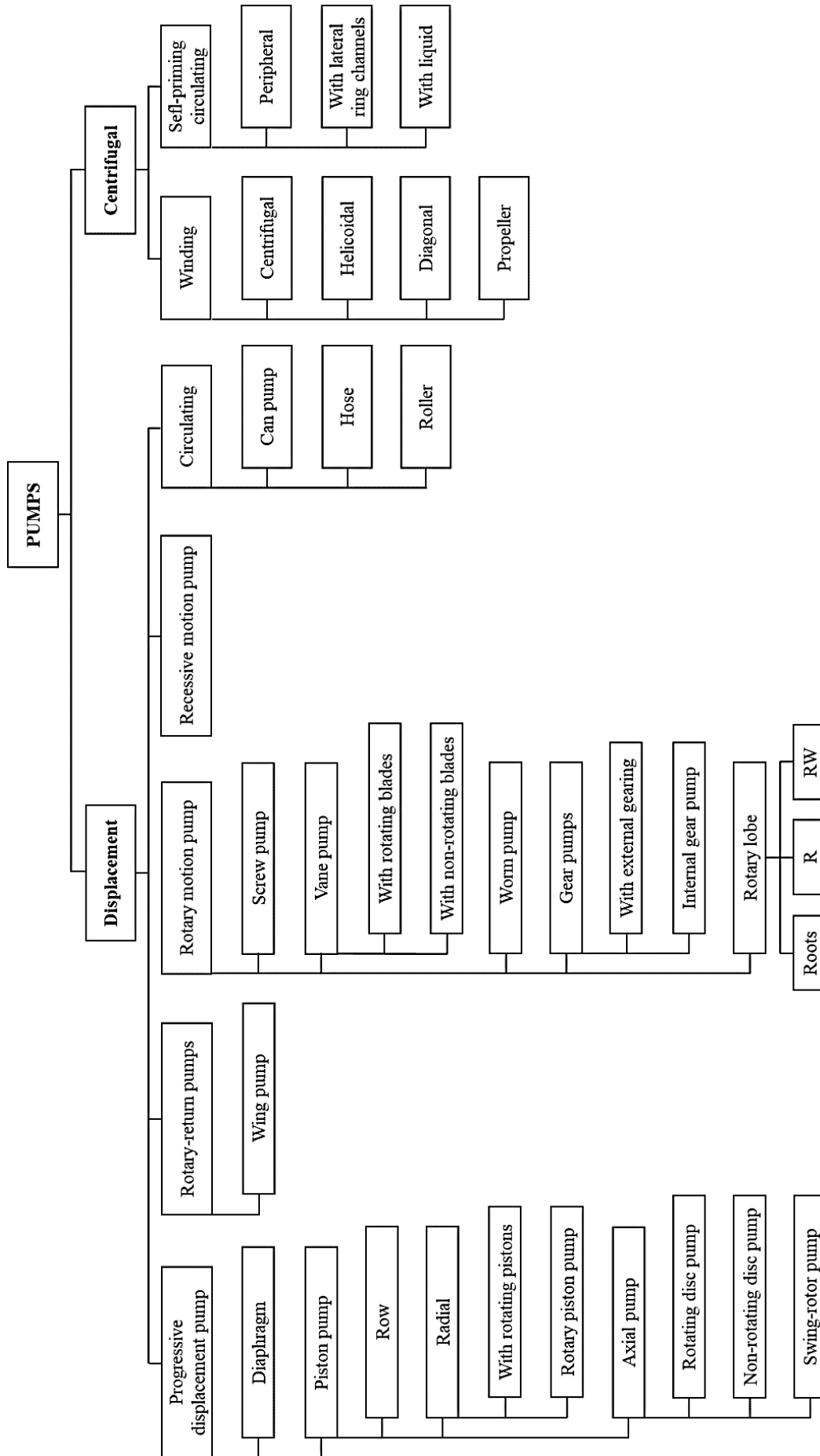


Figure 4. Classification of centrifugal and positive displacement pumps.
Source: Osinski, 2013.

Despite the existence of numerous patents, literature and a huge number of currently manufactured gear units, technical methods to ensure optimal internal tightness, maximum operating pressures and minimum performance pulsation and noise emission have not yet been exhausted. In particular, the paper (Osiński, 2013) presents possibilities and methods to reduce performance pulsation and to propose new design solutions to increase operating pressures while ensuring high internal tightness. These tasks required solving a number of technological, design and construction problems.

For a pump to be widely used in hydraulic power transmission systems, it must meet, among other requirements:

- high operating pressures should be produced with the highest possible efficiency,
- adequate and least fluctuating capacity should be ensured over the entire operating pressure range.

Realization of these requirements is connected with ensuring the highest possible internal tightness, which also influences the value of the overall efficiency of the gear pump. The efficiency of the pump is closely related to the energy losses occurring during the operation of the unit. The efficiency of positive displacement pumps is affected by many factors of design, technology and operating conditions. The most important of these are:

- operating medium and operating conditions-hence the research methodology presented in (Osiński et al., 2013),
- the toothing parameters and the design of the sealed space relief-therefore the research on the optimization of the polyvolute outline presented, among others, in (Deptuła, Osiński, 2017),
- the quality of the mating surfaces, machining, and tolerances of the components-hence the research methodology undertaken in (Deptuła et al., 2017),
- the design of the new units involved several stages of retrofitting and testing of prototype pumps.

5. Application of multi-valued logic trees in the optimization of a discrete undercut gear pump

The paper (Osiński et al., 2013) describes the study of a prototype gear pump manufactured at Wytwórnia Pomp Hydraulicznych Sp. z o.o. in Wrocław. The innovation of the prototype unit consisted in modifying the profile of the evolute in its lower part by so-called undercutting of the tooth foot (Figure 5).

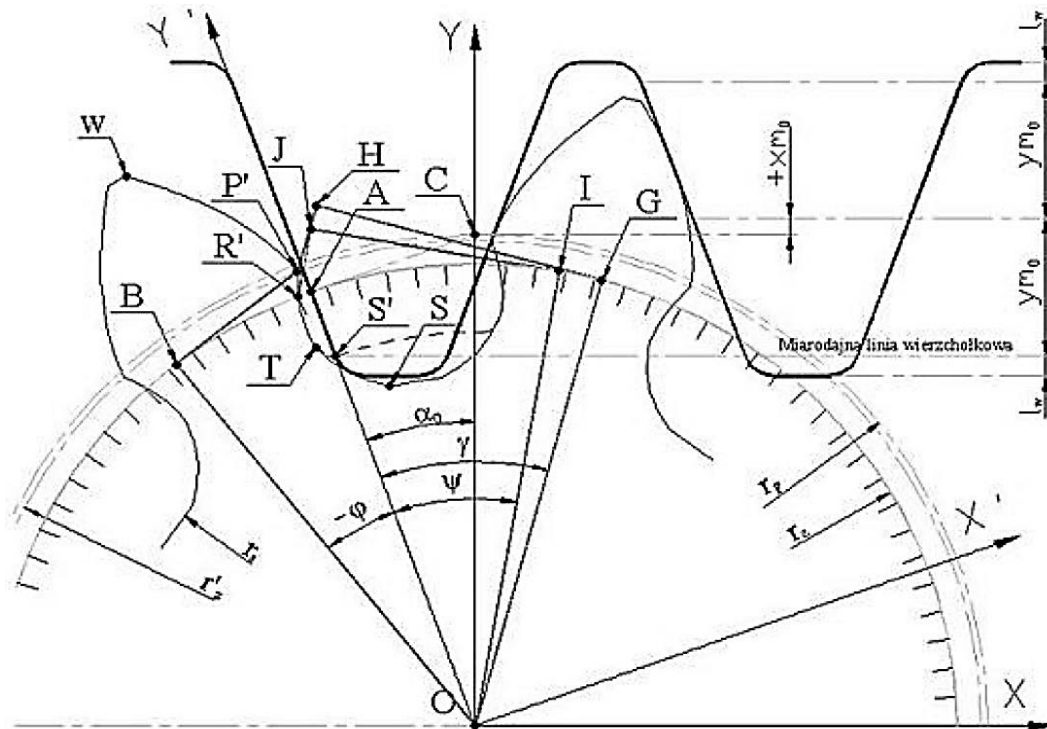


Figure 5. Undercutting the foot with a trapezoidal toothed tool.

Source: Kollek, Osiński, 2009.

In the model of the involute tooth outline (Figure 5), it was assumed that as a result of rounding or chamfering the cutting edge, the authoritative vertex line would be shifted in the direction of the tool foot radius by the value of the vertex clearance l_w .

The application of multi-valued logic trees in the optimization of a discrete gear pump presented in (Osiński et al., 2013) presents a new approach to the problem, as it was previously calculated by other methods (Kollek, 1996). In order to determine the optimal operating conditions and operating medium parameters, it was necessary to consider compartmental coding and the relationship between gear pump design parameters and operating parameters in a hierarchical approach.

The total efficiency can be expressed as follows:

$$\eta_c = \frac{1 - c_\mu \frac{p}{2\pi\mu \cdot n} - c_r \frac{1}{n} \sqrt{\frac{2p}{\rho}} \sqrt[3]{q^{-1}}}{1 + c_v 2\pi \frac{\mu \cdot n}{p} + c_\rho \frac{\rho \cdot n^2}{2p} \sqrt[3]{q^2} + c_p} \quad (8)$$

In the search for the optimal value of the functions: $\eta_V, \eta_{hm}, \eta_c$ the corresponding arithmetic values of the ranges of change of the parameters under study were taken, which were encoded with logical decision variables in logical decision trees. If in the gear pump, with undercut tooth foot, all paths of multi-valued logical trees mean the set of all theoretical variants of the process of optimization of the corresponding efficiency η_c, η_{hm} and η_V , then only the true variants should be extracted (paths in bold - depicted graphically) (Figure 6).

Complex multi-valued logical functions by swapping the floors of the logic tree allow to determine the rank of importance of logical variables from the most important (at the root) to the least important (at the top), as there is a generalization of the bivalued quality indicator to multi-valued: $(C_k - k_i m_i) + (k_i + K_i)$, where C_k - the number of branches of k -th floor, k_i - the multiplicity of simplification on k -th floor of the m_i - value variable, K_i - the number of branches of $(k-1)$ - ego floor, from which the non-simplifying branches of k -th floor were formed. In this way, the minimum complex alternative normal form can be obtained. MZAPN of a given logical function, which has no isolated branches on the decision tree, and at the same time has a minimum number of true (realizable) branches, which in particular can be considered as elementary design guidelines (Figure 6). All transformations are described by the so-called Quine - McCluskey algorithm of minimizing individual partial multi-valued logical functions.

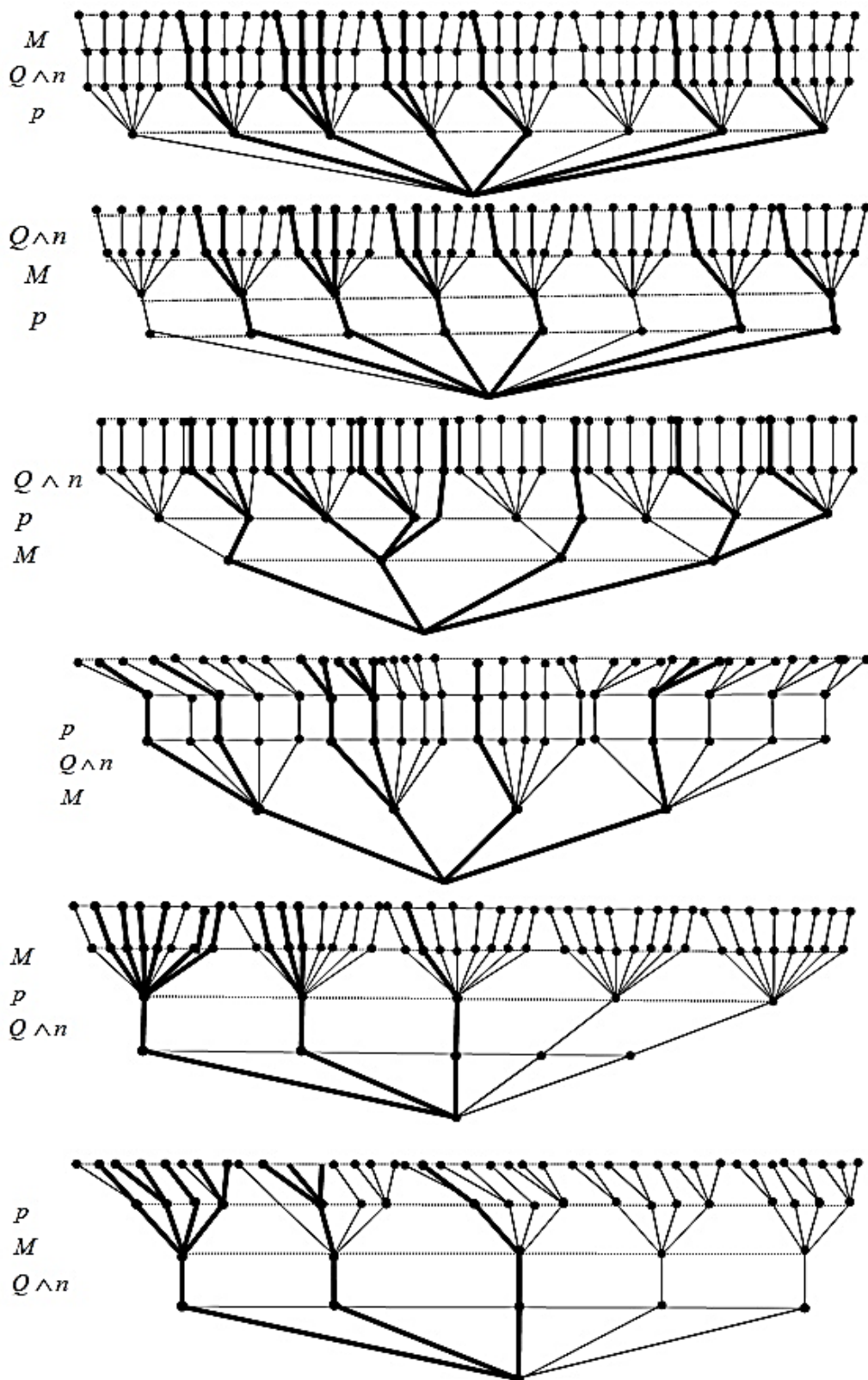


Figure 6. Multi-valued logic trees for hydraulic-mechanical efficiency η_{hm} .

Source: based on own research analysis.

If the number of realizable variants for the corresponding efficiencies with interchangeable floors with logical variables assigned to the design parameters Q , n , M , and p is calculated for the logic trees, only the logic trees with the least number of true branches describe the importance rank of the parameters, from the most important at the bottom to the least important at the top. Figure 7 shows the optimal multi-valued logic tree for volumetric efficiency η_V .

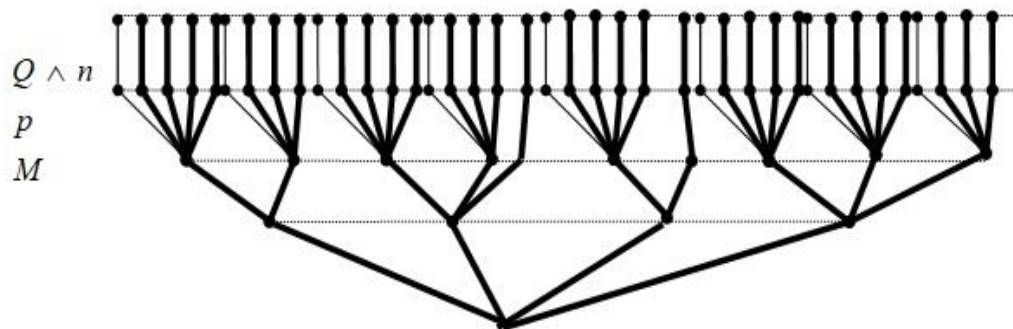


Figure 7. Optimal multi-valued logic tree for volumetric efficiency η_V .

Source: based on own research analysis.

It is shown in (Osiński et al., 2013) that for total efficiency there are two optimal multi-valued logic trees. The most important parameters are n and Q_{rz} - treated as one surrogate variable and the moment M . For mechanical and volumetric efficiency there are single optimal multi-valued logic trees. For mechanical efficiency, the most important parameters are n i Q_{rz} and for volumetric efficiency η_V , moment M .

In another source of knowledge (Deptuła et al., 2018), the presented analysis of the validity of the structural and operational parameters of the gear pump was supported by the results of alternative verification methods:

- analysis of additive and multiplicative multiple regression models,
- assessment of the importance rank of operational parameters based on the results of the Fisher-Snedecor test and the values of standardized BETA coefficients (Łuszczyna, 2011).

5.1. Optimization of a polyvent tooth outline

The phenomenon of seizing of the working fluid in the recesses of mating gear pairs occurs in pumps with external gearing when the number of adhesion is greater than unity. The optimized polyvolute outline should provide small changes in the dynamic force in the mesh as a result of the applied modifications and corrections. In addition, a smoother course of the dynamic force in the gearing can be influenced by an oblique tooth notch. When considering a polyvolute consisting of two normal involutes, the following cases are distinguished (Figure 8):

- the upper turret support angle has a larger value than the lower turret support angle $\alpha_0^g > \alpha_0^d$, such a solution has the advantage of relieving the confined space and causes a mitigation of the dynamic force changes in the meshing (change of stiffness of the mating pairs of teeth),
- the top turret lip angle has a smaller value than the bottom turret lip angle $\alpha_0^g > \alpha_0^d$, this solution results in worsening of the cap space relief and an increase in the dynamic force amplitude.

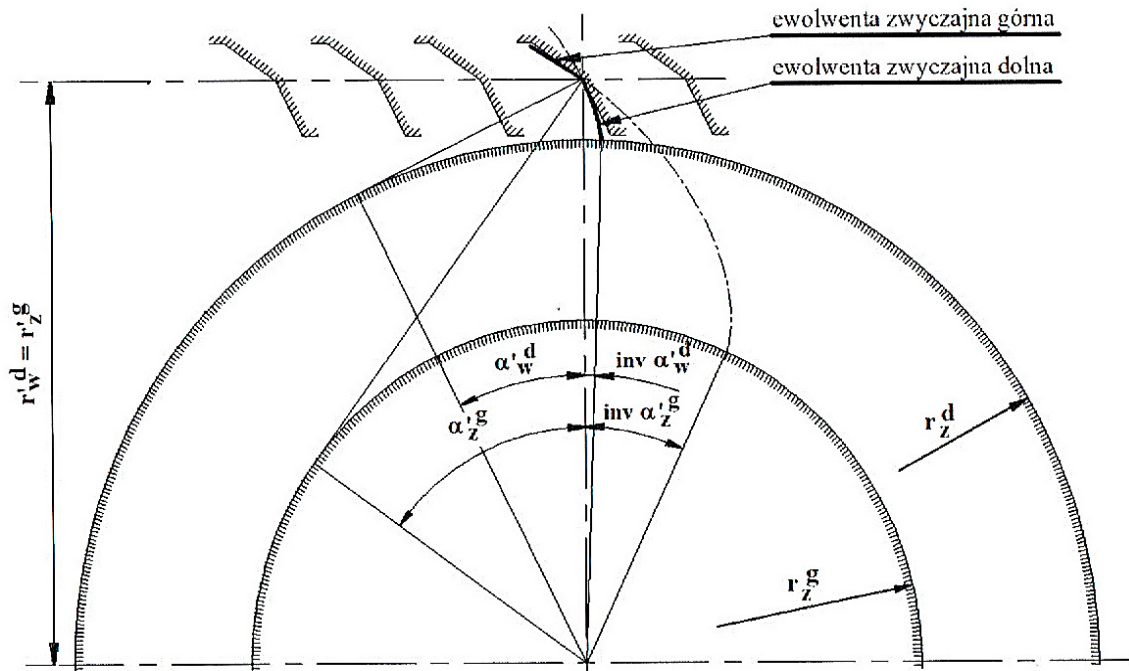


Figure 8. Two-evolution outline composed of ordinary polyevolutes.

Source: Osiński, 2017.

The optimization process was carried out taking into account five basic criteria: technological feasibility of the tool, obtaining a minimum compression ratio, occurrence of small changes of dynamic forces in the mesh, obtaining a minimum efficiency pulsation ratio and ensuring high energy efficiency.

Outline optimization using multi-valued logic trees required a two-step analysis (Deptuła, Osiński, 2017). For this purpose:

1. A computer model program was developed for the hydraulic parameters of the gear pump and to calculate the minimum, maximum, and instantaneous capacity and to generate the polyvolute outline.

2. A two-step approach was used in solving the problem using multi-valued decision trees:
 - application of multi-valued logic trees with weighted coefficients to determine the relationship between the $\alpha_0^1, \alpha_0^2, \alpha_0^3$ evanescent support angles in the polyvolute outline (stage I),
 - verification of criterion conditions and selection of variants of polyvolute outlines,
 - application of multi-valued logic trees to select the optimal variant of polyvolute outline (stage II).

For the study of multi-valued logic trees, a method taking into account weighting factors was additionally developed. In order to take into account the weight coefficients, the Quine-McCluskey algorithm of minimization of multi-valued functions was modified by introducing additional operations, such as definitions of impure gluing.

The impure gluing operation for multi-valued canonical elementary products is performed with respect to the weighting factor with the smallest value, i.e. $\min\{w_1, \dots, w_n\}$.

An impure gluing operation is a transformation of:

$$\begin{aligned}
 & w_0 A j_0(x_r) + \dots + w_{m_r-1} A j_{m_r-1}(x_r) = \\
 & = (\min\{w_0, \dots, w_{m_r-1}\}) \cdot A + \sum_{s=i_0, \dots, i_{m_r-2}} w_s \cdot A \cdot j_s(x_r). \quad (9)
 \end{aligned}$$

In partial data of multi-valued logical functions $f_i(x_1, \dots, x_n)$ n variables (m_1, \dots, m_n) - values, weighting factors had to be included in the gluing and pseudo-gluing operations ($w_n, w_{n-1}, w_{n-2}, \dots, w_1$), assigned to the corresponding multi-valued logical products.

A schematic of the polyvolute outline optimization algorithm is shown in Figure 9.

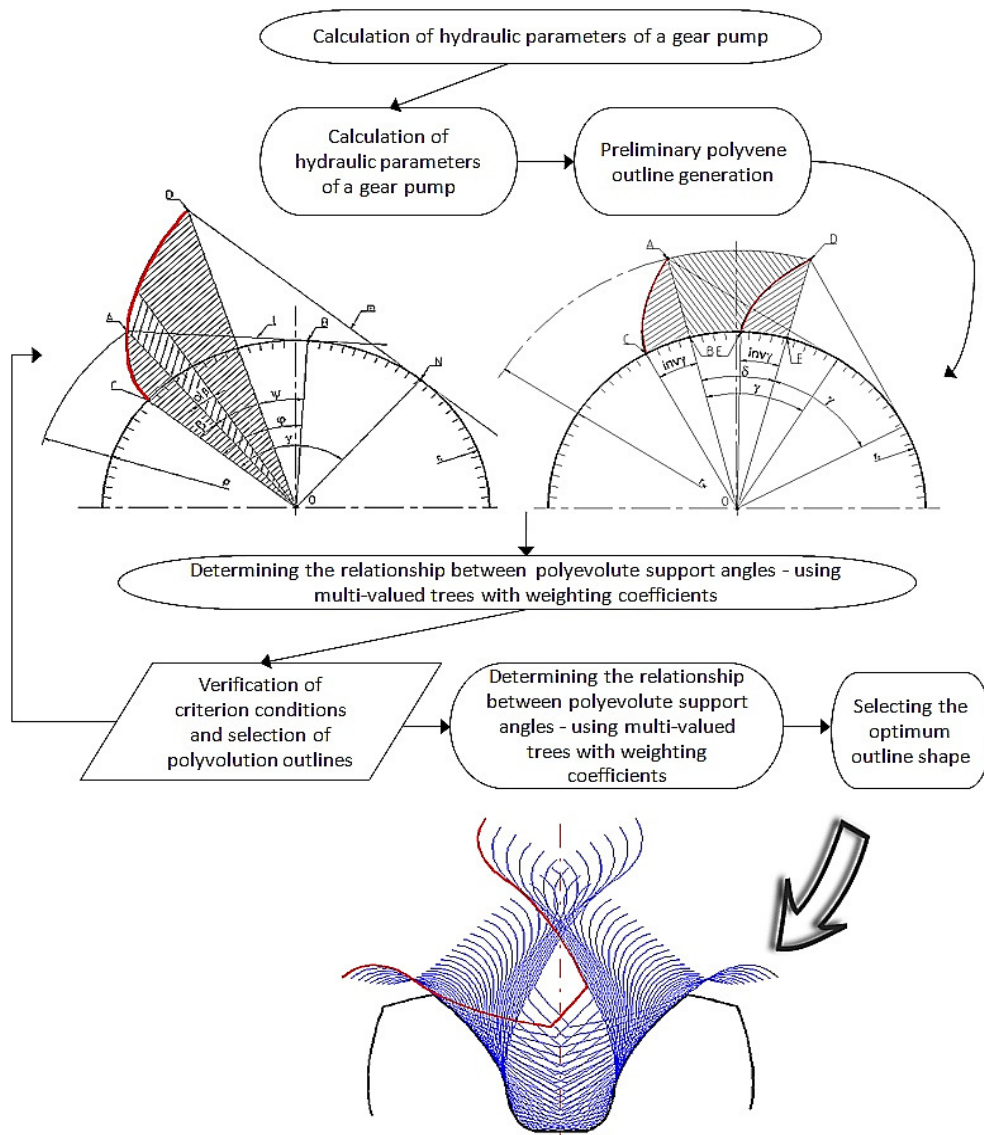


Figure 9. Schematic of the polyevolution outline optimization algorithm.

Source: Deptuła, Osiński, 2017.

In the first step, multi-valued logic trees with weight coefficients were used. 20 realizable solutions were obtained. Figure 10 shows an example of a multi-valued logic tree with weighting coefficients with stacked parameters $\alpha_0^1, \alpha_0^2, \alpha_0^3$.

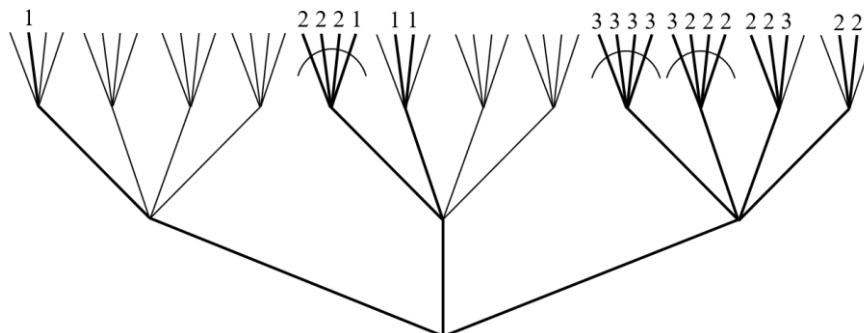


Figure 10. Multi-valued parameter logic tree: $\alpha_0^2, \alpha_0^1, \alpha_0^3$. Minimization of solutions.

Source: based on own research analysis.

We then proceeded to determine the final shape of the polyvore outline. There were 216 theoretical solutions and $n! = 1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 = 120$ multi-valued logic trees were obtained. The optimization process of the polyvolute outline indicated a solution of type *XI* (Figure 11) which consists of two ordinary evolutes located in the upper and middle parts and an elongated evolute causing undercutting of the tooth foot.

In addition, the optimization determined the correlations between the support angles of the usual evolutions, i.e. $\alpha_0^g > \alpha_0^d$ and $\alpha_0^d = 20^\circ$. Based on the calculations and technological capabilities of Hydrotor S.A. (the entity implementing the design), a whole series of gear pumps with a three-rotor outline was designed. Shown in Figure 12 (Deptuła, Osiński, 2017) the model wheels were equivalent to the wheels designed for the pump of the second group with unit capacity $q = 8 \text{ cm}^3/\text{rev}$.

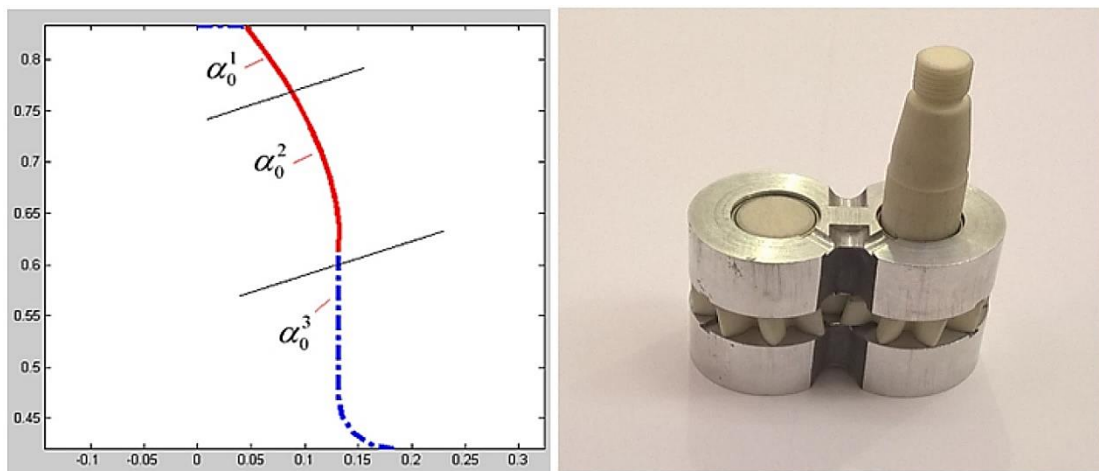


Figure 11. Polyvolute tooth outline consisting of three evolutes α_0^1 , α_0^2 , α_0^3 and three evolute wheels made with 3D printing technology.

Source: based on own experimental experience.

For such assumptions, the wheels should be corrected and the value of the correction factor $x < x_{min} = x_g$, this relationship implies the number of teeth $z_1 = z_2 < z_{min} = z_g$. The literature for strength reasons defines the maximum permissible value of correction factors according to the relation:

$$x_{max} = x'_g = y \frac{z'_g - z}{z_g}. \quad (10)$$

Figure 12 shows an example of a dentition outline.

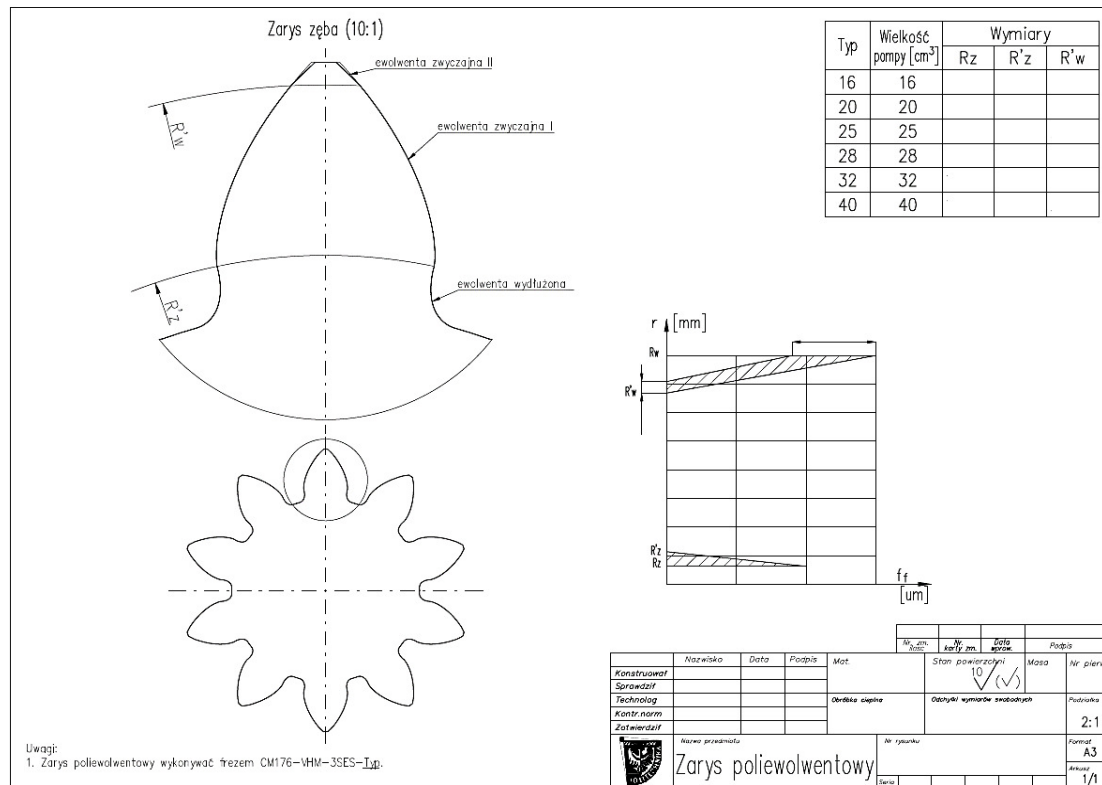


Figure 12. Structural drawing of an XI-type three-rotor outline.

Source: Deptuła, Osiński, 2017.

The manufacture of gear pumps with reduced acoustic emissions has required an increase in product accuracy. Attention is primarily given to increasing performance while increasing manufacturing accuracy. In order to achieve sustained accuracy at the micrometer level, a whole range of errors, i.e. kinematic errors, geometric errors induced by the cutting forces and the adopted machining parameters, must be continuously checked and compensated. Using multi-valued logic trees at a further stage in the work (Deptuła et al., 2017; 2020), optimization of the machining technology of the elements affecting the overall efficiency of the newly designed units was performed. Performed analysis of dimensional and shape tolerances in the end allowed to select control dimensions: critical, important and unimportant.

5.2. Optimization of processing technology for components affecting overall efficiency of newly designed units

The purpose of carrying out the identification of the influence of the technology of making polyvolute pump structures was to determine the sensitive control dimensions (values/tolerances) of the tested pumps for teeth made in the technology of chipping and grinding.

Model and prototype pump designs of the types 2PWR-SE, 3PWR-SE, 1PWR-SE and 2PW-SEW were the objects of the study. The paper (Deptuła et al., 2017) presents the results for the model pump of the 3PWR-SE series, while the papers (Deptuła et al., 2018a; 2019; 2018b) present the results for the other pump types.

In order to determine the influence of manufacturing technology on the level of noise emitted to the environment, it was decided to make gears in the ground chip technology

The computational methodology consisted first of determining the mutual effect of the given control measurements on the total efficiencies at given speeds $n = 500, 800, 1000, 1500$ and 2000 rpm. In the calculations it was assumed that the degree of sensitivity of the control dimensions (values/tolerances) implies differences in the efficiency values of the tested pumps. Figure 13 shows a comparison of the total efficiency of ten gear pumps *3PWR-SE-32/28-2-776* for $n = 500$ rpm.

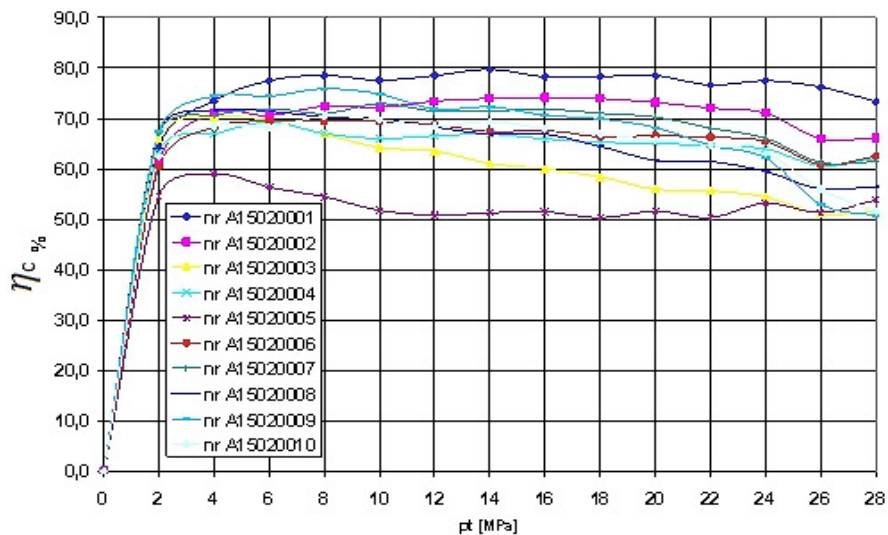


Figure 13. Comparison of total efficiency η_c of *3PWR-SE* pumps for $n = 500$ rpm.

Source: based on own research analysis; Kolley et al., 2015.

Then, for the rotational speed $n = 500, 800, 1000, 1500$ and 2000 the maximum values of the total efficiency η_c of the pumps were determined. A 5% deviation was assumed and for such a range: 95-100% of the maximum efficiency value a set of pumps meeting this criterion was determined. Identification of the influence of the measurement points tolerance on the given efficiency values required application of the Quine - McCluskey algorithm of minimization of partial multi-valued logical functions for the common interval range of all 10 pumps. After applying the multi-valued logic tree method, the control dimensions critical, important, and unimportant were determined for the six details of the pumps in question: a driven gear, a driven gear, a bearing set, a body, a plate, a cover, and a bolt tightening force.

Figure 14 shows the schematic diagram of the assembly drawing of the *3PWR-SE* pump (Deptuła et al., 2017).

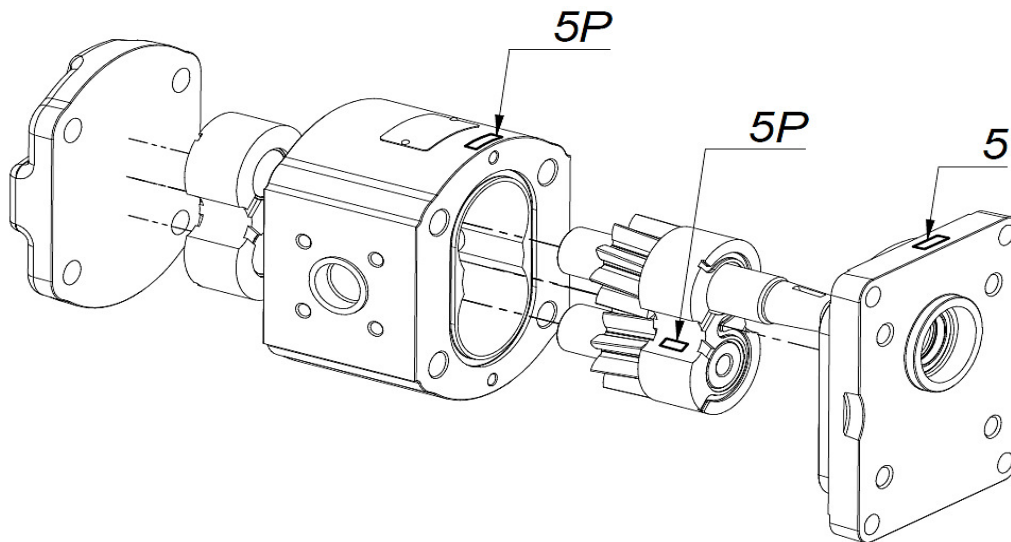
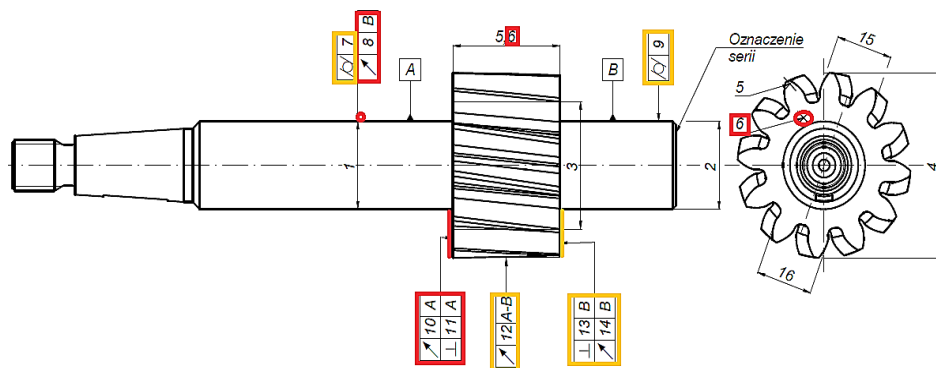


Figure 14. Assembly drawing of tested prototype gear pump 3 PWR.

Source: Deptuła et al., 2017.

Figure 15 shows the most important and less important control points for the details (active and reactive gears and body assembly):

a)



b)

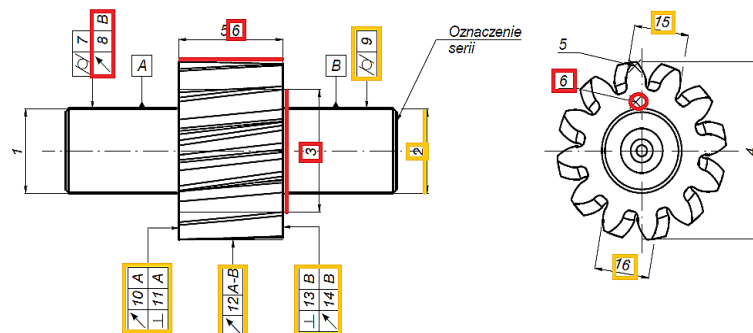


Figure 15. The most important and less important control points for active and reactive gears.

Source: based on own experimental experience.

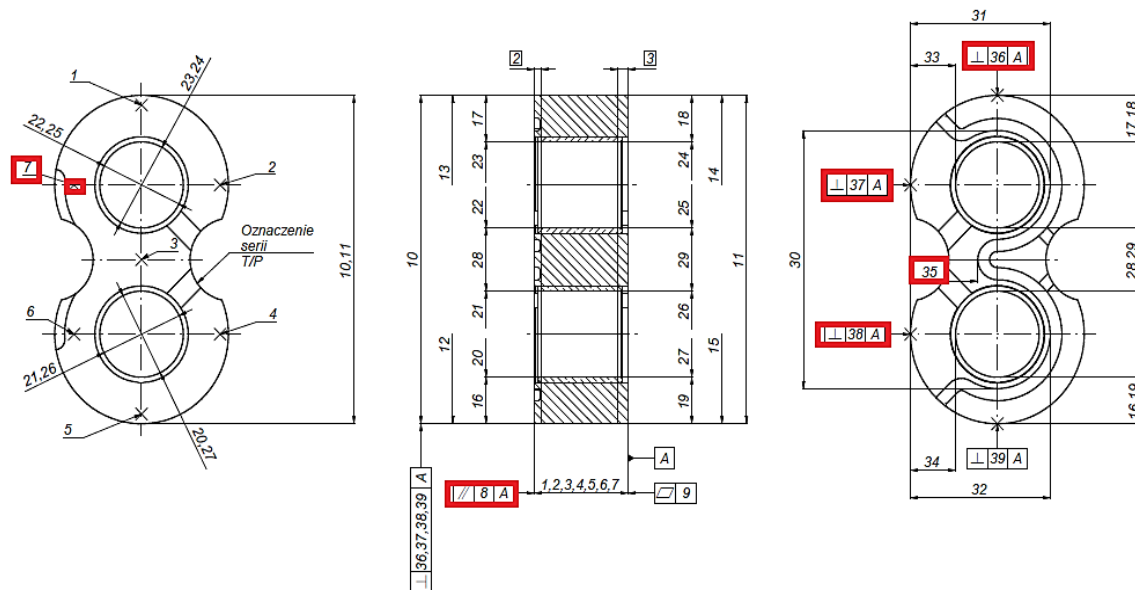


Figure 16. Bearing housing assembly.

Source: based on own experimental experience.

A total of 40 units of model and prototype pumps *2PWR-SE*, *3PWR-SE*, *1PWR-SE*, and *2PW-SEW* were tested. The number 142 control dimensions were evaluated for each pump making a total of 5.680 dimensions. The study of identification of the influence of manufacturing technology of model units by the method of multi-valued logical trees showed that significant (important) dimensions affecting the efficiency of pumps generally repeat in all details regardless of the analyzed group. The most frequently occurring critical dimensions for individual components of the pump are runout of the journal and side surface of the gear ring, perpendicularity of the tooth side surface to the journal (axis of rotation of the wheel) and perpendicularity of the well to the pump face (Figure 17) as well as perpendicularity of the forming outline to one of the bearing thrust planes: flatness of the bearing thrust surface, parallelism of the bearing thrust planes (Figure 18).

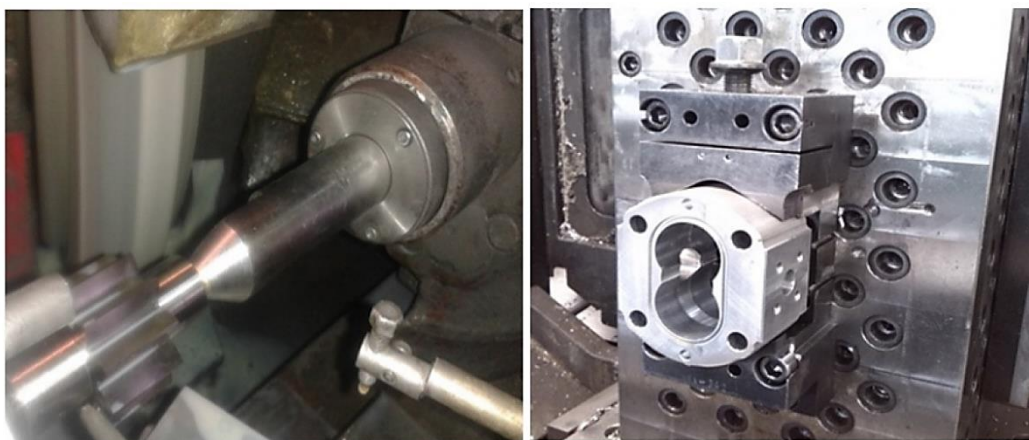


Figure 17. Grinding of journals on the claw grinder - detailing driven and driven gears, clamping of the body made on the CNC machine - pump body.

Source: Osiński, 2017.

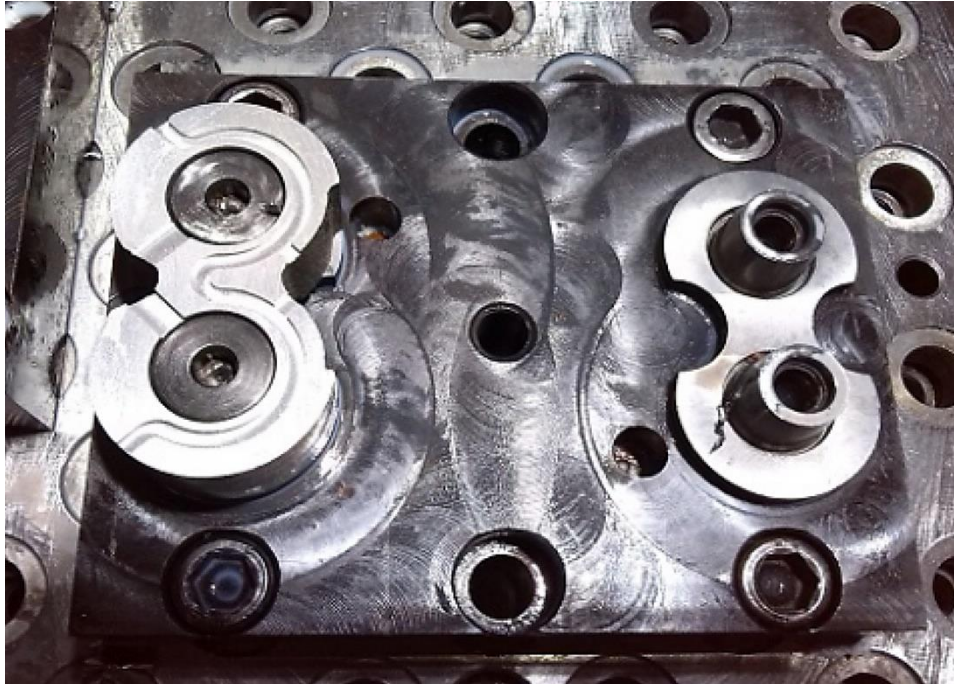


Figure 18. Mounting of plain bearing housing on CNC machine table - detail of bearing housing assembly.

Source: Osiński, 2017.

After the optimization of prototype pump manufacturing technology, less scatter in the efficiency results is observed. Comparing the acoustic characteristics of prototype pumps with ground and chipped wheels (Deptuła et al., 2020) made in backlash-free technology, it turned out that the solution with ground wheels has 3 to 5 dB lower noise emission to the environment. Optimization using multi-valued logic tree methodology resulted in a rational narrowing of dimensional and shape tolerances where necessary and a reduction of accuracy class in minor locations. This ultimately contributed to lower production costs and increased productivity.

6. Results

The developed and adopted methodology for designing gear pumps with the use of multi-valued logic trees concerns two aspects: the object of design - the studied pump and the design process - a sequence of activities with logical ordering. In particular, they are applied in the improvement design, which concerns the existing systems and is oriented at the elimination of the identified deficiencies in the applied solutions and their improvement. The methods are also applicable in basic design.

A general scheme for finding solutions using the multi-valued logic tree method is shown in Figure 19.

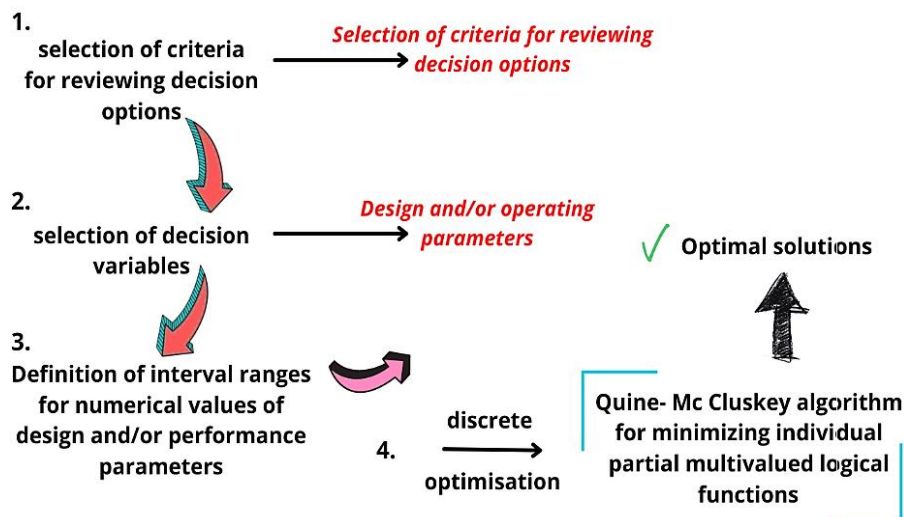


Figure 19. Solution search method using multi-valued logic trees.

Source: based on own research analysis.

The objects of the research were model and prototype pump designs whose tooth outline was optimized using multi-valued logic trees. The optimization process has been carried out taking into account five basic criteria: technological feasibility of the tool, obtaining minimum compression ratio, occurrence of small changes of dynamic forces in the gear, obtaining minimum efficiency pulsation ratio, and ensuring high energy efficiency.

After a positive verification of the wheels printed in polyethylene we started to make them in industrial conditions. The surface of the three-rotor outline was made using the following technologies: ground and chipped (Figure 20). Using logical decision-making structures, an optimization of the technology of processing of elements influencing the total efficiency of the newly-designed unit was also carried out. The analysis of dimensional and shape tolerances ultimately allowed for the selection of control dimensions: critical, important and unimportant. This resulted in rational narrowing of dimensional and shape tolerances where it is necessary and lowering of accuracy class in places of minor importance. Optimization of manufacturing technology contributed to lowering of manufacturing costs and increasing its efficiency.

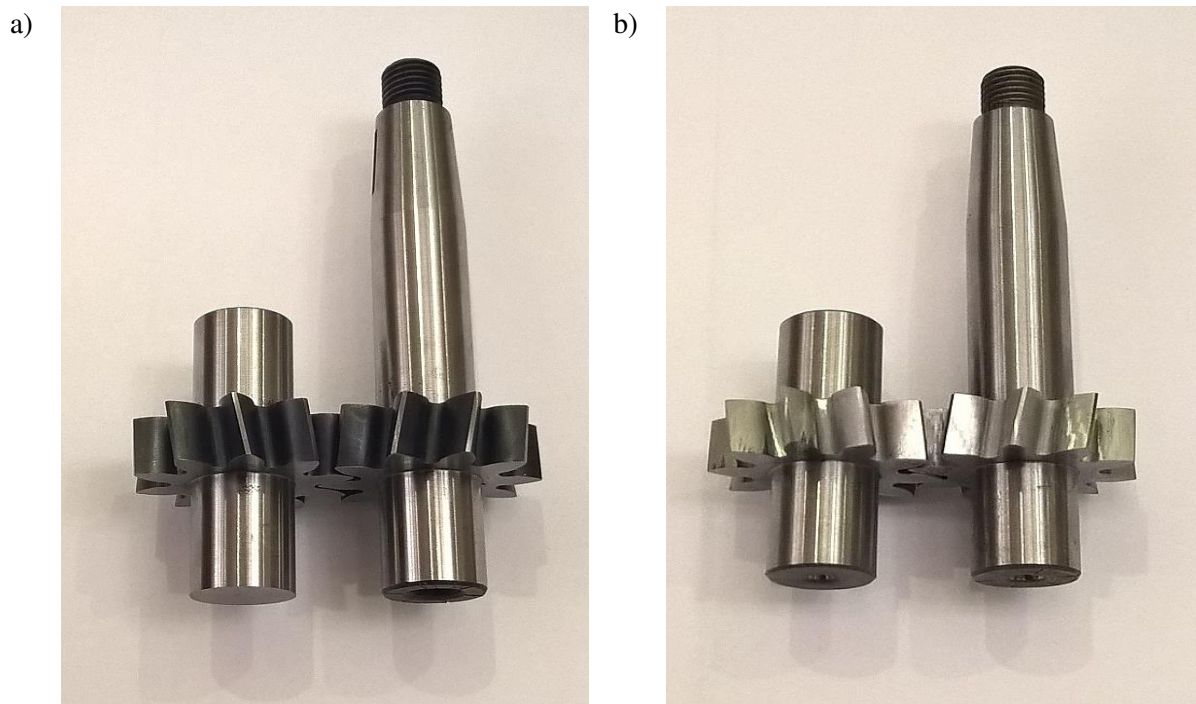


Figure 20. Gears: a) chipped, b) ground.

Source: Osiński, 2017.

After the optimization of the technology of making prototype pumps, smaller scatter in the results of the efficiency run is observed.

7. Conclusions

The paper presents a methodology for designing gear pumps using multi-valued logic trees. The solutions obtained by means of the adopted methodology have been structurally supported by two patent applications and industrial implementation. The most important utilitarian features of the newly developed pump designs include:

- 78.5% reduction in performance pulsation,
- 4 to 5 *dB* reduction in ambient noise emission,
- reduction of sound generating vibrations by approx. 50%,
- increase in total efficiency from 9 to 12%,
- improving the conditions for relieving the congested space by providing a degree of coverage $\varepsilon \approx 1$.
- reducing the compression ratio to 1.

The development of the multi-valued logic tree methodology required, among other things:

- Introduction of multi-valued weighting coefficients for determining the most important design guidelines. This made it possible to apply the method of multi-valued decision trees to solve technological problems, especially in the technological process of gear pump manufacturing.
- The use of systems of logical equations as a formal decision-making description for testing the importance rank of changes in the arithmetic values of such parameters.
- Development of the method of minimization of logical equations of multi-valued systems taking into account different multi-valued decision variables, as a method of optimization of bypass valves and other hydraulic systems.
- Consideration of certain and uncertain information data in optimization of dynamic properties of machine systems.

The developed methodology of multi-valued logic trees and parametric graphs in particular provides a new method for discrete optimization. The analytical description of the object speeds up finding the optimal solution and significantly reduces the cost of the optimization process. The methods for finding the global minimum of the objective function can be divided into two groups. The first group are heuristic methods, which allow to find the global minimum only with certain probability. In which also synthesis and analysis of the problem can be considered (Bamford, 2002). The second group consists of methods that allow finding the global minimum with some known accuracy. At this stage one can recall the method of subjective objective system (Ziv-Av, Reich, 2005) which has applications in many engineering fields (e.g. mechanical engineering), but also non-engineering fields (e.g. design of a new magazine, banking service, and also in the case of studying the effect of wood anisotropy on its mechanical properties - with respect to the effect of scale (Malaga-Tobola et al., 2019).

The multi-valued decision tree method is a new optimization tool classified as an interval optimization method. The estimation of global minimum obtained by the method of compartmental global optimization is correct in every iteration step what gives a possibility to terminate calculations at any time or when assumed structural and design accuracy is achieved. The structuring of the problem described by means of multi-valued logical trees and parametric graphs makes it possible to introduce appropriate formal notations and, in particular, it is even possible to combine complex quantitative and qualitative features of varying degrees of detail according to the principles of a multidimensional morphological array. Moreover, morphological and decision arrays can be analytically and numerically encoded according to the definitions and theorems of the logic of multi-valued decision processes, which enables a variant way of identifying and classifying information in computer terms during the search and modification of solutions in the design process. The analyzed problem, can also be categorized as design methods (Daalhuizen, Cash, 2021) allowing to capture key procedural knowledge, crucial for the design process, practice and education.

The method of optimization of a discrete gear pump, using multi-valued logic trees, is a new approach to the problem. A suitably adapted method of coding selected parameters on multi-valued trees and an algorithm for determining realizable design guidelines for a pump with tooth foot modification, allowed to generate the importance rank of design parameters and optimal changes to improve mechanical, volumetric and total efficiency. The discrete optimization also showed that it is possible to significantly reduce the dynamic load amplitudes in the pump already at the design stage. At the same time, the obtained results initiated further research on optimization of different pump types using multi-valued logic tree methodology.

It is important to note that, while the methods used in this study - such as multi-valued logic trees and finite element analysis (FEA) - enabled effective optimization of gear pump design, certain limitations are present. Primarily, our experiments were conducted in laboratory conditions, which may not fully reflect the diverse operational environments encountered in industrial applications. Additionally, precise modeling of dynamic phenomena such as cavitation and variable loads, which may arise during extended pump operation in changing environments, presents some constraints. The numerical approach we employed is also limited by the assumptions and simplifications inherent to mathematical modeling, which may affect the accuracy of results. Several key areas could guide future research. First, we plan to conduct tests in real-world conditions to assess the performance and durability of prototype gear pumps under varied operational settings, such as high-pressure environments, elevated temperatures, and fluctuating loads. Further advances could be achieved by refining flow modeling, specifically by applying advanced CFD methods to deepen understanding of the effects of dynamic parameters, such as variable load and cavitation, on pump durability and efficiency. Another potential direction involves the development of hybrid models that combine finite element analysis with artificial intelligence-based optimization methods, which could further enhance design precision. Additionally, the incorporation of composite or wear-resistant materials may improve pump durability in demanding conditions. In summary, supplementing our research with real-world testing and implementing advanced modeling and optimization methods could significantly expand the industrial applications of our findings, representing a promising direction for future studies.

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BARRIERS TO THE DEVELOPMENT OF MANUFACTURING COMPANIES IN POLAND

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Purpose: The aim of this study is to provide an overview of the barriers to the development of manufacturing companies operating in Poland, on the example of stonemasonry companies.

Design/methodology/approach: The main conditions and obstacles to a more dynamic development of stonemasonry are analysed. On the bases of literature, the proposed set of barriers was identified and use to figure out groups of barriers peculiar for stonemasonry industry. These obstacles were then described based on in-depth interviews with business owners and an industry expert.

Findings: The development of stonemasonry companies, which mostly belong to the SMEs sector, is contingent on overcoming or eliminating barriers of an institutional, economic, market and managerial type. These barriers are to some extent the same as those of other manufacturing companies, but the specific nature of the stonemasonry company influences their different character. Solutions have been proposed that could mitigate the barriers and influence the development of enterprises.

Research limitations/implications: The research is not representative, it is a preliminary, exploratory research. It is based on in-depth interviews with owners who have been in business for at least 15 years but represent micro and small companies. It is necessary to study a large sample of stonemasonry companies to have a representative sample. The research must also include medium-sized companies and those operating not only in the production of tombstones or building products (like stone mines). The determinants of their business may be different.

Practical implications: The research is of a practical nature and significance, as learning about the barriers to activity in the industry described is of importance to business owners and managers for decision-making and strategic processes.

Originality/value: The subject matter undertaken is new and has not been studied in detail before. The results of the research can be used by managers of stonemasonry companies and can clarify the internal conditions of the functioning of their companies, as well as future entrepreneurs looking to enter the industry.

Keywords: stonemasonry companies, barriers, SMEs sector, manufacturing companies.

Category of the paper: Research paper.

1. Introduction

Companies in the SMEs sector dominate the market space, thus constituting a pillar of the economy. “They represent about 90% of businesses and more than 50% of employment worldwide. Formal SMEs contribute up to 40% of national income (GDP) in emerging economies. These numbers are significantly higher when informal SMEs are included” (World Bank, Small and Medium Enterprises Finance, 2019). Small companies, due to their size, on the one hand can react more quickly to changes in the environment, but on the other hand these reactions require an appropriate level of resources, which they suffer from a shortage of SMEs sector influence on economic growth and development, while being under its influence (Woźniak, Duda, Gąsior, Bernat, 2019).

The company has limited ability to influence the external environment, its dynamics and complexity are challenging, in many sectors we talk about the idea of VUCA (volatile, uncertain, complex, ambiguous), which can only be dealt with the adequate resources and leadership. The constant process of change means a permanent need to search for methods of survival and development in the environment. This applies to essentially all companies operating on the market, although the level of volatility of the environment will determine the actions taken. Therefore the issue of the determinants of business development is at the center of interest for both academia and practice, as development in the broadest sense is the key to economic competitiveness. However, in every industry, companies face barriers to growth that, to varying degrees, force them to undertake or modify strategies that increase their resilience to the challenges of the environment.

In this paper, the focus is on companies in the manufacturing sector - stonemasonry companies. They belong to the vast majority of the SMEs sector and the nature of their activities has its own specificities. First of all, it should be emphasised that the activity has not been the focus of organisational management researchers to date, and the existing research is on geology and mining.

Poland is one of the European countries relatively rich in natural resources, with old mining traditions dating back to the Paleolithic times with silica, as well as salt, gold, silver, copper and iron ores (Kulczycka, Dziobek, Nowosielski, 2023). Looking back, stone was treated as a very luxurious material and the lack of technology and access to materials were the reasons for the high prices and low popularity of stone. The truncated possibilities did not allow the industry to develop and establish plants that would merit the term industrial. Polish stonemasonry companies are mostly located around natural stone deposits, mainly in the vicinity of Strzegom and Strzelin, a region called the "granite heart of Poland", but also near the Niemcza zone and the Karkonosze massif. In the The Lower Silesian, Świętokrzyskie and Carpathian there are sandstone mines, and other like limestone in Kielce and Kraków regions. But the dominating is granite. In the surrounding on mines are operating companies producing

elements for road construction, including paving slabs, curbs, wall stones and paving stones, remain an important segment of the stone market. Data available on the websites of the Central Statistical Office show that in 2022 the extraction of granites used for the production of building and road stones amounted to 1550 thousand tons, 90 thousand tons less than in 2021, but as much as 360 thousand tons more than before the pandemic, specifically in 2019. It is estimated that the road industry (cubes, curbs, bollards, paving slabs) uses 10 to 25% of granite mined in Poland for its production (Polish Stone Industry, 2024).

2. Barriers to companies' growth

Both in the literature and in the practitioners' studies, a significant role is attributed to the identification of factors influencing the growth and development of companies, while at the same time pointing out the barriers to this growth and development. Determinants, as well as barriers to growth, can be internal or external and depend on many factors, such as industry, company size, business profile, sector competitiveness, etc. Analysis methods can be used to examine both the external environment and internal potential. Research in this area can bring a great variety as well as subjectivity, but nevertheless many factors are common, especially for the SME sector.

Niedzielski (2016) based on research conducted in micro and small companies, identified external factors: macroeconomic stability, size of demand, level of fiscal liabilities, access to external sources of funding, cooperation with other companies, labor law liberalization, support from public institutions. Analysis conducted in SMEs in Romanian manufacturing companies showed that the highest need for improvement was seen by managers in the development of products and services as well as the cooperation with other companies (Tudor, Zaharie, Osoian, 2014).

International Business Report research conducted by Grant Thornton GT (2024), which inquired of medium and large companies in 32 of the world's most important economies about seven factors that may limit the growth of companies, in the case of Poland it identified strong or very strong barriers. It was labour costs (86% of companies indicated his constraint), energy prices (83%), economic uncertainty (71%), bureaucracy (56%), lack of skilled employees (51%), lack of orders (40%), access to finance (8%). Many studies emphasize the importance of access and deployment of resources, especially financial, as a condition for the competitive advantage (Eniola, Entebang, 2015). "Access to financing is essential for growth, productivity, and resilience" (Carvajal, Didier, 2024), therefore, it is a factor that, by virtue of its role, will be universal for the vast majority of SME companies, regardless of industry. Other research results pointed out political-legal, financial, human resources, education, employment costs, demand, cultural barriers (Dobrzynski et al., 2019).

Elhusseiny & Crispim (2022) analyzing barriers of Industry 4.0 adoption in SMEs listed 4 main groups: a) technical barriers (ICT infrastructure and lack of skilled staff), b) organizational barriers (lack of financial resources, lack of management support, resistance to change, and lack of R&D infrastructure, the fear of becoming unemployed, lower ability to react to demand changes, and fear of failure of I4.0 technologies), c) technological barriers (due to the lack of knowledge to use advanced services technologies and due to the complexity of maintenance or usage of the said applications), d) legal barriers (lack of collaboration and integration between managers and departments and privacy concerns).

Enterprises of the SME sector must in such a turbulent environment take adoption actions in advance, which can be accomplished by long-term perspective planning and clear vision (Ejedys, 2014). Related to this is also innovation, which is one of the key conditions for building a competitive advantage (Tu, Hwang, Wong, 2014), at the same time, however in SMEs their financial resources might be a key factor of their innovation – innovations require funds (Sipa, Gorzeń-Mitka, Skibiński, 2015). Eggers (2020) has identified in his research three business areas which are crucial for businesses in times of crisis: finance, strategy and strategic orientation and institutional environment. Appropriate actions taken in these areas are a precondition for functioning also beyond the time of crisis. Macroeconomic indications arising from government policy are also important. The low-tech SME's operating in countries with advanced digital technologies performance tend to exhibit higher profitability – country-level digitalization is critical resources for companies to achieve, develop, and sustain a competitive advantage (Cicchello et al., 2024). Sharma et al. (2024) identifies similar barriers – organizational, operational, strategic, and technological, focusing on the barriers encountered by SMEs during the COVID-19 pandemic.

Prasannath et al. (2024) analyzing government support policies conditioned development by implementing various direct (targeted) support policies, including financial (grants, credits, subsidies, incentives) and nonfinancial (technical and training, advisory, and trade-related) support initiatives, and via indirect (non-targeted) support policies to develop a conducive institutional environment and entrepreneurial ecosystem (regulatory framework, taxation, competition policy and institutional environment). Lack of that macro-economic support is an obstacle for development. Similarly, another report focusses on legal barriers related to legal acts of the governmental and self-governmental level, institutional barriers (analysis of conditions of organisational conditions and responsibilities), economic barriers (analysis of financing possibilities) and additional ones concerning various individual issues (analysis of potential social barriers) (Regionalne Biuro Gospodarki Przestrzennej Województwa Zachodniopomorskiego, 2017).

3. Methodology of the research in stonemasonry companies

The stone industry is quite diverse in terms of its business profile. It includes block stone mines (mining stone block that is processed into stone plates, but more often directly into curbs, paving slabs or other road or landscaping elements), stonemasonry (processing stone slabs for production; in this group one can identify those focused on the production and installation of tombstones and oriented to production and assembly for the needs of the construction industry), importers of stone in blocks and/or slabs and companies producing and delivering machinery, tools, accessories for all the industry.

For the aim of this paper, the author took into consideration and analyses companies – stonemasonry, classified in sector C of business economy, “Manufacturing”, “Manufacture of other non-metallic mineral products” – “Cutting, shaping and finishing stone” (code 23.7) (Nace Rev.2. 2008, p. 66).

On November 6, 2024, there were 5,981 registered enterprises engaged in the predominant business activity with the code 23.70.Z “Cutting, shaping and finishing of stone”. In terms of legal form, most of them are sole proprietorships - 83%, civil partnerships account for 9%, while limited liability companies account for 7%. Also registered were 39 general partnerships, 15 limited partnerships, 1 limited joint-stock partnership, 3 joint-stock companies and 3 cooperatives. The oldest registered establishment was established in 1967, while in terms of the number of entities, 1485 were established by 2000. Another 1432 were established by the end of 2009, while the remaining 3064 companies were registered from 2010 to November 2024 (the statement does not include changes in the form of business during the period under review) (Baza firm i osób decyzyjnych).

The growth of companies in virtually any sector depends on several determinants, and the stonemasonry company is no different. However, there is a major gap in the research, as the sector has not been of interest to researchers so far, especially in terms of barriers to growth. In order to fill this gap, a preliminary exploratory study was conducted. The method used was in-depth interviews with 8 owners of stonemasonry businesses, all who were in that business at least 15 years. The research was semi-structured, based on an interview scenario with topics to be discussed. The aim was to obtain the owners' views on the barriers they face in running their business. In addition, an expert in the industry, who has been involved in the industry for many years, was interviewed. The study was further based on desk research.

Fundamental level of ensuring competitiveness is macroeconomic (Seergev, Akhmetshina, Grabovyy, 2019), and because of the aim of this study, the focus will be on external barriers, that stonemasonry companies may face. The barriers mentioned in the interviews were grouped by the author into 4 areas: institutional, economic, managerial and organizational and market.

4. Significant constraints to growth and development of stonemasonry companies in Poland

4.1. Institutional barriers

The efficient operation of companies and their development, regardless of the sector, is always conditioned by the legal system in which they operate. It is difficult to point to specific political threats to the functioning of the industry, although general legislation on the functioning of the private business sector is cited as a barrier to growth. The taxation and other obligations of running a company are particularly relevant here. This article describes mainly SME companies, so they will be affected by the development conditions typical of this size of company, as described above.

As the object of stonemasonry is to process stone, which is a natural resource, its extraction and sale are subject to strict supervision.

The stonemasonry produces waste, primarily unused stone residue and sludge. However, their management has long been regulated by law. Other restrictions relate to protecting the worker from harmful working conditions - primarily exposure to noise, vibration and dust. Related to this is the obligation of regular testing and reporting, and businesses are subject to strict controls on environmental impact and measurement of harmful factors.

Institutional barriers also include issues related to education. A considerable concern and at the same time a potential obstacle to the long-term development of the industry is the lack of educational support. In 2019, a decision has been made to launch a "Technical secondary school for stonemasonry" in Strzegom-as a cooperative initiative of local authorities, Polish Masonry Association and Polish Aggregates Producers' Association. The school was to train professionals for stone and aggregate works and fill the gap in the lack of specialists for managerial positions, in the operation and programming of modern machinery or in controlling. Unfortunately, despite the efforts and expected high demand, the school was not launched due to a lack of applicants. Instead, at present an "Opencast mining technician" occupation was on offer, for which there are candidates. The question arises as to what the reason for young people's lack of interest in professional training as stonemasons is. Perhaps working in small companies, as opposed to open-cast mines, does not, in their opinion, offer prospects for development and prestige. Meanwhile, the perspective in terms of human resources is not optimistic for owners. As they said in interviews, the workforce is mainly middle-aged men, fewer and fewer young people are choosing to work in this profession, and at the same time the problem is the time required to train an employee - a relatively long one. This is because it is not only important to be familiar with the instructions of the machines, but it is the technique that is of a much higher significance. In addition, the working conditions themselves (noise, working in contact with water, moderate physical effort required, precision and accuracy required) also act as a disincentive to potential employees. It seems that stronger measures are

needed to encourage work in the stone industry. The author was unable to obtain information on average wages, but a good, experienced worker has no problems finding work. However, there are fewer and fewer of these in the market.

Another aspect is the seasonality of the work, which in smaller entities results in production being halted during the winter months, which can be a source of concern for the lack of stable employment. It should be added that seasonality depends primarily on the products and services on which the companies focus. In those that concentrate on the production of tombstones, it is the weather that determines whether the product can be installed, hence the shutdowns during the winter period. However, for companies that make building products, seasonality is not strongly felt and is often used for stockpiled production.

The conditions for development certainly include active and strong industry institutions supporting the development of the industry. In the case of the stone industry, the main one to highlight is Polish Masonry Association (Polski Związek Kamieniarstwa). According to the website statement, the goals focus on three areas: integrating the stonemasonry community and enabling business contacts (mainly through meetings, trainings and conferences), activities to popularize stonemasonry and stone, and education and qualification improvement (courses and exams in the stonemasonry and paving professions). The organization also strives to provide substantive support on legal and fiscal issues by organizing training courses, lectures and panel discussions. The association has been in existence for 20 years and has more than 150 members from all over the country - mainly stonemasons, but also manufacturers and traders of machinery and equipment in the industry. As you can read, “Stone industry is a fragmented craft, bringing together mainly micro and small enterprises. Networking is an important element in protecting the interests of the industry, but it also opens up development opportunities for members of the organization which are not available to individual entrepreneurs” (Polski Związek Kamieniarstwa, 2024). The relatively low interest in belonging to the organization is an obstacle to creating a strategy for the development of the entire industry, especially since it operates in Strzegom, manages Polish stonemasonry companies, and its board is made up of company owners.

4.2. Economic barriers

Economic determinants constitute a large group of factors affecting the achieved by companies and their competitive position. Many of these are due to the peculiarities of the industry described and the risks associated with them.

One of the primary barriers to the development of the stone industry is the lack of capital, especially for investment. Due to a very large increase in the price of electricity, on which the manufacturing process is based, profitability from the business has decreased significantly over the past few years. Many manufacturers are looking for alternative energy sources like photovoltaics, but unfortunately, they cannot count on rebates or other benefits, meanwhile these investments are very capital intensive. Also, other financial burdens related to labor costs

(the systematic increase in minimum labor and the overall cost of employment) and doing business are barriers to the development of companies and their investment capacity.

The market for stone masonry in areas where their activities are concentrated (mainly Lower Silesia) is highly competitive. In spatially small areas there are dozens of plants, which offer products made of Polish stones, but also imported from China or India.

Stone processing in most companies is not of a mass nature (except for large plants, which represent a minimal percentage and were not a subject of this research), it is more work on individual customer orders. The times when a few designs of finished products were offered are long gone, and today customers demand a wide range of products. In the case of tombstone production, however, where dimensions are more standardized according to size, customers expect an exhibition of finished products, they want to see the goods and often ultimately modify them. This requires a large capital outlay, which at the same time is frozen until the finished product is purchased from the display. In addition, as in any industry, stone products are also affected by fashion. Meeting customer expectations requires a modern technical infrastructure. Entrepreneurs who were interviewed emphasize that their machinery is sufficient, rather modern, which, however, required large capital investments. However, servicing the equipment is proving to be a problem. The most automated ones are usually manufactured abroad and require training to fully utilize their capacity, in addition, each breakdown requires professional service. This generates additional costs and downtime. As per the *Taxonomy of economic activities according to their average level of R&D Intensity* (calculated as the industry's business R&D expenditure divided by gross value added), manufacturing of other non-metallic mineral products is classified in medium level (below high and medium-high level), comparing to Eurostat Technology classification – medium low (Galindo-Rueda, Verger, 2016). Considering the lack of research in this area, it is difficult to say what the level of R&D expenditure is in companies operating in Poland, but from the interviews conducted it does not appear that small companies are investing in these areas.

Raising investment funds for business development purposes can be challenging for many. The seasonality of work affects the income levels of companies, which tend to be very low during the winter period, especially for companies focusing mainly on the production and installation of tombstones. Some companies choose to suspend operations altogether during this period, which in turn can result in the loss of employees. This problem does not arise in larger companies with a more extensive business focus.

4.3. Managerial and organizational barriers

One of the biggest barriers limiting growth is company management, which can be rooted in the distinctive nature of stonemasonry companies - they are small/micro and family-owned and have roots in craft production. They are typically characterized by linear structures, according to the interviews and observations conducted for this article. The overriding function is that of the founder-owner or partners (in the case of partnership) and the focus on

manufacturing is reflected in the lack of development and expansion of functional structures. The preparation and commissioning of production is centralized and, in micro-firms, usually carried out by the owners or employees appointed for this purpose. In the case of the latter, their positions are rather informal, and their function is derived from experience and knowledge of processes. In bigger (in that aspect small companies), their tasks are more formalized, although, citing an expert “If even a production director, sales manager or marketing director is established they do not really have any decision-making power. Still all decisions are taken by the boss” (Wawrzyńkiewicz 2017).

The functional positions, or rather their absence, are also identified as an obstacle to more dynamic development. Based on the already mentioned BNF report, there are only 277 of their registered websites in the database of 5981 registered entities. Of course, it should be emphasized that this does not mean that the remaining companies do not have such websites, but the lack of providing such contact details (or keeping them up to date) raises questions and may be subject to further analysis. However, based on the interviews conducted, it can be concluded that many entities are active on the web, have their own websites and even run social media, at the same time there is rarely a separate marketing or sales department in their structure. Consequently, marketing planning is a product of the owners, and one can rarely speak of professional strategies (In general, the subject of marketing activities, like the industry as a whole, is specific and should be subject to deeper analysis).

The centralised and hierarchical approach to management typical of micro companies, in the case of stonemasonry companies, is related to little formalisation and at the same time a rather flat structure. It is important to remember that working with stone requires a lot of experience, which is gained over time. Many companies in the industry were established in the 1990s and the owners themselves spent years gaining knowledge of processes, production organization, characteristics of stone. Mention for example the mere process of purchasing stone blocks used in production. Many of the founders of the companies still personally choose the block in the mine, guided by their experience, which cannot be acquired in a short time and in other than practical ways. This consciousness causes concern among owners, as well as contributing to succession problems.

The peculiarity of this industry lies not only in gaining technical skills in operating machines such as a circular, grinder or automatic polishing machine, but also in experience in working with natural stone. As the owners of these companies emphasised in interviews, each block and even slab is different. They have natural overgrowths which, if not handled correctly, can lead to inefficient use of the raw material. In addition, there is the issue of the quality of the components' workmanship. Skilled workers are becoming a valuable resource in this industry, and it takes time and commitment to train them properly.

Bearing in mind the above considerations, it becomes apparent that the management model applied in many companies, based on one-person management, will not support growth in the long term, but only the survival of the market. Many of the companies in the sector still focus

on the production of tombstones, while the industry offers many other opportunities. However, in order to recognize them it is necessary to think strategically, look for opportunities (such as participation in tenders for tasks contracted by the state and local administration), cooperate within the industry, etc. This, however, requires time, which entrepreneurs are lacking. One should also mention the elements of strategic management, considering mission, vision, strategic goals, and preparing a professional business plan for future investments. This requires expert consultancy support, which is also against the mentality of some entrepreneurs. After all, knowledge of raising funds from outside sources, such as European funds. Entrepreneurs could cover the gap in financial resources using various forms of investment lending, but for this you need knowledge and certification in raising such funds.

The importance of an organisational structure that is adequately designed yet ensures efficient management is crucial. Each company must adapt it to its operating conditions, size, profile, resources, etc. This is one of the main conditions for further development.

4.4. Market barriers

The stone companies that are the subject of this work operate in the field of natural stone processing. Few design and manufacture tombstones and monuments (offering installation as well) and complementary stone accessories (lanterns, vases). In addition, they offer interior building elements: windowsills, stairs, floors, countertops, columns, balusters, fireplaces, as well as exteriors: cladding, fences, terraces, fountains, etc. A large part is profiled for construction, i.e. the production of granite blocks, road kerbs and fences. As recalled by the owners of companies operating in the market since the 1990s, the early days were definitely in the tombstone business, while today focusing only on this segment is not enough. The number of traditional burials is declining; admittedly, no official statistics are kept in this area, but estimates say that in 2022, 40% were cremations (Polska Agencja Prasowa, 2024). An upward trend is predicted, and such a change will have a direct impact on the development strategies of stone companies. First of all, they will have to conduct intensive marketing activities to attract customers, and secondly, they must offer a wide and deep assortment. This applies both to the types of stone and the inclusion of imported stones, as well as to the original design of products, tailored to the needs and capabilities of the customer. One should not forget about the premium segment customer, interested in material of the highest quality, but also originality, usually exotic stones for more luxurious interiors. Such customers are more demanding not only in terms of product but also service and display. The development of the industry must move toward satisfying the needs of different customer groups, which necessitates intensive marketing and distribution activities, both traditional and omnichannel.

Stone substitutes, or rather, materials that are so postured by customers, are also another market barrier. We are talking about artificial stones, conglomerates, ceramics, which are, mainly because of their affordable price, often chosen as an alternative to stone, mainly in interior design.

Eventually, export as a vital driver for survival and grow (Bertrand, Betschinger, Brea-Solis, 2022) should also be considered, because the potential of resources enables polish producers to sell ready products abroad. Now, the scale of exports is not high, which also requires further analysis and the search for effective internationalization strategies.

It is worth mentioning one more barrier of a market nature but concerning stonemasonry on the customer side. As already mentioned, Poland has own natural stone resources, but to ensure a wide assortment and diversified offer, stone from abroad is imported. This gives the opportunity to offer unique goods and gain a competitive advantage, but imports, however, are capital-intensive and burden Polish producers with additional risks (currency fluctuations, long waiting periods and uncertainty about the quality of stone, delivery costs and other customs barriers. In 2022, Polish stonemasons imported just over 442,000 tons of natural stone into the country (raw or pre-processed blocks and stone slabs, paving stones and curbs, processed building stone elements). This is 36.5 thousand. tons more than in 2021. This is probably the third best result in the last decade. The best year so far was 2015, when about 623,000 tons were imported. Looking at the import directions of this stone, it depends on the product, but in general three countries dominate: India, China, South Africa (Polish Stone Industry, 2024).

5. Discussion

The development of companies may require a change in the approach to the management of stone companies. The overwhelming majority of them belong to the small and medium-sized business sector, which is reflected in their organizational structures. Moreover, family businesses predominate, and this also determines the way decisions are taken. The author recognizes the need to carry out representative research that would allow the management processes undertaken to be described in depth. This would make it possible to analyze and propose optimal business models, adapted to the specifics of the industry and its conditions.

Another condition is a change in the mentality of the owners themselves, who must understand the need to share power and focus on development activities - mainly of a strategic type. Any company pursuing development must look towards opportunities in the environment and respond to them flexibly. Meanwhile, the focus on coordinating the current daily production processes, planning and allocating tasks, controlling, purchasing raw materials, dealing with human resources and administration, and customer service - the regular tasks of many stonemasonry company owners - do not allow sufficient latitude for strategic thinking. A change in thinking and the delegation of some tasks to established functional positions seems necessary. There comes a stage in the life cycle of every organisation when it is necessary to expand the organisational structure and involve experts in management, sales or marketing. Here, there is also the issue of succession, which is important for many family businesses -

a problem that many entrepreneurs point out. In the case of stonemasonry, this is a big problem, because younger members of the founders' families are not eager to take over the business. This problem needs special study. Anyway, managers must focus on changing the mindset, opinion and activities to maximal use of the potential of their enterprises Strakova (2017).

A prerequisite for the further development of companies is the provision of adequate human resources not only at the higher levels mentioned, but also at the lower - executive - levels. Young people are not massively interested in working in masonry, perceiving it as hard and demanding. Training an employee, meanwhile, takes a lot of time and dedication, and entrepreneurs complain about fluctuation - the employee, having acquired the skills, looks for a better-paid job and often leaves the employer 'overnight', easily finding employment with a competitor. This causes tension and conflict in an already highly competitive environment. Simultaneously, employers do not sufficiently protect themselves against this phenomenon by signing properly constituted employment contracts.

Business cooperation and networking seems to be a way to reduce many problems and strengthen the role of stonemasonry companies in the Polish industrial sector. Unfortunately, at the moment companies are not convinced by the idea of association, not seeing the benefits of sectoral cooperation, despite the existence of prerequisites and opportunities for clustering. The reason for this may be the high level of competitiveness in spatially limited areas, but also, and perhaps above all, the lack of knowledge regarding the benefits of clustering. Institutional support from state institutes and policymakers in developing support system providing consultancy services and fostering networks, collaborations among SMEs is vital. Small companies usually have too little potential to conduct research and development activities independently, so collaboration may be a chance for the joint use of the competing companies' resources (Daniluk, Tomaszuk, 2016). These alignments help to share knowledge, resources and practices that create synergies in response to market challenges (Matloob et al., 2025).

Stone processing is a specific industry in many respects, because on the one hand the material used is expensive, much more expensive than its non-material substitutes, and on the other hand each order is individual. The material is a natural, unique raw material which is both a disadvantage and an advantage. There are customers for whom natural overgrowth, color changes or porosity of the stone is its advantage, for others quite the opposite. Conflicts may arise in this background between the manufacturer and the customer. That is why the support of industry associations is so important. Mass promotion of stone and its unique properties as a natural material could increase the interest of stone in the interior finishing, decorative goods or broader construction industry.

Cooperation of manufacturers and strong industry institutions should strive to promote stone and its unique qualities. Still not enough companies run professional showrooms, offer comprehensive consulting services or cooperate with interior designers. The development is conditioned by the emphasis on professional marketing activities, creating strategies for different groups of customers. Stone is timeless, but the activities of companies processing it

must be flexible and adapted to the changing needs and expectations of stakeholders, including, above all, customers.

The limitation of the presented results is, above all, the very small group of entrepreneurs surveyed, but the research was exploratory in nature, providing a basis for research on a representative sample. The surveyed entrepreneurs represented micro and small companies, which is another weak point, but at the same time an intentional move on the part of the author, whose aim was to subject to analysis the companies dominating in this sector. Nevertheless, in medium-sized companies the listed barriers may be of a different nature or intensity, and others may also appear. This aspect also requires in-depth analysis. In addition, the owners surveyed were mainly involved in processing stone for tombstones and building purposes, while mines and companies specialising in other segments should also be surveyed.

6. Summary

Identifying barriers to development is the first step in identifying factors that create preferences for development in this industry, which can bring economic, social and even technological benefits.

The general market situation in the industry described in this article should provide a developmental trigger for owners and managers, especially in the direction of modifying the management model. However, this requires further research, which will be directed towards determining development strategies.

The importance of strong and stably growing stone companies is important, because although their numbers are relatively small compared to many other manufacturing activities, they have potential. Companies in this industry face many challenges and barriers, but the right management can influence the leveling off many of them. At the same time, some of the external conditions mentioned in this work require only an adaptation strategy, but observation of foreign competition gives hope not only for their survival, but also for stable development.

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SPATIAL ASSOCIATIONS IN THE SCOPE OF INVESTMENT ACTIVITY OF MUNICIPALITIES IN POLAND

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Purpose: The aim of the article is to identify spatial correlation concerning the involvement of municipalities in investment activity in Poland.

Design/methodology/approach: The subject literature was studied to show the specificity of the investment activity of local governments and various factors influencing the capital expenditures of these units. Then, using the data for the period 2019-2023 for the population of municipalities in Poland, the spatial autocorrelation statistics were calculated and visualized to identify the spatial associations, i.e. spatial clusters and outliers.

Findings: The paper shows that there are significant spatial associations between municipalities in Poland in the field of investment activity, i.e. a tendency toward positive clustering of similar values of the share of investment expenditures in total expenditures. This tendency increased during the period of increased investment activity of municipalities. At the same time, there were also outliers, mainly of the 'black sheep' type, i.e. units with the low values of the analysed ratio, surrounded by the municipalities with the high values of the indicator studied.

Research limitations/implications: The paper presents the character of spatial associations in the field of the share of investment expenditures in the total expenditures in the municipalities in Poland, which contributes to the selection of the variables examining the investment activity at the sub-national level.

Practical implications: The research study is aimed at examining the significance and types of the spatial associations in the field of investment activity of the local governments. This may contribute to the selection of variables for the model explaining the capital spending of these units.

Social implications: The survey contributes to the higher recognition of the spatial relationships in the field of investment activity, e.g., in the process of creating local and regional strategies or regulations concerning joint implementation of tasks.

Originality/value: The research study identifies significance and types of spatial associations related to the investment activity of municipalities in Poland. There is a dearth of surveys showing the scope of spatial relations in the geographical space.

Keywords: municipality, investments, Moran Index, spatial autocorrelation.

Category of the paper: Research paper.

1. Introduction

Investments or capital expenditures of local government are important for multiple reasons. They aim to develop infrastructure for local social sustainability, quality of life, the need to expand infrastructure to support economic growth and welfare of the local community (Rivenbark et al., 2018, p. 402). As a part of public investments, they stimulate the economic activity through short-term effects on the aggregate demand, and raise the productivity of existing private, physical and human capital. Moreover, they encourage a new private investment to take advantage of the higher productivity (Miyamoto et al., 2020, p. 15). Their effects might be determined by the source of financing (Olejnik, 2024, p. 15). However, the specificity of local government investments is their ongoing nature, which is why the expenditures for their implementation systematically appear in the public budget. As a consequence of economic development, local governments are required to provide new services or develop new areas for industrial activities or housing, which determine the need for capital spending (Galiński, 2011, p. 62).

The investment activity of municipalities may be determined by various circumstances related to the local budget condition, the situation of the public finance sector, socio-economic conditions or political issues. However, these factors do not take into account spatial interactions and the complexity of processes in the economy. Moreover, many standard statistical methods may be inappropriate to identify certain associations in geographic space (Comber, Brunson, 2021, p. 3). Thus, there is a dearth of the studies examining the possibility of the existence of the spatial relationship between municipalities in terms of the role of the capital spending. These ties are visible in the area of the financial liquidity (Galiński, 2023a, p. 148), or the debt (Galiński, 2023b, p. 127). Therefore, it is crucial to detect the spatial associations to investigate their nature and specificity. Taking into consideration these issues the aim of the article is to identify spatial correlation concerning the involvement of municipalities in investment activity in Poland. These local public units operate in a specific institutional environment and can therefore influence each other. Thus, the research hypothesis of the study is that there are significant spatial associations between municipalities in Poland in the field of investment activity.

2. Literature review

The concept of 'investment' is widely described in the economic literature. Investment is most often understood as an outlay of money intended to generate income or the process by which monetary resources are converted into other assets. Many definitions of investments

emphasize primarily the desire to obtain specific cash flows as a result of the implementation of specific economic projects. However, the issue of functioning of local governments as public units requires adapting the investment concept to the specific nature of their activities and the scope of public tasks performed. This results from the purpose of local government investments, which should primarily meet the needs of the local or regional community, and not only seek to achieve financial benefits (Galiński, 2011, p. 61).

In local government, 'investment' is identified with 'capital expenditure', where the incurred spending brings benefits spread over many years (Jacobs, 2008, p. 4). In a broad sense, the capital spending or the investment spending is any outlay focused on long-term benefits (Staff Paper, 1998). According to this definition, local authorities can possess physical assets for local government use (e.g., office buildings), physical assets to support private sector development (e.g., roads, water systems), and intangible assets (e.g., education, research) (Jacobs, 2008, p. 4). Capital assets are particularly important because of their support for the delivery of public services and economic growth (Lewis, Oosterman, 2011, p. 149). In this context, certain types of investments might be distinguished, i.e.: (a) replacement investments – related to the reconstruction of used fixed assets; (b) modernization investments – aimed at improving the current technical and economic parameters by rebuilding fixed assets; (c) development investments – related to the creation of new production or service equipment (Sierak, 2014, p. 97).

The capital spending of local government is an integral portion of the public investment activity, which is determined by the miscellaneous factors, e.g.: the level of unemployment, the level of corporate investment, the share of agriculture in GDP, the government efficiency or the political cycle (Chmura, 2023, p. 363). The investment activity of local governments is, in turn, affected by financial constraints resulting from the shortage of funds in relation to the imposed tasks, the need to comply with fiscal rules, limited availability of financial instruments or little interest of private partners in certain types of investments (e.g. implemented in the public-private partnership formula) (Filipiak, Dylewski, 2015, p. 870). This activity is also affected by the socio-economic, legal, political, administrative, technical, geographical, historical and cultural factors (Zawora, 2020, p. 155). Interest rates are also taken into account in the investment process when the debt finances that activity but may not be a primary factor in capital expenditure decisions (Page-Hoongrajok, 2021, p. 203).

In turn, Ryu et al. (2022, pp. 347-349) argue that from managerial and political perspectives, the main factors influencing capital spending decisions (investments) are resource availability and political dynamics. In the latter case, partisan theory suggests that local politicians pursue or behave as if they were pursuing specific ideological goals through the party. In turn, the political budget cycle theory suggests that incumbents (opportunistic policymakers) use capital spending to increase their chances of re-election (Veiga et al., 2017).

Thus, capital expenditures of local governments are affected by two main factors, i.e. (Galiński, 2011, p. 65): (a) external factors, resulting primarily from the financial system in the field of revenues, legally defined public tasks, and the general economic, social, financial, institutional (e.g. fiscal rules) and political situation in the country and in the world; (b) internal factors, as a consequence of the financial, socio-economic, political (Wang, Wu, 2018, pp. 79-80), asset situation of local government unit and its area, e.g. trends and modifications in the industrial and commercial structure of the commune, the rate of wear and tear of existing assets and the need to replace them or changes in the demand for the new infrastructure (Pagano, 2002, p. 2).

The presented classification of factors influencing the investment activity of municipalities shows that the scholars do not take into account spatial associations between the units studied. However, according to the Waldo Tobler's First Law of Geography everything is related to everything else, but near things are more associated than distance things (Anselin, Li, 2020, p. 494). This is therefore the foundation of the fundamental concept of spatial dependence. In addition, the Second Law of Geography indicates that the phenomenon external to an area of interest affects what goes on inside in the unit (Yan, 2019, p. 6). Miller (2004, p. 284) claims that spatial association does not necessarily imply causation. Two related things may create a causal relationship, or there may be other hidden variables causing the relationship. He adds that although correlation is not causation, it provides evidence for causation that might be evaluated in the context of theory, or specifics of the system, in which the units operate. These links may therefore result from similar structures of revenues and expenditures resulting from demographic or geographic composition. The municipalities may perform their tasks together (e.g. investment projects) or may apply similar tax rates. The latter case refers to the concept of tax competition, which describes a situation in which the tax policy in a commune is determined by the policy pursued in neighbouring communes (Felis, Rosłaniec, 2019, p. 51). In addition, the similarity in the level of investment outlays may result from the availability of external resources, including EU funds, which in Poland are also managed at the regional (voivodeship) level. Moreover, the development strategy of the municipality should be consistent with the development strategy of the voivodeship (Article 10e para. 2, Act of 8 March 1990 on Gmina Local Government), which determines the investment policy.

3. Methodology and Data

Spatial associations between municipalities (the basic units of local government in the administrative division in Poland) in the field of the share of investment expenditures in total expenditures of municipalities in Poland are identified using the Moran's Index (I). This measure is separately calculated for each year between 2019-2023, using the data provided

by the Central Statistical Office (CSO) as part of the Local Data Bank for the population of all 2411 municipalities and 66 cities with county status in Poland.

The Moran's I statistic of spatial autocorrelation takes the form (Dubé, Legros, 2014, p. 68):

$$\text{Moran's } I = \frac{N \sum_{i=1}^N \sum_{j=1}^N w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^N \sum_{j=1}^N w_{ij} \sum_{i=1}^N (y_i - \bar{y})^2}, \quad (1)$$

where:

N represents the total number of observations (municipalities in this research study),

y_i is the observation in the municipality i ,

\bar{y} denotes the mean of all the observation units,

w_{ij} stands for the matrix of binary spatial weights or the strength of interactions between observations i and j ($w_{ij} = 1$ if they share a common border, or 0 otherwise, and it is the sum of all the observations) (Gao, 2022, p. 100).

In the study, the Moran's I was calculated based on a spatial weight matrix by the queen contiguity (order contiguity = 1) (Li, 2022, p. 284). The Moran's I is interpreted based on the expected value, a pseudo p -value, and a z -score under the null hypothesis of no spatial autocorrelation (Grekousis, 2020, p. 223). Since the Moran's I statistic is a measure of spatial autocorrelation, the expected value, in large samples, vary between -1 and +1, testing its significance. However, the index higher than 0.3 or lower than -0.3 is an indication of relatively strong positive or negative autocorrelation (Grekousis, 2020, pp. 211-215). Thus, this index shows the relationships of the analysed investment activity in the local government with the value of the phenomenon in neighbouring units, taking into account the significant due to the level of the p -value (Galiński, 2023c, p. 597).

The article also presents the local indicators of spatial autocorrelation (or association), which refer to the acronym LISA (I_i), and are calculated as follows (Grekousis, 2020, pp. 222-223):

$$I_i = \frac{(y_i - \bar{y}) \sum_{i=1}^N w_{ij} (y_j - \bar{y})}{\frac{\sum_{i=1}^N (y_i - \bar{y})^2}{N}}. \quad (2)$$

As a result, I_i provides a measure of the spatial association of each unit (municipality) within the larger study region (neighbouring units) (Burt, Barber, Rigby, 2009, p. 560).

The outcomes of the calculation of this measure are visualised on the LISA cluster map, within which there are presented four types of spatial relations, i.e. (Galiński, 2023c, p. 598; Wang, 2011, p. 183; Dubé, Legros, pp. 84-85):

- 'high-high' - high values surrounded by neighbours of similar high values ('hot spots'),
- 'low-low' - low values surrounded by neighbours of similar low values ('cold spots'),
- 'low-high' - low values surrounded by the high values ('black sheeps'),
- 'high-low' - high values surrounded by the low values ('diamonds in the rough'),
- 'not significant' - areas that are not significant at significance level of 0.05.

The appearance of ‘black sheeps’ and ‘diamonds in the rough’ indicates the presence of outliers in geographical space (Mohanty et al., 2019, p. 472).

4. Results and Discussion

The investment activity is a crucial sphere of functioning of municipalities in the context of economic development. In Poland, the average share of investment expenditures in total expenditures ranged from 14% to 18% in 2019-2022, and in 2023 it increased to almost 28% (figure 1). In 2020, despite the Covid-19 pandemic, these activities were not significantly disrupted. However, the rapid increase in the analysed ratio resulted in the continuation of the relaxation of fiscal rules concerning local debt in order to ensure that local government units can make maximum use of their investment opportunities. In addition, it was caused by the availability of the additional central funds for investment purposes at the local level in Poland (CM, 2024, pp. 8-9).

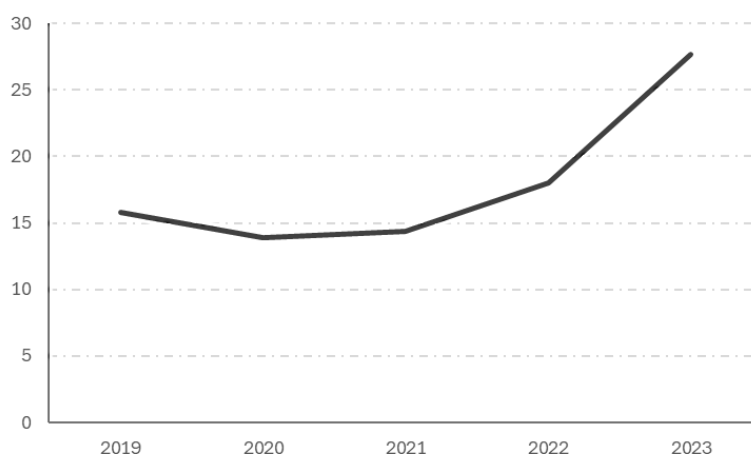


Figure 1. Average the share of investment expenditures in total expenditures (%) for municipalities in Poland in 2019-2023.

Source: own elaboration based on BDL GUS (2024).

Table 1.

Moran's I and the spatial associations for the investment activity in the municipalities in Poland in 2019-2023

Year	2019	2020	2021	2022	2023
Moran's <i>I</i>	0.1208	0.0851	0.0829	0.0680	0.1655
<i>p</i> -value	0.0010	0.0010	0.0010	0.0010	0.0010
Spatial relations - no. of the municipalities					
high-high	108	96	99	99	183
low-low	161	134	114	97	172
low-high	83	65	73	71	75
high-low	53	60	48	58	59
not significant	2 072	2 122	2 143	2 152	1 988

Source own elaboration.

As far as the spatial associations in the field of the share of investment expenditures in total expenditures are concerned, there were positive associations throughout the 2019-2023 period (table 1). Therefore, it reflects tendency toward positive clustering of similar values, i.e. ‘high-high’ or ‘low-low’. So, in Poland in the years 2019-2023 the neighbouring municipalities have similar values in the field of the share of investment expenditures in total expenditures. However, Moran's I values ranging from 0.0680 (2022) to 0.1655 (2023) (table 1) indicate very weak global spatial autocorrelations in each year, which indicate low spatial dependencies. It is worth noting that the highest value of this index occurred in the year characterized by the highest share of investment activity, i.e. in 2023. It shows that increased investment activity of the municipalities in 2023 has resulted in greater spatial dependencies in this year.

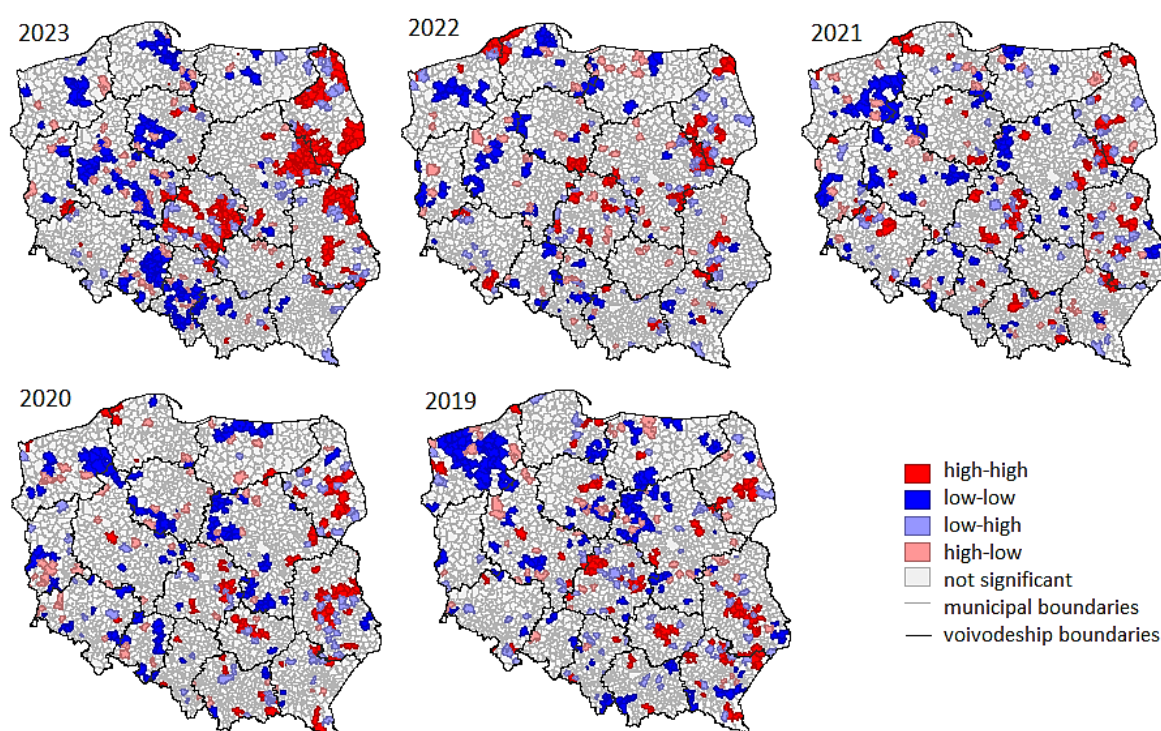


Figure 2. LISA cluster maps for the investment activity in the municipalities in Poland in 2019-2023.

Source: own elaboration.

As can be seen from the LISA cluster maps for investment activity (figure 2), there is no consistent pattern in the distribution of spatial relations in the years 2019–2023. In terms of significant spatial associations, the ‘low-low’ relationship dominated in each of the years 2019-2021. Thus, from 114 (2021) to 161 (2019), a low value of this indicator was associated with a low value in the neighbours. In turn, in 2022 and 2023, the ‘high-high’ type of the relationship prevailed. It means that in the above cases, i.e. both ‘low-low’ and ‘high-high’, local authorities were to some extent guided by their investment activity based on their neighbours. According to the findings of Zimny (2008, pp. 118-119) joint investment projects with other municipalities as part of an inter-municipal association/agreement are undertaken much more often by

municipalities characterised by a low degree of financial independence than by municipalities with a high degree of independence. The joint investment activity is also determined by the investment propensity, measured by the share of investment expenditures in the total expenditures or investment expenditures per capita (Zimny, 2008, p. 46). Therefore, the similarity in terms of investment involvement may result from the revenue structure of individual local governments or investment needs. However, implementation of infrastructure tasks by more than one municipality creates benefits in the form of opportunities for more effective cooperation. Nevertheless, there are also certain risks of this form of functioning, i.e. blurring of competences, inadequate preparation of these entities to apply for external funds or even disputes regarding the achievement of benefits by individual members of certain agreement (NIK, 2021, p. 6).

In each year, the group of spatial outliers was dominated by 'black sheeps', i.e. municipalities with a low share of investment expenditures in total expenditures surrounded by units with increased investment activity.

The findings also show that there is no common spatial pattern of behaviour in investment activity in Poland or in the voivodeship (the highest-level administrative division) that has been maintained for many years. In 2023, the 'high-high' spatial associations were located mainly in the eastern and central parts of the country, while the majority of the 'low-low' cases were located in the western part of the country. In many cases the cluster boundaries were consistent with the voivodeship boundaries (figure 2). It can therefore be seen those certain characteristics of the voivodeships determined the spatial relationships in the field of investment activity.

5. Conclusions

The investment activity of local government is determined by various factors related to the economy, finance, demographics and politics. Therefore, scholars try to include these determinants in their surveys. However, most studies omit the existence of specific spatial associations or do not take into account factors that shape these relationships. This concerns aspects of linking the spheres of revenues or expenditures of the budgets of individual units, as a result of joint implementation of tasks (local infrastructure management and development) or imitation in the sphere of shaping tax policy (e.g. similar tax rates). In addition, units can operate in a specific area, which determines their development strategy and financial potential. Municipalities with strong budget management capabilities can achieve high level of investment outlays as an indicator of budget efficiency, which translates into better functioning of local government administration (Sutopo, Siddi, 2018, p. 229). Investment outlays may positively affect local governments' performance (Zamzami, Rakhman, 2023, p. 333).

The article reveals that there are significant spatial associations between municipalities in Poland in the field of investment activity, i.e. in the share of investment expenditures in the total expenditures. Thus, the research hypothesis was positively verified. Throughout the entire analysed period, there were significant positive spatial associations, i.e. a tendency toward positive clustering of similar values of the examined ratio. This tendency increased during the period of increased investment activity of municipalities, which contributes to the spatial clustering. Hence, the municipalities imitate their investment policy to some extent. In turn, there were spatial outliers. This group was dominated by municipalities with a low share of investment expenditures in total expenditures, surrounded by units with a high level of this ratio. This indicates that there is room for searching for specific factors influencing studied spatial associations to strengthen the investment potential of municipalities.

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EVALUATION OF SELECTED ASPECTS OF EDMS IMPLEMENTATION IN HOSPITAL

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Purpose: The aim of the article is to assess selected aspects of the implementation of an electronic document management system, which is based on the presented case study. Concerning a review of the literature, key success factors in this area that were identified and analyzed based on a selected implementation project.

Design/methodology/approach: The research was conducted by using a case study combined with the use of direct observation by the co-author of the article. The selection of a clinical hospital in the discussed scope allows for the formulation of appropriate final conclusions.

Findings: The analysis of the case study allows for the formulation of conclusions regarding implementation projects in the field of electronic document management system in healthcare units.

Research limitations/implications: Using a case study of one hospital confirms a limitation in the complete generalization of the final conclusions.

Originality/value: The article indicates important aspects of conducting research in the field of management of IT project implementations in healthcare units. For practitioners associated with the healthcare sector, the article can be a reference point in searching for inspiration and good practices in the discussed research area.

Keywords: electronic document management system; hospital, change management, project management.

Category of the paper: Case study.

1. Introduction

The issue of implementing innovative solutions in the health care sector has been playing an important role for many years (Głód, Głód, 2014). Technological and IT technologies play a crucial role in this area. The healthcare sector is a knowledge-based industry, therefore its computerization should bring new opportunities (new quality) in the medical and organizational fields. Unfortunately, it is not satisfactory either in terms of the pace of its implementation or because of the results achieved. This may be the result of unstructured and chaotic computerization processes by individual medical entities (Pawłowska, 2015).

What seemed to be an innovative solution a few years ago (Strzelecka, 2015) is now becoming a standard and a necessity in increasing efficiency in everyday work. In addition, the experience of the pandemic situation and the need to use remote work have strengthened trends in this area (Almacen, Cababaluna, 2021; Rogalska, Syrkiewicz-Świtała, 2021). In this context, the implementation of electronic document circulation is a challenge for many healthcare entities in Poland (Tynda, 2008), and the search for key success factors of this type of projects that would be a significant research challenge (Fontainha, Martins, Vasconcelos).

2. Implementation of the Electronic Document Management System (EDMS)

The implementation of the EDMS system in the computerization process consists of an internal organizational change. This system is a completely new tool that is designed to improve the performance of office activities, including the collection, storage, sharing and archiving of documents in electronic form. The entire process of computerization consists in the introduction of modern tools and methods of conduct in the entity, both in contacts inside and outside the administration, which is why the proper implementation of the EDMS system, which is important in this process (Adamus-Kowalska, 2018).

The internal area of organizational change during the implementation of EDMS, in the process of computerization of public administration, should include: – implementation of ICT tools of the EDMS system, – elimination of paper documents within the organization, – appointment of a coordinator of office activities and granting him appropriate authorizations in the EDMS system, – change of internal regulations governing the manner of conducting cases, – training and introduction of employees to work in the EDMS system, – continuous improvement and motivation of employees to work in the EDMS system.

The external area of organizational change during the implementation of EDMS, in the process of computerization, should include: – communication with external entities via electronic channels of information flow – digitization of public services through the wider use of dedicated systems to handle specific tasks performed by the administration, – elimination of paper documents sent externally, – creation and use of modern applications for communication with public administration, in particular on mobile devices, – constant monitoring of the level of use of electronic tools for communication and periodic assessment of the entity in terms of the level of computerization (Adamus-Kowalska, 2018, pp. 161-162).

Electronic Document Management System (EDMS), as defined in the Regulation of the Prime Minister of 18 January 2011, is an ICT system for electronic documentation management enabling the performance of office activities, documenting the course of handling cases and collecting and creating electronic documents.

The main purpose of the EDMS system is to make it possible to perform work that previously was required a longer and more expensive paper route, with the use of computer equipment that facilitates operation and shortens working time (Hic, Nowakowski, 2017, p. 27). The Electronic Document Management System is often analysed in the context of processing a specific type of documents, for example accounting documents (Kotyła, 2021), and in the context of a specific type of organisation, including healthcare entities of interest in this article (Sánchez, Savin, Vasileva, 2005).

In this context, it is important to identify the key success factors for the implementation of EDMS systems (Ziemba, Papaj, Descours, 2022). Alshibly, Chiong and Bao categorized this in this regard (Table 1).

Table 1.
Categorization of CSFs for EDMS implementation

Factor groupings CSFs	Factor groupings CSFs
Technological readiness	Architecture readiness. Infrastructure readiness. Process readiness
Top management support	Top management, leadership, and commitment toward EDMS. Top management encouragement toward utilization of EDMS. Clear mission developed regarding business objectives. Top management encouragement toward formal/informal. Communication. Gaining commitment and support of chief executive officers. Planning and project management
Training and involvement	Providing the employees with adequate information of EDMS related principles through training. Adequate training and support for users. Employees are trained on EDMS job-specific skills. Involving EDMS end users. Management always updating their knowledge. Involving all levels within the organization and external stakeholders. Actively encourage employee participation in EDMS-related decisions

Cont. table 1.

Resource availability	Prior existence/development of necessary infrastructures. Sufficient financial resources provided to support EDMS implementation. Human resource availability. Technical resources (e.g., software, equipment) are provided. Requirement-driven procurement planning
System-related factors	EDMS functionality. Effectiveness of EDMS. Efficiency of EDMS. User friendliness of EDMS. Usability and understandability of output Integrating systems and technology. Demonstrating benefits. Piloting and testing
Work environment and culture	Policies and guidelines. Communication. Aligning projects with business objectives. Ensuring a project has a clear agenda. Change management. Sharing expertise. A spirit of cooperation and teamwork. Supporting team-based approaches to problem solving

Source: Alshibly, Chiong, Bao, 2016, p. 293.

An important issue in this regard is certainly the appropriate preparation of staff for the implementation of this type of solutions (Jensen, 2009). It is the attitude of employees that largely determines the success or failure of the process of implementing an electronic document management system (Bobowska, 2021, p. 28).

Thanks to the implementation of electronic documentation management tools, a healthcare entity may achieve measurable benefits. The advantages of implementing this type of systems are as follows:

- remote access to public services using the Internet,
- reduction of service costs,
- increasing the availability of the entity,
- automation and acceleration of document workflow,
- the ability to manage workflows,
- monitoring of work (Raczko, 2017, pp. 41-42).

The table below presents examples of the benefits of implementing EDMS.

Table 2.
Benefits of EDMS

Benefit	Effect level	Type of benefit
Centralized storage of information	Individual user	Intangible
Improved document search	Individual user / Organization	
Better quality		
More efficient business processes		
Improved staff morale and team working		
Compliance with laws and regulations	Organization	Tangible
Transparent organizational processes	Society	
Accessible historical records	Organization	
Cost savings		
Saving floor space from document storing		
Improved productivity and competitive advantages	Organization	Tangible / Intangible

Source: Kuosmanen, 2019, p. 18.

The benefits presented may concern the level of the individual user, the organization and the society as a whole. They can be both tangible and intangible.

3. Research Method

The analyses were based on a case study on preparations for the implementation of the EDMS system in a healthcare entity. The selection of the organization due to its size, wide range of services provided and specific development, seems inspiring and correct for the possible formulation of conclusions that may also be at least partially applicable to other entities of the health care sector.

The hospital on the basis of which the assessment of selected aspects of EDMS implementation in health care was carried out is a university unit. The hospital is located in a pavilion building, where there are wards in individual buildings and laboratories as well as administration. This type of development is characteristic of hospitals from the 19th and 20th centuries, as well as when they were designed from the beginning when infectious diseases appeared. The key features and advantages of pavilion hospitals are the isolation of wards. Thanks to separate buildings, isolation between wards can be distinguished, which is particularly important in infectious diseases. Separate pavilions limit contact between patients, but also cause difficult contact between employees. The circulation of documents in a unit located in a pavilion should be organized in a way that ensures efficiency, security and transparency of processes. The hospital has 16 departments in two locations and is perceived as a comprehensive health unit in the treatment of children and adults in the field of lung diseases, neurology, internal medicine and nephrology. Each department specializes in a different area of treatment, which allows for a wide range of medical services. It employs 1024 employees, including doctors, nurses, laboratory diagnosticians, psychologists, administration and technical staff. The employees working in the system on a daily basis will mainly be the broadly understood administration, i.e. about 100 people, because it is a system for electronic management of documentation such as correspondence and financial documents, e.g. invoices. Doctors and nurses mainly use the medical information system in the field of patient treatment. On the other hand, all documents requiring the approval of the management board, i.e. consent to the tests, will take place within the EDMS system. To a large extent, the task of the system is to provide team communication in order to gain access to information.

The use of the case study aims to present and at the same time evaluate selected aspects of EDMS implementation. The analysis concerns the pre-implementation period from the second and third quarters of 2024, and the planned implementation period is to be 8 months.

The implementation of Electronic Document Management System (EDMS) in a hospital is a process that requires preparation, analysis and coordination of many technical and organizational elements. EDMS helps to organize document workflow, archiving, automation and streamline administrative processes, which increases the efficiency and availability of data. An important issue is the fact that the government administration is preparing to be included in the e-delivery system and will be obliged to do so by January 1, 2025. Local government units and their associations, metropolitan associations and local government budgetary establishments will be determined to apply the provisions of the Act with regard to the delivery of correspondence using the public registered electronic delivery service no later than from 1 January 2025, and with regard to the delivery of correspondence using the public hybrid service from 1 October 2029. At the same time, in accordance with the bill amending certain acts in connection with the development of e-administration, the provisions of the Act on the National Archival Resource and Archives will be modified.

4. Analysis of pre-implementation activities of the EDMS system

Before the introduction of the Electronic Document Management System (EDMS) system in a medical entity, several key actions had to be taken to ensure the smooth implementation and functioning of this system. The first step was to conduct a review of the organization's resources, documentation, and processes. An analysis of the current organizational structure, list of files, circulation of documents and identification of key employees who will be involved in the implementation of EDMS was carried out.

Ultimately, the EDMS implementation process will consist of the stages presented in the table below.

Table 3.
EDMS implementation stages

Stage sequence number	Stage name	Substantive scope of the stage
1.	Conducting a needs and requirements analysis	<ul style="list-style-type: none"> defining the objectives of the implementation, e.g. whether the system is to support only archiving or also document circulation, digitization of paper documentation or handling administrative processes, process analysis – identifying key administrative processes to understand which areas will need to be changed after the system is implemented, definition of technical and organisational requirements, including necessary functionalities, level of access to documents and regulatory compliance.

Cont. table 3.

2.	Choosing an EDMS system	<ul style="list-style-type: none"> • software selection - a decision whether to implement a ready-made commercial solution, or choose a free one (e.g. EDMS RP offered by the Polish Ministry of Digital Affairs), or create a tailor-made solution, • adapting the system to the specifics of the organization - the system must respond to specific needs, e.g. integration with existing databases or ERP systems, • compliance with legal regulations, in particular with regulations on the protection of personal data (GDPR) and archival requirements (e.g. regulation on the classification and qualification of documents).
3.	Preparation of technical infrastructure	<ul style="list-style-type: none"> • hardware and software update - the EDMS system often requires a more powerful server infrastructure and appropriate database software, • integration with other systems - EDMS must be integrated with systems that the hospital already uses (e.g. ERP, financial systems, HR), • Security - Installing appropriate security measures, including access controls, encryption, and regular backups.
4.	Digitization of paper documents	<ul style="list-style-type: none"> • scanning documentation and converting it to a digital format, in compliance with legal requirements for electronic archiving, • creating a digital archive and classifying documents according to categories, dates or departments in the EDMS system.
5.	Development of new procedures and training of employees	<ul style="list-style-type: none"> • defining the rules and procedures for working with EDMS, including workflows, case classes and archiving rules, • preparation and implementation of security policies and rules for access to documents, • employee training – providing support and training in the use of the EDMS system and user manuals for various groups of users.
6.	Testing the EDMS system	<ul style="list-style-type: none"> • pilot: implementation of the EDMS system in one of the organizational units as a pilot project to check how the system works in practice and catch any errors, • testing the circulation of documents and the functions of searching, registering and archiving documents in order to ensure their correct operation, • collecting user feedback and making possible adjustments and adjustments based on feedback.
7.	Full system implementation and monitoring	<ul style="list-style-type: none"> • introduction of EDMS throughout the organization and monitoring of its functioning, which allows to detect possible problems and introduce further improvements, • technical support and updates - regular updates of the EDMS system and monitoring of its operation to ensure smooth document handling, • effectiveness assessment - periodic reviews of effectiveness and analysis of whether EDMS meets the assumed goals.

Source: own work.

On the basis of the general substantive scope of the schedule presented above, it was only possible to develop a detailed implementation plan, taking into account the various stages of work and the involvement of relevant people.

Another important step is to determine which processes in the organization will be covered by the EDMS system, as well as to identify possible exceptions that will require separate proceedings. It is crucial to develop consistent rules for the electronic circulation of documents, registration, assignment, signing documents, archiving, etc. It is also worth analyzing which documents can only be kept in electronic form, and which will require paper form. In order to implement EDMS, it is also necessary to properly prepare the organization's technical infrastructure. Computer hardware, software, configuration of accesses and permissions, as well as the means to securely store and archive electronic documents must be provided.

It is also crucial to upload qualified certificates that allow documents to be signed electronically. An extremely important element before the launch of EDMS was training for employees who will use the system. Users should be trained in the use of the system, new rules of document circulation, signing documents electronically, as well as archiving. It is also worth appointing people responsible for supporting users and solving current problems. The introduction of EDMS is associated with a change in the way employees work and habits. Therefore, effective internal communication is crucial, informing about the benefits of implementing the system, as well as about new rules and processes. It is necessary to change the organizational culture so that employees are open to new solutions and actively participate in the implementation of EDMS. To sum up, before implementing EDMS, it is crucial to comprehensively prepare the organization - from resource review, through process definition and infrastructure adjustment, to employee training and organizational change management. Only such a comprehensive approach will ensure the smooth implementation and effective functioning of the EDMS system in the long term.

During the pre-implementation analysis, the general operation of the system was discussed with the employees participating in the process in terms of:

1. generating barcodes from the system, rules for sticking documents with barcodes, using the code in the document registration process,
2. rules for registering cases on the example of correspondence, case registration window on the example of correspondence, file of the created case, instructions, tabs collecting other information in the case, rules for attaching document files, document versions, case linking, case registers with search options,
3. granting permissions, i.e. to each document of a given type,
4. tasks in the user profile, tasks for the department, notifications about a new task, task deadline and visibility of the deadline in the document register,
5. the way the system supports the storage of attachments in any format, documents attached in the system after clicking on a link open in programs designed to support a given format,
6. e-Delivery: this is an electronic equivalent of a registered letter with acknowledgement of receipt, from the EDMS system, it will be possible to send, receive and track the status of the shipment, thanks to full integration with the Poczta Polska system,
7. e-Sender: the service allows you to generate envelopes with the sender's, addressee's data and the number of the contract with Poczta Polska. All you have to do is print out the envelope generated from the system and take the parcel to the post office without having to receive a confirmation of postage there,
8. ePUAP.

During my daily observations of work in the field of traditional, i.e. paper-based document workflow, many observations came to mind, which in turn strengthened the change management process in this area. Pointing out significant benefits from the implementation of a new solution, also of an organizational nature, is a key success factor in this aspect.

Paper document workflow has many disadvantages, especially compared to modern, electronic document management systems. The most important are:

1. Time-consuming – transferring documents between people or departments takes time, especially in pavilion buildings. Employees have to manually deliver documents or wait for them to be delivered, also the need to manually complete, segregate and sign documents is time-consuming, which prolongs decision-making and administrative processes.
2. Risk of losing or destroying documents – paper documents can easily be lost or accidentally destroyed (e.g. by water, fire or improper storage). Paper documents can be difficult to find, especially with large archival collections, which creates the risk of missing important information.
3. High costs of storage and maintenance – storing paper documents requires additional space, e.g. cabinets, archives, and even separate rooms, which is already problematic in the hospital.
4. Difficult access to documents – searching for documents in paper archives is time-consuming and requires manual search through physical collections. Another issue is the fact that only one person can view a given document at a time, which limits the availability of data for more employees, especially when the document has to go through several people in a short time.
5. Limited control over access and security – paper documents are more difficult to secure. They can be easily copied or extracted without proper control procedures, increasing the risk of unauthorized access. It is difficult to keep track of who has reviewed or changed documents, which can lead to problems with oversight and accountability.
6. Difficult collaboration and lack of flexibility – Difficulty sharing documents quickly makes collaboration limited, especially when employees are in different locations or working remotely. Documents are not accessible outside the office, which limits the possibility of remote work or access to data in emergency situations.
7. Lack of automation and limited reporting capabilities – paper document workflow does not allow for process automation, which increases the number of manual tasks and the risk of mistakes. It is difficult to generate reports and track administrative processes, as documentation must be manually searched and processed.
8. ecological burden – paper production, transport and disposal generate an ecological footprint and contribute to the depletion of natural resources and CO₂ emissions. For paper-intensive institutions, cost-effectiveness and environmental performance can be significantly lower than for digital workflows.

Traditional, paper-based workflows therefore have numerous limitations that can affect efficiency, data availability, as well as costs and security. Electronic documentation systems are the answer to many of these problems, improving the accessibility, safety and environmental performance of the organization.

The traditional document workflow currently in force in a hospital is described in the document flow manual and applies to paper documentation and the physical movement of documents between departments or people.

The process can be broken down into the following activities related to the circulation of documents:

1. After holding the document in an electronic version, hospital employees print it out and, as in the case of the paper version, then hand over the document to the Office.
2. The persons running the Office accept all external documents provided by the post office, Hospital employees and individuals, the institutions then stamp the documents with a stamp of receipt as well as a stamp needed to describe the document in terms of content as well as formal and accounting. Then they enter it in the correspondence book and assign a sequential number. The received correspondence is forwarded on the day of receipt or on the next working day against a receipt to the appropriate organizational units.
3. Purchase invoices, after registration in the Office, are forwarded to the substantive departments for substantive control within 4 working days (i.e. confirmation of the performance of the service, compliance of the performance with the order, entering the contract or order number and payment date).
4. External and internal correspondence, after registration in the Office, is forwarded to the Director's secretariat, who assigns it to individual cells, and then forwards it back to the Office, which divides it into the indicated cells.
5. After checking the documents in terms of content, individual departments submit the evidence to the Hospital Office. The Office submits the documents to the Finance and Accounting Department at the latest on the next working day in order to carry out a formal and accounting control.
6. Formally and accounting-checked documents are qualified for inclusion in the accounting books by indicating the month and the method of assignment and the signature of the person responsible for these indications within 5 working days of receiving the document from the Office.
7. Then the Finance and Accounting Department transfers it in folders to the Chief Accountant, where a preliminary control is carried out by the Chief Accountant and approval for implementation (payment) by the Director.
8. In the case of orders or tenders, individual departments prepare documents, which are then forwarded to the Director's secretariat.

9. From the secretariat, the files of individual departments are collected by the Chief Accountant.
10. The Chief Accountant, after approval in the financial scope, forwards the folders with documents to the Director.
11. After approval by the Director, some of the documents are sealed by the secretary and only from the Secretariat the signed files are collected by individual substantive departments.

Due to the fact that the Hospital is located in a pavilion structure, a person often has to travel with the document at least twice, and sometimes even more times. Weather conditions are a big difficulty. First, by submitting the document to the Office, then on the next day by collecting it and returning its approval in terms of content. In the event that mail is collected from the Polish Post Office and handed over in a traditional way by the postman, the Office is closed at that time, which causes another loss of time for employees who want to hand over or collect documents from the Office. In the paper version, everything is based on the transfer of the paper version between units. Due to this fact, it is difficult to locate the document, the only option is to make a phone call or visit the Office in person, where you can check whether such a document has been received by the unit at all. Unfortunately, this is not an easy process, because checking the paper correspondence book requires a lot of time, and sometimes in a situation where it is not known in what period a given correspondence has been received by the Hospital, it is even impossible. Another important problem is the inability of the Directorate to identify at what stage a specific case is.

At the stage of pre-implementation analysis, the following scopes were established:

Incoming correspondence

1. The correspondence registration window will allow you to enter the following data: barcode, external case number, form of delivery, type of sender - contact/contractor checkbox, sender - selection of the sender from the database or the possibility of creating a new one, type of correspondence, responsible person/department, date and time of receipt, date from the document, postal number, related documents - field with the register of incoming, outgoing and internal letters, description, attachments.
2. Correspondence can be registered from the command under the navigation button, an e-mail sent to the mailbox connected to the system, e-Delivery and ePUAP.
3. The system will register correspondence that has been received on paper via traditional mail, by courier, by e-mail, in person, e-Delivery, ePUAP.

Incoming correspondence

1. The incoming correspondence workflow will work according to the following process description:
 - When receiving correspondence, the Law Firm verifies to whom it is addressed, none of the employees prints the documents that they receive to their e-mail box, but sends them in an electronic version to the address of the Office.
 - The Law Firm registers the letter and forwards it to the Director within the scope of the Ministry of Health and the National Health Fund, while the remaining correspondence is sent directly to the organizational unit to which the case relates, bypassing the Director's assignment.
 - Case handling - if the correspondence is addressed to a department, the Law Firm forwards the letter directly to the indicated department in order to take up and complete the case. In a situation where the letter in which the Director is indicated by the registrant will be forwarded directly to the Director.
 - Director's approval - the letter goes to the Director and the Director may:
 1. reject - refer the case back to the responsible department to improve the response,
 2. accept the prepared response and forward the information to the responsible department,
 3. terminate.

The hospital's management department will have access to all correspondence of the hospital, at any time it will be able to view what correspondence has been received by the unit, at what stage a specific case is and which department is currently dealing with it.

Internal correspondence

Two types of internal correspondence workflow paths will be created, one correspondence to the Director (1), the other will be employee correspondence (2).

Process Description 1:

- each employee has the option of sending internal correspondence,
- during the registration of internal correspondence to the Director, the letter will be sent directly to the Director,
- The Director, after reading the letter, decides on the method of response,
- the employee, after receiving a response from the Director, may end the case, or prepares a response to the Director.

Process Description 2:

- each employee has the option of sending internal correspondence,
- during registration, you can immediately indicate the person who is the recipient of the correspondence,
- A dedicated employee ends the document workflow or can assign it to another person for further service.

Outgoing correspondence

- correspondence registered by the Law Firm will be immediately placed in the register of outgoing letters with a sequential number of the outgoing letter,
- correspondence registered by employees will be sent to the Office and it is the Office that will create new outgoing correspondence,
- the system will have the option to generate labels for printing with the name and address of the recipient and the number.

Before implementing EDMS, it was important to have a thorough understanding of the specifics of the hospital's operations, the types of documents that will be managed, and the flow of information. This helped to adapt the system to the needs and eliminate potential problems at later stages. Employees should be familiar with the functions and operation of EDMS, so it was important to organize appropriate training. The introduction of practical exercises allowed for a better understanding of the system and will prepare employees to work with it on a daily basis. After the implementation of EDMS, it is important to regularly monitor its operation and effectiveness in document management. It is worth collecting feedback from users and conducting periodic evaluations of the system to constantly improve it.

5. Conclusions

The electronic circulation of documents was introduced to increase the efficiency of the hospital's operations, it is aimed at simplifying the process of implementing a given case and reducing the number of stages of settling the case. Computerization of the document workflow process allows for many key improvements and benefits for the unit. Electronic document workflow significantly speeds up the flow of information and documents in the hospital, eliminating the time needed to manually transfer, copy and store paper documents.

Processes are automated and documents can be quickly uploaded, viewed, accepted and archived electronically. This saves time for employees who can concentrate on other tasks. It provides central storage of all documents in digital form, which allows better control over the circulation and status of cases. Employees have convenient and quick access to the process history and full documentation. In addition, the system provides document validation and electronic signature support, guaranteeing the integrity and authenticity of data. It can significantly reduce the costs associated with printing, copying, scanning and physically archiving paper documents. In addition, the digitization of processes reduces the need to store large amounts of paper and enables better management of office space.

The electronic document workflow system improves the organization and transparency of the flow of information in the medical entity. It allows you to automatically assign tasks, monitor progress, generate reports, and optimize business processes. Thus, it ensures better coordination of activities between employees. Compared to paper document workflow, the electronic version offers a higher level of data security. Documents are protected against destruction, loss or unauthorized access.

An electronic workflow system can also provide encryption, backup, and change tracking, increasing information security. The electronic form of documents allows multiple employees to access and collaborate on the same materials at the same time, regardless of their location. This allows you to improve teamwork and speed up decision-making. Employees have constant and convenient access to the necessary documents.

To sum up, the computerization of document circulation brings numerous benefits to the hospital, such as increased efficiency, improved management, cost reduction, improved process organization, and a higher level of data security and availability.

The implementation of EDMS requires a consistent approach and cooperation between different departments of the organization to ensure smooth and consistent activities.

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THE EXAMINING THE STATE OF THREE-DIMENTIONAL BENEVOLENT LEADERSHIP IN POLAND

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Purpose: The purpose of this study is to identify and assess the level of benevolent leadership in Poland.

Design/methodology/approach: Data were collected from 187 companies in Poland. Due to the multi-informant approach, data were obtained from 861 individuals who served as informants in the field study. Benevolent Leadership was assessed using the Karakas and Sarigolu scale. We adapted this scale to Polish conditions. After formal evaluation, the collected data were subjected to statistical analysis, including the use of descriptive statistics, U Mann-Whitney test and ANOVA Kruskal-Wallis test.

Findings: The analysis of the research results revealed that the level of three-dimensional benevolent leadership in the surveyed companies is satisfactory. Respondents value leaders' social engagement the most. Another significant characteristic of benevolent leadership in Polish companies is leaders' ethical sensitivity. The spiritual dimension of leadership was rated the lowest. Employees' demographic variables do not significantly influence the perception of benevolent leadership. However, the characteristics of the enterprise itself are important—higher scores for the construct were observed in family-owned businesses and smaller enterprises.

Research limitations/implications: The data were collected from a single source by conducting surveys among companies. The cross-sectional nature of the research may therefore constitute a limitation, so it is worth considering a longitudinal research project that might capture changes in such constructs as benevolent leadership over time. The results may also be difficult to generalize because the research was conducted within a single culture. This highlights potential future directions of research in this area that would take other contexts into account.

Practical implications: The conducted research shows that subordinates highly value leaders' social engagement. Moral values of supervisors are also crucial. The results confirm that morality and ethics are important in business practice. Organizations should therefore invest in the development of leaders who are guided by values and ethics. Training programs, coaching, or mentoring can sensitize leaders to social and ethical issues, helping to foster responsible attitudes. Value-based leadership is appreciated by employees and can contribute to organizational effectiveness.

Originality/value: Our research shows that leaders' social engagement and moral values hold great significance for subordinates. This sheds new light on the importance of ethics in leadership. Our findings enrich the literature on value-based leadership.

Keywords: Benevolent Leadership, Value-based Leadership, Enterprises.

Category of the paper: Research paper.

1. Introduction

Antwi et al. (2019) note that workplace challenges have become more complex than ever before. As a result, leadership models previously effective, focused on competition and hierarchy, no longer meet the needs of contemporary organizations. These models are ill-equipped to address the global complexity, rapid pace of change, and intricate demands of today's realities. A transformation in leadership is essential—shifting from competition to collaboration, from an exclusive focus on financial outcomes to including social and environmental results, and from managing through fear to fostering trust and empowering employees. Modern leadership should balance economic interests, employee well-being, and social responsibility. As Mintzberg (2006) argues, it is also crucial for leaders to move away from materialistic motivations toward pro-social goals. New challenges call for leadership that is courageous, value-driven, and impartial. Leadership must not only embody ethics and morality in the workplace but also extend to social responsibility, addressing the needs not only of organizational members but also of its broader stakeholders (Freire, Gonçalves, 2021; Ghosh, 2015).

To date, the literature has widely embraced concepts of value-based leadership, such as ethical, authentic, servant, responsible, and charismatic leadership. While acknowledging their significant importance, it is important to note that there remains a lack of research on value-driven yet interdisciplinary leadership. Such leadership should encompass not only ethics but also other aforementioned norms and patterns of leader behavior (Shi, Ye, 2016; Thakur, Sharma, 2019).

The answer to this challenge could be *Benevolent Leadership (BL)*, proposed by Karakas and Sarigollu (2012). This leadership style is conceptualized as a process of creating positive change in organizations through ethical decision-making, creating a sense of purpose, fostering hope, developing the courage to take meaningful actions, and having a positive impact on the larger community. Benevolent leadership is rooted in deep moral values, honesty, and care for the common good, rather than solely focusing on personal interests. Its goal is to pursue the common good, based on the needs of the entire community.

As Ivanova (2018) writes, leadership plays a crucial role in shaping employee behavior patterns. Existing global studies in this area indicate that value-based leadership has a positive impact on many desirable behaviors and attitudes of subordinates (Kose, Metin, 2018; Lee

et al., 2018; Mustofa, Muafi, 2021; Nahum-Shani, Somech, 2011; Zehir et al., 2014). However, the discussions in this field have taken a rather narrow cognitive perspective. They most often focused on just one leadership style that spreads values, but only within the organization, neglecting its external environment (Cavazotte et al., 2013; Fang et al., 2009; Greenleaf and Spears, 2002; Mustofa, Muafi, 2021; Rehman, Afsar, 2012). It is therefore important to fill this gap and focus on multidimensional benevolent leadership.

The aim of this article is to identify and assess the level of benevolent leadership in Poland. The authors sought to answer the following questions:

- Which dimension of benevolent leadership is manifested at the highest level?
- Are there differences in the perception of benevolent leadership depending on the characteristics of the subjects being studied?

The article is divided into several parts. First, we present a description of value-based leadership concepts that underpin benevolent leadership. We then characterize authentic, ethical, servant, and spiritual leadership. Next, we introduce the benevolent leadership model, followed by an outline of how this phenomenon is understood in the context of Polish cultural conditions. The next part of the article focuses on describing the research sample and the methodology, after which we present the results, discussion, and final conclusions.

2. Theoretical Framework

2.1. Moral Concepts of Leadership in the Context of Benevolent Leadership

Karakas and Sarigollu (2012) began their work on the concept of benevolent leadership by conducting a multidisciplinary literature review to identify other theories regarding ways in which leaders initiate the common good. Inductive analyses allowed them to identify four key research streams in this area – *morality, spirituality, positivity, and community*. As the authors assumed, these four paradigms relate to the creation of the common good within organizations. They can be used to create, lead, and sustain positive changes. "Common good" here refers to the overall conditions, shared benefits, or positive outcomes for all members of the organization and its immediate environment. Referring to the above-mentioned research streams, Karakas and Sarigollu (2013) concluded that benevolent leadership particularly stems from leadership concepts such as **authentic, ethical, servant, and spiritual leadership**.

The original concept of authenticity in leadership was introduced to the literature in the 1960s by Rome and Rome (1967), who described it as a function within the organizational hierarchy. However, the operationalization of the concept of **authentic leadership** was presented only later by Henderson and Hoy (1983), distinguishing between "authentic and inauthentic" leadership. Authentic leadership can be understood as a synergistic combination

of self-awareness, sensitivity to the needs of others, creativity, honesty, and transparency in relation to oneself and others (Avolio *et al.*, 2009). It is believed that authentic leaders have the moral ability to take responsibility for their own actions and the actions of their followers (Shapira-Lishchinsky and Levy-Gazenfrantz, 2015).

Brown, Treviño, and Harrison (2005) presented the concept of authentic leadership in an interesting and clear way. The authors argued that this construct consists of four dimensions: self-awareness, openness to feedback, transparency, and morality (ethical behaviors). The key goal of authentic leadership is to achieve good and long-lasting organizational outcomes. In the early 21st century, global research focused on the connection between authentic leadership and employee attitudes, behaviors, and outcomes. It was found that this type of leadership has a positive impact on employee effectiveness, creativity, and emotional engagement at the team level (Borgersen *et al.*, 2014; Rego *et al.*, 2013). Hmieleski *et al.* (2012) research also showed that authentic leadership positively influences the performance of the entire organization.

Another concept of leadership based on moral values is ***ethical leadership***. Brown, Treviño, and Harrison (2005, p. 120) defined it as *the demonstration of normatively appropriate conduct through personal actions and interpersonal relationships, and the promotion of such conduct to followers through two-way communication, reinforcement, and decision-making*. The enduring interest in ethical leadership stems primarily from values such as honesty and credibility, which are integral elements of it. Ethical leadership focuses on the moral aspect and does not treat ethics merely as an additional activity. Brown, Treviño, and Harrison (2005) described it as encompassing both the traits (being a moral person) and the behaviors of the leader (moral manager). According to them, ethical leadership manifests through honesty, social responsibility, fairness, and concern for the consequences of decisions. Ethical leadership is also evident in actions that promote ethics in the workplace, with the moral stance of the manager translating into the support of ethical behaviors among employees (Mostafa, 2018). Ethical leaders are respectful, credible, and fair; they encourage employees to express their opinions openly and make decisions that are fair to the team (Chughtai *et al.*, 2015).

This style of leadership is associated with responsibility and goodwill toward employees, the community, and even competitors, regardless of the circumstances (Tutar *et al.*, 2011). Moreover, ethical leadership not only reduces the occurrence of negative phenomena in the workplace but also supports positive aspects, such as job satisfaction (Neubert *et al.*, 2009).

Servant Leadership is another concept that is related to benevolent leadership. An increasing number of organizations are striving for a model in which every employee thinks and acts like a leader. The ability for self-leadership is one of the core assumptions of servant leadership. Servant leadership is considered an important area of research due to the potential success it can bring to organizations (Mcquade *et al.*, 2021). Special attention to this concept was given by Greenleaf, who, although he never directly defined servant leadership, believed its goal was to make followers wiser, freer, more autonomous (Greenleaf, 1977). Furthermore,

the same author (1998, p. 4) argued that the *servant-leader is primarily a servant [...] Everything begins with a natural feeling of wanting to serve, and only later does the conscious choice lead to the aspiration to lead*. A servant leader places the needs of their employees first, before their own interests. As Spears (2004) pointed out, such a leader cares for their "followers" and believes that the main goal of an organization is to have a positive impact on the lives of those associated with it. Hoch et al. (2018) emphasize that servant leadership aims to achieve long-term organizational goals by supporting the development and well-being of employees. Research conducted by Liden et al. (2014) showed that this leadership style increases employee engagement, promotes prosocial behaviors, and improves effectiveness. Additionally, it contributes to higher employee satisfaction, which leads to lower turnover rates and greater trust in the organization (Jones, 2012).

The concept of **spiritual leadership** gained recognition in the literature in the 1990s when it was noted that spiritual aspects could also be significant in the context of organizational management. An important step in the development of this idea was Fairholm's 1996 article, which treated organizations as structures with a spiritual dimension. Fairholm argued that since people spend a significant portion of their lives at work, it is unreasonable to expect them to separate their spiritual identity from their professional one (Fairholm, 1996). Spirituality manifests both in rational, objective actions and in the personal sphere, guided by moral values and emotions. In simple terms, this means that professional and spiritual commitments can be pursued simultaneously (Pandey et al., 2008). Fry et al. (2005, p. 836) defined spiritual leadership as *comprising values, attitudes and behaviours required to intrinsically motivate one's self and others in order to have a sense of spiritual survival through calling and membership – i.e., they experience meaning in their lives, have a sense of making a difference, and feel understood and appreciated*. Fry (2003) in discussing spiritual survival, emphasized the importance of spiritual values in organizations. Spiritual leadership is considered key in meeting the fundamental needs of spiritual and moral well-being for both leaders and their followers by fostering a sense of belonging, as well as shaping vision and value alignment at the individual, team, and organizational levels. The source of spiritual leadership lies in the pursuit of a deeper sense of life and action beyond one's self-interest. Although it is the least popular concept among the four discussed, it is significantly recognized in countries of the Far East. Nonetheless, as a values-based model, it can serve as the foundation for modern management concepts that focus on morality.

2.2. Benevolent Leadership

Despite the fact that all of the aforementioned leadership concepts addressed the issue of positive change in organizations, none of them went far in explaining the attitudes and behaviors of leaders in terms of their kindness and willingness to contribute to the surrounding world.

It was only Karakas, and Sarigollu (2012), who took on the task of defining the role of leaders in initiating positive changes in organizations and their environment. These researchers concluded that visible results can only be achieved through an eclectic combination of various disciplines within a broader leadership context. As a result, they developed a conceptual model of Benevolent Leadership (BL), which was published in the *Journal of Business Ethics* in 2012 and has since become the subject of numerous scientific analyses. Karakas and Sarigollu (2012) described this model as a process of supporting and implementing positive changes in organizations to achieve visible benefits for the common good.

Benevolent leadership consists of four distinct but interconnected dimensions derived from the previously mentioned leadership concepts. The Benevolent Leadership model thus includes the following dimensions: **ethical sensitivity, spiritual depth, positive engagement, and social responsiveness.**

Ethical sensitivity refers to a leader's ability to engage in moral reflection and assess what is right and wrong in a professional context. This is a key aspect, especially in today's world, where we face issues such as corporate scandals, corruption, unethical behavior, and an unprecedented decline in moral values and character. Karakas and Sarigollu (2012) noted that ethical sensitivity encompasses not only a leader's approach to morality and making decisions in line with ethical principles but also their own moral behaviors and actions. Therefore, it can be said that ethical sensitivity is one of the most important traits of a leader in the context of moral leadership research.

When assessing a leader's level of ethical sensitivity, consideration is given to their attitude towards moral principles and ethical standards, keeping promises and commitments, as well as analyzing the ethical consequences of decisions made. It is also important to evaluate whether the leader adheres to high ethical standards, takes responsibility for their mistakes, stands up for what is right, acts in accordance with their values and beliefs, and serves as a model of integrity and honesty for others. The most important manifestations of ethical sensitivity (Karakas and Sarigollu, 2013) include responsibility and fairness, respect for and protection of the rights of employees, consumers, and employers, making decisions consistent with ethical principles, fair actions, awareness of personal values, adherence to rules and regulations, promoting moral values in the workplace, and a heightened sense of ethical responsibility.

The next dimension of benevolent leadership is **spiritual depth**. Karakas (2009) defines it as the leader's pursuit of finding meaning and purpose in their work. In this context, emotional engagement is crucial – putting one's "heart and soul" into the tasks performed, as well as caring for emotional, psychological, and spiritual well-being. A leader who operates within this dimension shows empathy, care, and sensitivity, treating the organization as a whole and seeking deeper meaning both in their own work and in the work of their colleagues (Karakas and Sarigollu, 2012). Such a leader strives to support their subordinates, act authentically, be understanding of difficulties, and consciously seek a meaningful mission in their work. They recognize the ethical consequences of the decisions they make and are characterized by empathy and sensitivity toward colleagues and other stakeholders.

Positive engagement, the third dimension of benevolent leadership, refers to initiating valuable changes in the organization by inspiring employees and instilling in them hope and courage. Karakas and Sarigollu (2012) define this engagement as an approach based on building positive transformation, which motivates others to act by showing them a shared vision of improvements. When subordinates recognize this engagement in their leader, they also become more involved and support their colleagues. At this level of leadership, it involves skillfully reducing resistance to change, leading and inspiring the team, managing negative emotions, and shaping a shared vision of a positive future for the organization. A high level of this engagement in a leader is manifested in their passion for change, ability to inspire courage in colleagues, willingness to take on challenges, and openness to new ideas and innovations.

Finally, the last dimension of benevolent leadership—**social responsiveness**—relates to the concept of corporate social responsibility and corporate citizenship. As Maak (2016) notes, modern leaders operate in a stakeholder society, which requires them to go beyond the traditional role of a leader and act as a coordinator in relationships with various stakeholder groups. In practice, this means engaging in areas such as human rights, responsible marketing, sustainable development, fair trade, local economy, and environmental protection. This dimension reflects the civic attitude of the organization and concern for future generations. It emphasizes the leader's role in creating value for all stakeholders, including the global community. In practice, this takes the form of supporting socially responsible projects, participating in charitable actions, and building lasting relationships with stakeholders. These four dimensions of benevolent leadership together assess its level within the organization. Benevolent leaders must take into account moral, spiritual, transformational, and social issues when making decisions.

So what exactly is benevolent leadership? Karakas (2009, p. 48) defined it '*as the process of creating a virtuous cycle of encouraging, initiating, and implementing positive change in organizations through: a) ethical decision making and moral actions, b) developing spiritual awareness and creating a sense of meaning, c) inspiring hope and fostering courage for positive action, and d) leaving a legacy and positive impact for the larger community*'. Benevolent leaders are those who bring about real, lasting benefits for the common good. The central value here is the common good, and the result of these leaders' actions is a positive impact that is felt not only by individuals but also by a broad range of stakeholders. Such changes often begin with improving employees' well-being, values, and beliefs, as well as implementing innovations that lead to better working conditions. The common good also includes a good atmosphere, trust, and positive relationships within the organization. Benevolent leaders go beyond the organization, caring for the local community and diverse stakeholders, for example, by engaging in social innovation, participating in charitable activities, caring for the environment, or getting involved in social initiatives. Such leaders are an example of authentic action that benefits both the organization and its environment. Benevolent leaders inspire, motivate, and are characterized by a strong sense of social responsibility, ethics, and morality.

They are open to innovation – especially social innovation – set positive behavioral examples, create a vision for development, and believe in the achievement of their goals. Through their full commitment and emotional dedication to their work, they set an example for their colleagues, inspiring them to find meaning in what they do. All these qualities support the regular implementation of positive changes within the organization and contribute to the development of its community. Thanks to benevolent leadership, employees feel united, work together towards common goals, embrace change, and know that they are treated fairly. Clients and suppliers appreciate working with an ethical organization, and the surrounding community recognizes the leader's responsible, charitable actions. These examples clearly illustrate the positive impact that benevolent leadership can bring.

Benevolent leadership can therefore be viewed as a modern style that helps implement positive changes in 21st-century organizations. It serves as a behavioral model for leaders, combining ethical sensitivity, honesty, and self-awareness with ethical leadership, positive engagement with authentic leadership, spiritual depth, integrity, and hope with spiritual leadership. It also includes social responsibility and wisdom, which are common with servant leadership. A holistic view of these four dimensions allows leaders to gain a broad perspective on actions and effectively contribute to the common good.

These four streams – ethical sensitivity, spiritual depth, positive engagement, and social responsiveness – are the core traits of a benevolent leader. This model differs from other valuable leadership models by focusing primarily on creating positive change, especially in terms of human values (Luu, 2019). It balances the ethical, transformational, and social concerns of leaders and provides guidance on how to create understanding-based, ‘human’ organizations. Table 1 presents the attributes of a benevolent leader compared to other value-based models. These attributes include ethical sensitivity, spirituality, calling, self-awareness, life wisdom, social responsibility, engagement, serving others, building hope, and integration. While each of these attributes is part of one of the leadership models, only benevolent leadership focuses on all of them simultaneously.

Table 1.

The attributes of a benevolent leader compared to other value-based models

Attributes of a values-based leader	Ethical Leadership	Spiritual Leadership	Authentic Leadership	Servant Leadership	Benevolent Leadership
Ethical Sensitivity	+				+
Spirituality		+			+
Calling		+		+	+
Self-awareness	+	+	+		+
Life Wisdom		+		+	+
Social Responsibility	+			+	+
Positive Engagement			+		+
Serving Others				+	+
Building Hope		+	+		+
Integrating	+	+	+	+	+

Source: Own elaboration based on (Karakas, Sarigollu, 2013).

In summary, the model of benevolent leadership is based on the synthesis and integration of all four value-based leadership theories. It incorporates key values from ethical, spiritual, authentic, and servant leadership. Its focus is on creating benefits, actions, and outcomes for the common good. The emphasis on the common good is critical here, as the very essence of benevolent leadership is centered around creating positive changes or engaging in activities that benefit the broader community.

2.3. Benevolent Leadership in Poland

The concept of benevolent leadership presented by Karakas (2009) was developed based on the results of an extensive literature review, followed by empirical research. It is particularly noteworthy that after the conceptualization and operationalization of this concept, the author, together with his collaborator Sarigollu (2012), subjected the measurement scale to a multi-stage validation process. Given the possibility of replicating the research in a new empirical context, the aforementioned scale was chosen to measure benevolent leadership in Polish enterprises. However, the Polish studies focused on testing benevolent leadership from the employees' perspective.

To date, all research on benevolent leadership has relied on self-assessment—leaders evaluating their own level of benevolence. In this study, the focus was shifted to testing benevolent leadership from the perspective of employees (subordinates). It was the employees who assessed the benevolence of their leader. The rationale for adopting this approach was a belief shared by a significant group of researchers, which posits that when individuals evaluate themselves or their performance, they are likely to rely on internal thoughts, feelings, and personal traits (Jaramillo *et al.*, 2005). A meaningful and objective assessment of a leader's benevolence can, therefore, be obtained from their subordinates. This approach to evaluating leaders has been used by many researchers, including Mostafa (2018); Zhang & Yao (2019) and Engelbrecht *et al.* (2017). Thus, this study represents a novel approach to researching the phenomenon, incorporating the perspective of employees and their evaluation of the leader's benevolence.

In summary, the approach to measuring benevolent leadership was based on a replication study with an extended scope, as both the time and the cognitive context (country and group of informants) differed from the original research. The replication included not only the verification but also the adaptation of the original scale.

Originally, the construct's pioneers assumed that benevolent leadership consists of the four dimensions mentioned above: ethical sensitivity, spiritual depth, positive engagement, and social responsiveness. Each of these dimensions is measured using 10 indicators, making the measurement tool consist of 40 statements (10 for each dimension). This same measure was applied in the present study. Due to the new research context, after conducting the main study, an explorative factor analysis (EFA) was performed.

However, the number and structure of dimensions did not fully align with the original solution proposed by Karakas and Sarigollu. It was found that, in the Polish context, a three-factor solution was more appropriate.

The obtained results, however, did not allow for adopting all the same labels as in the original study. From the original framework, the dimensions of *ethical sensitivity* and *spiritual depth* were retained, as they were loaded exclusively by the indicators previously associated with these dimensions. The third dimension, however, was assigned a different label, encompassing elements from both the original dimensions of *positive engagement* and *social responsiveness*.

Thus, considering the content of the questions representing the specific measurement indicators for the third dimension of benevolent leadership, the label *social engagement* was proposed.

In summary, benevolent leadership in the Polish research context is a multidimensional phenomenon comprising the following dimensions:

- 1) **Ethical Sensitivity** – This pertains to the leader’s moral domain, specifically their approach to ethical decision-making and fulfilling commitments. This dimension of benevolent leadership also emphasizes fair treatment of employees and attentiveness to the moral conduct of both the leader and their subordinates.
- 2) **Spiritual Depth** – This involves seeking deeper meaning in one’s work. This dimension reflects empathy and patience. In this context, benevolent leadership also encompasses the pursuit of purpose and deeper fulfillment in the professional careers of both the leader and their employees.
- 3) **Social Engagement** – This pertains to the leader’s behaviors aimed at motivating not only themselves but also their subordinates to achieve positive outcomes. This dimension also refers to the leader’s social responsibility and their impact on the lives of others.

The measurement indicators included in the final, three-dimensional approach to benevolent leadership are presented in Table 2.

Table 2.

Final Measurement Indicators of the Three-Dimensional Benevolent Leadership Model

Dimension	Measurement indicators
Ethical Sensitivity (ES)	My supervisor reflects on ethical consequences of decision
	My supervisor takes a moral stand
	My supervisor takes ethical rules seriously
	My supervisor acts in accordance with ethical values and beliefs
	My supervisor is the role model of integrity and honesty
	My supervisor challenges colleagues when they depart from ethical values
	My supervisor works guided by high ethical standards
Spiritual Depth (SD)	Spirituality makes my supervisor a gentler person
	My supervisor tries to nurture spiritual growth of colleagues
	When faced with an important decision, spirituality of my supervisor plays important role
	My supervisor searches for something that makes his life feel significant and satisfying

Cont. table 2.

Social Engagement (SE)	My supervisor feels and acts like a responsible leader
	My supervisor is willing to devote time and energy to community
	My supervisor is involved in social responsibility projects
	My supervisor evaluates consequences of his managerial decisions for all stakeholders
	My supervisor gives his time and money to charitable causes
	My supervisor work makes a difference in people's lives
	My supervisor cares about the legacy for future generations
	My supervisor is hopeful about what we can accomplish together
	My supervisor beliefs in abilities to produce positive results

Source: Own elaboration.

3. Sample and measures

The study was conducted between July and November 2021, utilizing the Computer Assisted Personal Interview (CAWI) technique. In this study sources of information from a single organization were differentiated, thus employing a *multi-informant approach*¹. This methodology, as highlighted by Kaufmann and Astou Saw (2014) is uncommon in management research but significantly increases the reliability and depth of the findings (De Los Reyes *et al.*, 2015). The study using a multi-informant approach examines the problem from the perspective of several relevant participants, taking into account perceptual and cognitive differences (Fang *et al.*, 2008). This is particularly important in studies that use (self-)perceptual measures (Kaufmann, Astou Saw, 2014; Ketokivi, Schroeder, 2004). This approach also mitigates potential biases from systematic measurement errors, such as social desirability, consistency motifs, and implicit theories (Podsakoff, Organ, 1986). The leaders evaluated in the study were decision-makers in companies, such as owners or managers responsible for the organization's social initiatives. To ensure credibility, evaluations were conducted by at least two direct subordinates reporting to each leader.

The study received approval from the Scientific Research Ethics Committee at Nicolaus Copernicus University (permit no. 4/2022/FT). Participants provided informed consent before participating, and they were fully informed of the study's purpose and their right to decline or withdraw at any time. Ethical standards for human research were upheld throughout, with participants' confidentiality and autonomy respected.

Data was collected from 187 companies. Due to the multi-informant approach, data were obtained from 861 individuals who served as informants in the field study and reported to benevolent leaders within their companies. The structure of the studied sample is presented in Table 3.

¹ It was assumed that data would be collected from a minimum of two to a maximum of five informants per organization.

Table 3.
The structure of the research sample

Criterion	Number	%
Company age		
>10 years	61	32,6
10+ years	126	67,4
Industry		
Production	90	48,1
Trade	64	34,2
Services	33	17,6
Company Size		
Micro (up to 9 employees)	11	5,9
Small (10–49 employees)	23	12,3
Medium (50–249 employees)	88	47,1
Large (250 or more employees)	65	34,8
Ownership (family business or not)		
Yes (family business)	49	26,2
No	138	73,8
Market scope		
Regional	9	4,8
National	115	61,5
European	48	25,7
Global (outside the EU)	15	8,0

Source: Own elaboration.

Benevolent Leadership was assessed using the Karakas and Sarigolu scale (2012). We adapted this scale to Polish conditions. BL in the Polish research context consists of dimensions such as ethical sensitivity (7 items), spiritual depth (4 items), and social engagement (9 items) – Table 2. It is important to note that in this study, the responses were provided by subordinates who assessed the level of benevolence of their direct supervisor. Therefore, instead of statements like “I feel and act like a responsible leader”, equivalent formulations such as “My supervisor acts like a responsible leader” were used. Cronbach’s α coefficient was found to be 0.790. All scales were assessed on a five-point Likert scale (“1 = strongly disagree”, “5 = strongly agree”). The survey was translated from English into Polish by two independent experts. The agreed Polish version was back-translated into English by another expert with satisfactory degree of convergence with the original.

4. Results

Starting the analysis of the level of benevolent leadership in the studied organizations, the first aspect evaluated was the ethical sensitivity of leaders, which mainly relates to their moral stance. The result for this dimension was rated at an average level of 4.01. When looking at the average values for individual indicators, the highest rating was given for the leaders' application of high ethical standards, which scored 4.27. It is worth noting that for over 95% of the study participants, the average rating of 4 or 5 exceeded 95%. The lowest result (though

still relatively high) concerned the situation in which a superior reacts when employees make decisions contrary to ethical values, with an average rating of 3.79. Detailed data is presented in Table 4.

Tabela 4.

Descriptive statistics of the measurement indicators of ethical sensitivity

Ethical Sensitivity (ES)	Average	Percentage*
My supervisor reflects on ethical consequences of decision	3,87	68,7
My supervisor takes a moral stand	4,07	78,3
My supervisor takes ethical rules seriously	4,03	73,9
My supervisor acts in accordance with ethical values and beliefs	4,08	77,7
My supervisor is the role model of integrity and honesty	3,94	73,9
My supervisor challenges colleagues when they depart from ethical values	3,79	64,3
My supervisor works guided by high ethical standards	4,27	95,2
	4,01	

* The frequency of affirmative responses (labels on the 4 and 5 scale). Due to the multi-informant approach, affirmative responses were considered those for which the average for a given organization was above 4.

Source: own elaboration based on conducted research.

The **spiritual depth**, which refers to the leaders' ability to perceive a deeper meaning in their work, was assessed at an average level in the studied organizations, with a score of 3,51. Within this dimension, the highest rating (3,71) was given to the indicator regarding the leader's sensitivity when making important decisions. The lowest rating was given to the indicator reflecting the leader's search for deeper meaning and satisfaction in life, with a score of 3,31. It is worth noting that informants had difficulty providing a clear assessment of this aspect, which is reflected in the high number of responses with a rating of 3—indicating "difficult to say" according to the Likert scale. Detailed results for the indicators of this dimension are presented in table 5.

Table 5.

Descriptive statistics of the measurement indicators of spiritual depth

Spiritual Depth	Average	Percentage*
Spirituality makes my supervisor a gentler person	3,63	56,6
My supervisor tries to nurture spiritual growth of colleagues	3,41	49,3
When faced with an important decision, spirituality of my supervisor plays important role	3,71	57,2
My supervisor searches for something that makes his life feel significant and satisfying	3,31	44,3
	3,51	

* The frequency of affirmative responses (labels on the 4 and 5 scale). Due to the multi-informant approach, affirmative responses were considered those for which the average for a given organization was above 4.

Source: own elaboration based on conducted research.

The third and final dimension of benevolent leadership – **social engagement** – was rated at an average level of **4,04** in the surveyed companies. The highest score was given to the indicator referring to the leader dedicating their time and energy to the broader community, which received a score of **4,31**, with over 82% of responses rated 4 or higher. On the other hand, the

aspect related to the leader's care for creating a legacy for future generations received the lowest score of **3,59**. The detailed results are presented in Table 6.

Table 6.

Descriptive statistics of the measurement indicators of social engagement

Social engagement	Average	Percentage*
My supervisor feels and acts like a responsible leader	4,19	86,6
My supervisor is willing to devote time and energy to community	4,31	82,8
My supervisor is involved in social responsibility projects	4,22	83,7
My supervisor evaluates consequences of his managerial decisions for all stakeholders	4,17	86,2
My supervisor gives his time and money to charitable causes	3,67	68,5
My supervisor work makes a difference in people's lives	4,01	75,1
My supervisor cares about the legacy for future generations	3,59	52,8
My supervisor is hopeful about what we can accomplish together	4,11	73,6
My supervisor beliefs in abilities to produce positive results	4,14	72,8
	4,04	

* The frequency of affirmative responses (labels on the 4 and 5 scale). Due to the multi-informant approach, affirmative responses were considered those for which the average for a given organization was above 4.

Source: own elaboration based on conducted research.

The descriptive statistics values obtained in the conducted study for the variable of benevolent leadership and its individual dimensions are presented in Table 7. Benevolent leadership was rated at 3,85. Among the three dimensions, the highest rating was given to social engagement (4,04), followed by ethical sensitivity (4,01), and the lowest rating was given to spiritual depth (3,51).

Table 7.

Descriptive statistics for the variable of benevolent leadership and its dimensions

Variable	COD	\bar{x}	Me	D	SD	S	K
Ethical Sensitivity	ES	4,01	4,13	4,32	0,53	0,315	-0,887
Spiritual Depth	SD	3,51	3,51	3,56	0,91	0,038	-0,298
Social Engagement	SE	4,04	4,21	4,24	0,58	-0,279	-0,641
Benevolent Leadership	BL	3,85	3,81	4,88	0,42	0,308	-0,624

Explanations: \bar{x} – Mean, Me – Median, D - Mode, SD – Standard Deviation, S – Skewness, K – Kurtosis.

Source: own elaboration based on conducted research.

In the next step, the perception of benevolent leadership was analyzed considering control variables such as company age (time on the market), sector, company size, ownership (family-owned or not), and market activity. This analysis revealed statistical differences in the entire construct or in one of the dimensions of benevolent leadership for three variables: company age, ownership, and company size. No differences were observed for the variables of market activity and sector. Detailed data are presented in tables 8 and 9.

Table 8.

Mann-Whitney U Test Statistics for Control Variables: Company Age and Ownership (Family Business or Not)

Specification	Benevolent Leadership (BL)	ES	SD	SE
Company Age				
Z - Mann-Whitney U test statistic	-1,205	-0,906	-0,137	-1,622
P - test probability	0,012	0,302	0,655	<,001
Ownership (family-owned or not)				
Z - Mann-Whitney U test statistic	-1,924	-3,728	-0,233	-1,923
P - test probability	0,024	<,001	0,723	0,014

Explanations: Z – Mann-Whitney U test statistic, p – test probability (p < 0,05).

Source: own elaboration based on conducted research.

The analyses conducted indicated that for the control variable *company age*, differences emerged in the *social engagement* dimension as well as in the overall construct level. In both cases, higher values were observed for companies that had been operating in the market for at least ten years.

For the control variable *family ownership or not*, differences were identified in two dimensions of benevolent leadership, as well as in its overall level. In both the *ethical sensitivity* and *social engagement* dimensions, higher average values were associated with family-owned companies. Similarly, the overall level of leader benevolence was higher in these organizations.

Differences in the *ethical sensitivity* dimension were also observed for the control variable *company size* (Table 9). Interestingly, higher values were noted in smaller companies—micro and small enterprises—while the lowest values were observed in medium-sized companies with up to 250 employees.

Table 9.

Kruskal-Wallis Test Statistics for Control Variables: Market Scope, Sector, and Company Size

Variables				
	BL	ES	SD	SE
Market Scope				
χ^2	1,261	0,021	2,282	0,314
df	3	3	3	3
P	0,724	0,986	0,418	0,924
Industry				
χ^2	2,871	3,398	1,459	3,882
df	2	2	2	2
P	0,317	0,265	0,612	0,212
Company Size				
χ^2	4,815	8,223	3,817	2,282
df	3	3	3	3
P	0,123	0,014	0,366	0,412

Explanations: χ^2 – chi-square, df – degrees of freedom, p – test probability (p<0,05)

Source: own elaboration based on conducted research.

In summary, the obtained results across different dimensions indicate that the variable *benevolent leadership* exhibits varying distributions of evaluations depending on three control variables. While characteristics such as the company's industry or geographical scope do not

differentiate benevolent leadership, factors such as the company's age, size, and family roots do play a significant role.

5. Discussion

The analysis of the research results showed that the level of three-dimensional benevolent leadership in the surveyed companies is satisfactory – participants rated it almost four on a five-point scale. Respondents most highly valued the social engagement of leaders, which highlights the growing importance of social responsibility and care for the environment, particularly in the 21st century. This is also important for employees, who are among the recipients of internal CSR activities (Furmańska-Marusza, Sudolska, 2017). Within this dimension, the highest ratings were given to leaders' behaviors in which they dedicate time and energy to the community, engage in social projects, and consider the impact of their decisions on all stakeholder groups. Their belief in achieving positive results and shared goals is also highly valued, as it motivates employees to emulate such actions.

An important characteristic of benevolent leadership in Polish companies is also the ethical sensitivity of leaders. Moral values are crucial for employees, as demonstrated by their appreciation for leaders who adhere to high ethical standards, act in alignment with their own values, and emphasize the importance of morality in the workplace. The research results confirm that morality and ethics in business practice are important, which is also reflected in the literature on the subject (Cameron, 2011; Pless, 2007; Voegtlin *et al.*, 2012). Employees, as indicated in the presented research, value the leaders' reflection on what is good and what is bad in the workplace.

The spiritual dimension of leadership was rated the lowest, although respondents emphasized the importance of traits such as empathy and inner sensitivity. Leadership is often associated with spirituality and compassion, treating them as key values of leaders (Driver, 2007; Kernochan *et al.*, 2007), and according to McCormick (1994), spirituality and compassion express a deep connection with others. The high rating of leaders' empathy is therefore directly linked to their ability to show compassion. It can be stated that benevolent leadership is based not only on the actions of leaders but also on their personality traits.

Structural analyses led to interesting conclusions: employee demographics do not significantly impact their perception of benevolent leadership, while company characteristics do play a role. Higher ratings of leader benevolence were recorded in family-owned businesses, where employees rated both ethical sensitivity, social engagement, and the overall level of benevolence more positively. It was also noted that in the ethical dimension, leaders of smaller enterprises received higher ratings, which may result from closer relationships and more direct contact with employees.

6. Summary

The aim of the article was to identify and assess the level of benevolent leadership among the surveyed companies. The authors also sought to answer which dimension of benevolent leadership is shaped at the highest level and whether there are differences in the perception of this leadership depending on the characteristics of the surveyed entities. The conducted empirical analyses proved that the level of three-dimensional benevolent leadership can be considered high. The most significant dimension for subordinates among all the dimensions of benevolent leadership is social engagement, followed by ethical sensitivity, and the least important is spiritual depth. Employee demographic variables do not have a significant impact on the perception of benevolent leadership. However, the perception of this construct is related to the characteristics of the company itself – higher ratings of the construct were obtained in family-owned businesses and smaller enterprises.

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THE IDEA OF A SMART CITY IN THE DEVELOPMENT STRATEGIES OF POLISH VOIVODESHIP CITIES – A GAP OR A POTENTIAL?

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Purpose: The concept of smart city has entered into discussion on urban development. Its applications in large and smaller cities are widely discussed in scientific publications, but on how to link the smart city concept with strategic documents - not so largely. The aim of the article is to verify the literature gap, as well as the degree of consideration of the concept of smart city in regional cities.

Design/methodology/approach: Bibliometric analysis of publications combining smart city themes and strategies available in the Scopus database served to answer the question whether the scientific literature corresponds to the current scale of application activities of the smart city idea. Polish voivodeship cities strategic documents' analysis was focused on the main dimensions of the smart city concept they hold, used NLP (Natural Language Processing) methods.

Findings: The literature on the implementation of the concept of smart cities in city strategies focuses on individual aspects of this concept – multidimensional in its essence. More comprehensive research is needed on balancing the goals and perspectives of city stakeholders. Strategies of cities analyzed for the implementation of smart solutions turn out to be fragmented – they focus on (from the most popular) smart economies, life, mobility, environment, governance to smart people. In addition, these strategies are mainly postulative, and the goal of cities is to obtain the status of a smart city rather than support it (only Lublin and Krakow declare this).

Research limitations/implications: Strategic documents alone are too alike to let conclude about the implementation of the smart idea in individual cities. They should be completed with qualitative data. The NLP tools applied, although they provide interesting results, need to be tuned on a larger set of texts than accessible.

Practical implications: Voivodeship cities shape strategies that are too similar to actually compete with each other. Thematic modelling of city-specific documents can unhide context that have not yet been recognized while reflecting their potential to stand out.

Originality/value: The results of topic modelling can reveal latent themes related to the city they manage to city authorities. The gap in theory needs completion by research on the relationship between the smart city concept and urban strategies.

Keywords: smart city, city strategy, thematic modelling, CLARIN.

Category of the paper: Research paper with literature review.

1. Introduction

Currently, the world is undergoing huge changes. The pace of urban development is enormous. At the beginning of the 19th century, less than 1% of the population lived in cities. Within a hundred years, this percentage increased to 13%, and at the turn of the millennium it was 47%. In 2007, the Rubicon was crossed for the first time – then the population of cities exceeded the number of people living in rural areas. It is predicted to reach 68% by 2050 (ESA, 2018). The cities themselves are also growing, reaching the status of megacities with more than ten million inhabitants. From Tokyo to Lagos, from New York to Mumbai, this phenomenon is transforming the socio-economic landscape of the globe as shown in Figure 1. Larger and larger agglomerations are becoming magnets attracting people looking for a better life, work, education or access to advanced services.

But giant urban centers, while vibrant and dynamic, face many problems: infrastructure often cannot keep up with the needs of a growing population, leading to increased congestion, pollution, overloading of transportation systems, etc. These transformations pose huge challenges for city authorities, force a new approach to management and the search for innovative ways to solve growing problems. As a result, modern technologies are increasingly used to enable intelligent management of resources and optimization of urban processes – more cities want to be smart.

Although the idea itself sometimes looks like a fashion, introducing concepts such as "smart management", "smart city" or "technology of the future" into the discussion about cities, nevertheless, "smart city" in the face of urban challenges – becomes a necessity. Smart management is essential for city leaders who need to improve their decisions, introduce sustainable technologies, and react quickly based on real-time data. The key to its implementation is the proper planning of activities at the level of strategic documents.

The aim of this article is to confirm the gap in the connection between the idea of smart city and the development strategies of voivodeship cities and the scope in which the assumptions of smart city are implemented in strategic documents. The question was sought whether and to what extent voivodeship cities consider all six dimensions of smart city developed by the University of Vienna, including smart economy, mobility, environment, residents, quality of life and management, in their development strategies. In addition, an attempt was made to find those areas of activity of local government units in which smart solutions are of particular importance, as well as to find the cities that are declaratively the smartest.

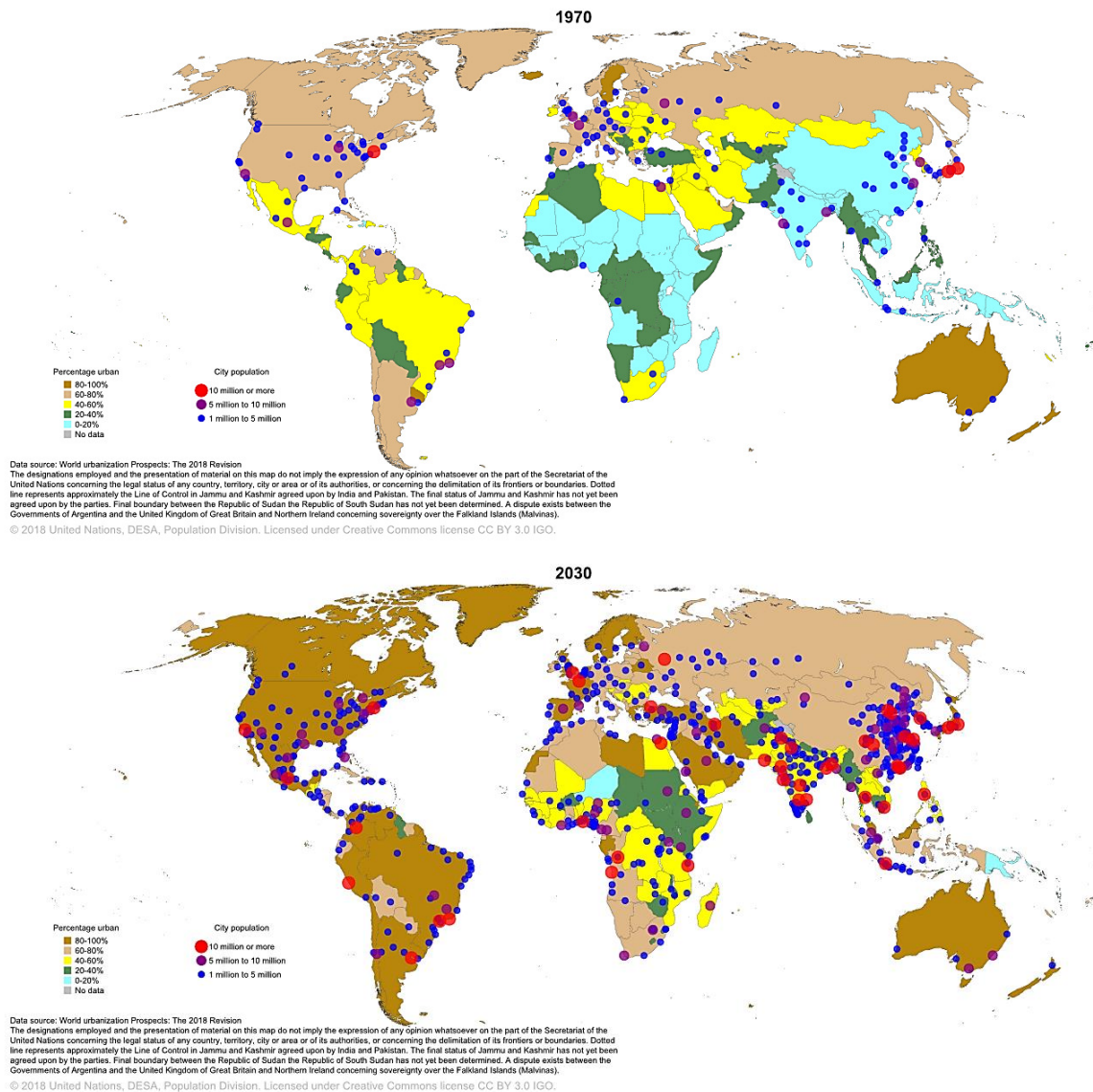


Figure 1. Population growth in cities – towards megacities.

Source: <https://population.un.org/wup/Maps/>, 26.09.2024.

The research procedure consisted of two stages. In the first one, a bibliometric analysis of the literature contained in the Scopus database was performed, which allowed to confirm the research gap. In the second stage, strategic documents of Polish voivodeship cities were reviewed. The analysis uses thematic modelling tools to find the dimensions of smart cities considered in the development strategies of Polish voivodeship cities.

2. The evolution of the smart city idea and the changing role of local administration

In today's dynamic and technologized world, the smart city concept holds the promise of a real improvement in the quality of life, entering the era of comfort and well-being of residents. This is confirmed by the spectacular metamorphosis that cities around the world have undergone over the past decades. From dusty streets and gray apartment blocks, cities have been transformed into sophisticated laboratories of innovation, quasi-organisms pulsating with the energy of digital life. However, this was not always the case. Technology did not at once become an ally to the inhabitants, and cities saturated with it, although impressive, often pushed people and their needs into the shadows.

The increase in popularity of the smart city concept has attracted the attention of not only business entities offering IT solutions, but also scientists, local government officials and residents. This has resulted in numerous definitions of smart city, which have made it possible to distinguish this concept from similar terms, such as information city (*information*), the digital city (*digital*) (Dameri, 2017), the city of knowledge (*knowledge*). Some authors also refer to the community (*community*) (Albino et al., 2015), to highlight the importance of involving residents in collective efforts to improve the quality of life in the city.

The analysis of the set of definitions with the use of Keytool¹ has identified 28 main themes describing smart cities in the definitions, which can be arranged in 11 thematic groups relating to both real and postulative features of the city and its components, management of it and its resources, dimensions of its functioning, as well as the characteristics of its inhabitants. The whole set has been assigned to the category of texts on technology with a probability of $p(a) = 0.9668374062$ (see table 1).

Table 1.

Selected definitions of smart city

Author/year	The content of the definition of "Smart city is...":	Key Terms*
Gififnger et al., 2007	... A city that thinks ahead considers the priorities of the economy, environment, society, mobility, based on intelligent combinations of resources and self-determined activities, as well as using the potential of its residents. <i>Smart city</i> finds and implements smart solutions that allow us to improve the quality of life of residents and expand the offer of public services.	Smart CTY, Smart Solutions, Mobility (Text Class: Economy, P(A)=0.7172861099)

¹ Keytool is a tool provided by CLARIN-PL (<https://services.clarin-pl.eu/services/keytool>) with the help of which you can extract key phrases and proper names from the text. This is done using generative models and multi-label classification. The procedure of identifying keywords in the definitions contained in Table 1 was conducted using the interactive mode on two levels: individual definitions and the entire set of definitions. Keywords for individual definitions are included in the table, along with the probability of assigning these definitions to the indicated labels. The set identified for the entire set of definitions was used to interpret them under the table.

Cont. table 1.

Eger, 2009	... a smart community that consciously responds to the implementation of ICT as a catalyst in solving the problems of residents and economic entities. A smart city focuses on building and expanding infrastructure but attaches key importance to the creation of local identity and civic pride. Smart communities strive not only to implement new technologies, but to promote economic development, employment growth and to improve the quality of life in the city. Thus, the implementation of technology is not an end in itself, but only a way to generate benefits for the local community.	Smart city, local identity, smart communities, ICT, (text class: economy, p(a)=0.7030823231; energy, p(a)=0.8058710098, technology p(a) 0.9243766665)
Harrison et al., 2010	... a city that combines communication, social, business and IT infrastructure, in order to use the collective intelligence of the city.	City, Smart City, City Intelligence (text class: Energy, P(A)=0.609548986, Technology P(A) 0.7799118161)
Chen, 2010	... cities that use the communication and sensor capabilities built into the infrastructure to optimize the flow of energy and the flow of people and goods, supporting the daily life of residents, contributing to the quality of life in the city.	smart city, quality of life, city (text class: economy, p(a)=0.8640865088; energy, p(a)=0.971239686)
Caragliu et al., 2011	... investing in human and social capital as well as traditional (transport) and modern (ICT) communication infrastructure in order to support sustainable economic development with rational management of natural resources, through participatory management.	Participatory management, smart city, sustainable economic development (text class: economy, p(a)=0.546046257; transport, p(a)=0.8190048337; energy, p(a)=0.8299167156; technology p(a)=0.6137210131)
Komminos, 2011	... self-learning, innovative areas, using the creativity of their inhabitants and the knowledge of business entities, as well as digital infrastructure, facilitating communication and knowledge management.	Knowledge management, smart city, (text class: economy, p(a)=0.9912993312; technology p(a) 0.8076601624)
Guan, 2012	... A city that is prepared to provide the conditions for a healthy and happy community in the challenging conditions that global, environmental, economic and social trends may bring.	city, smart city, health, sustainable development (text class: ecology, p(a)=0.6235412955);
Barrionuevo et al., 2012	... a city that uses all available technologies and resources in an intelligent and coordinated way for economic development, respecting the principles of sustainable development and caring for the quality of life	Sustainability, Smart City (text class: Energy, P(A)=0.7566955686; Technology, P(A)=0.9623322487)
Lombardi et al., 2012	... a city that uses information and communication technologies to increase the interactivity and efficiency of urban infrastructure and its components, as well as to raise awareness among residents	Mobility, Smart City (Text Class: Technology, P(A)=0.7716469765)
Bakıcı, 2013	... an innovative city, rich in advanced technologies (high-tech) that connects people, information and all elements of the city in order to create a green, competitive city with a high quality of life	Eco-City, Smart City, Smart City (Text Class: Economy, P(A)=0.75703758; Technology P(A) 0.9712774754)

Cont. table 1.

Duckenfield, 2014	... A city that is pleasant to live in, work and socialize, which is networked, technologically connected and modern	City, Smart City, Livable City (text class: Technology, P(A)=0.5536438823)
Marsal-Llacuna et al., 2015	Cities that aim to improve the functioning of the entire urban area by using data, information and information technology (ICT) to provide more efficient services, monitor and optimize existing infrastructure, and increase cooperation between different stakeholder groups are innovative cities that are implementing new business models	innovative city, smart city, ICT (text class: economy, p(a)=0.9962778687)

Source: own elaboration based on: (Hall, Bowerman, Braverman, Taylor, Todosow, Von Wimmersperg, 2000. https://www.researchgate.net/publication/241977644_The_vision_of_a_smart_city, [21.01.2021]; Giffinger, Fertner, Kramar, Kalasek, Pichler-Milanović, 2007; http://www.smart-cities.eu/download/smart_cities_final_report.pdf [21.01.2021]; Eger, 2009; Harrison, Eckman, Hamilton, Hartswick, Kalagnanam, Paraszcak, Williams, 2010; Chen, 2010; Caragliu, Del Bo, Nijkamp, 2011; Komninos, 2011; Guan, 2012; Barrionuevo, Berrone, Ricart, 2012; Lombardi, Giordano, Farouh, Yousef, 2012; Bakıcı, Almirall, Wareham, 2013; Duckenfield, 2014; Marsal-Llacuna, Colomer-Llinàs, Meléndez-Frigola, 2015.

A constitutive feature of a smart city is the presence of modern technologies, which are to improve the quality of life (Bakıcı et al., 2013; Barrionuevo et al., 2012; Chen, 2010; Eger, 2009; Giffinger et al., 2007; Guan, 2012; Duckenfield, 2014), optimize resource use (Harrison et al., 2010; Lombardi et al., 2012; Marsal-Llacuna et al., 2015), sustainable development (Barrionuevo et al., 2012; Caragliu et al., 2009).

Smart city is a city that intelligently combines its resources (Giffinger, Fertner, Kramar, Meijers et al., 2007) including natural (Caragliu et al., 2009) and technological (Barrionuevo et al., 2012; Harrison et al., 2010), and optimizing urban infrastructure (Marsal-Llacuna et al., 2015) as well as the flows taking place in it (Chen, 2010). This requires the use of information and communication technologies (Eger, 2009; Lombardi et al., 2012) and their development (Caragliu et al., 2009) or to use information technologies (Bakıcı et al., 2013; Harrison et al., 2010), which bring together the components of the city and the people (Caretaker et al., 2013; Duckenfield, 2014). A smart city can also be determined by a smart community, which is sometimes treated as an object of investment (Caragliu et al., 2009), but much more often as a subject. The creativity of the inhabitants co-creates the innovation of the city (Caretaker et al., 2013; Komninos, 2011; Marsal-Llacuna et al., 2015) involved with the city administration in participatory city management (Caragliu et al., 2009) or knowledge management (Komninos, 2011). The authors differ in their approach to the smart city goal. Marsal-Llacuna sees it in strengthening stakeholder cooperation, Guan in the health and happiness of the city's community, and Lombardi only in increasing the awareness of residents while improving the efficiency of the city's infrastructure. Harrison shifts the focus from people to the use of city intelligence, which for Barrionuevo is a means to economic development (the actual goal of the smart city). For Caragliu, the economic development of the smart city must be sustainable, and for Caragliu, the Bakıcı Smart City is supposed to be ecological.

Synthetically speaking, the common feature is the use of IT and ICT to achieve the city's goals, although also in this case the emphasis can be placed on intelligent solutions (not necessarily technologies – (Barrionuevo et al., 2012)), traditional mobility infrastructure

or the social dimension of the (Guan, 2012). It is worth noting the advantage of understanding the essence of a smart city as a city that is an abstract system in which residents are only one of the components. Only Eger considers a smart community to be a constitutive element of a smart city, while Komninos considers it in an urban sense. In the urban system, the role of the decision-making and executive center is played by its administration, with a greater or lesser involvement of residents and other stakeholders to achieve the assumed goals. A review of the definitions reveals discrepancies in the approach to smart city goals (quality of life, health and happiness of residents, economic and sustainable development, green city, use of city intelligence, optimization of urban infrastructure, increased awareness of residents, closer cooperation of stakeholders). Other features of a smart city form a diverse catalogue, divergent in some dimensions (e.g., the role of the community), in others postulated (e.g., ensuring happiness). According to the quoted authors, a smart city is a city of knowledge, innovation and creativity, with a wide participation of residents in management, rationally using all available resources and technologies for sustainable, competitive economic development, integrating its stakeholders. From this point of view, the idea of a smart city integrates perspectives expressed in the concepts of a digital city, a smart city and a city of knowledge.

The constant evolution of cities, reflecting the changing needs of societies, technological progress and growing environmental awareness has led to a re-evaluation of the understanding of smart cities. As a result, we can distinguish four development phases (Generation of smart city, 2024); which at the same time can serve as a typology of cities due to their degree of implementation of the smart city idea:

1. Smart city 1.0 – covers a period of experimentation and fascination with new information and communication technologies that allow for an increase in the efficiency of the city's functioning. It is identified with sensors and software algorithms integrated into the urban fabric (Kitchin, 2014), where the city authorities adhere to the "must have" philosophy, i.e. a vision of the city of the future controlled and driven by the private sector, in which the relations and interactions between the city and its residents have been lost.
2. Smart city 2.0 – this is the phase in which data is becoming the new standard, and the development of Big Data technology and data analysis has allowed for a deeper understanding of urban dynamics and effective city management. The Internet of Things (IoT) has brought a new era of real-time monitoring and management of city infrastructure, opening the door to endless possibilities for administrations to refine and improve the quality of life for residents. To avoid the risk of dehumanization of technology-oriented cities, the future of cities requires cooperation between local authorities and residents (Robinson, 2015). Only this synergy makes cities truly intelligent, becoming a source of inspiration and fascinating perspectives for urban development (Szołtysek, 2019).

3. Smart city 3.0 is a period of integration of various systems and services. Cities have moved from implementing siloed solutions to developing cohesive, human-centric ecosystems where residents actively take part in society and decide on the future of cities. In this phase, macroeconomic measures of the city's development lose their importance in favor of others that describe the quality of life in the city, such as creativity, innovation, democracy, a sense of happiness, the degree of acceptance by the environment or satisfaction with living in a given city (Montgomery, 2015, p. 129). Smart city 3.0 means a return to the human dimension of the city, aimed at building a civil society (Gehl, 2014, p. 3).
4. Smart city 4.0 – the latest version of the cities of the future, in which innovation is not the goal, but a means of its implementation. The logic of the city authorities and – to a greater or lesser extent – its inhabitants is dominated by the pursuit of sustainable development goals (the so-called UN Millennium Goals) and the involvement of residents in the active creation of solutions. Smart city 4.0 sets the boundary between traditional cities and the future of integrated and innovative communities. It is a vision of a city where technology becomes the foundation on which to build an improvement in the quality of life, social well-being and happiness of its residents. A challenge that may hinder the further development of this concept – at least in Europe – is still the issue of the energy needs of cities that are massively adopting ICT.

Since smart cities cover all areas of life, it is often treated as a panacea for city problems. In this spirit, solutions based on the use of modern technologies are already implemented in Smart City 1.0 in the area of the "pain" of a given urban center (and especially its business stakeholders): communication, pollution or optimization of urban management (Galati, 2017), especially in the context of mobility and infrastructure. In this regard, researchers from the Vienna University of Technology (see also: Lee et al., 2013) They identified six basic dimensions of a smart city: smart mobility, smart economy, smart environment, smart people, smart governance and smart living². This holistic approach enables city authorities to consider all relevant functional aspects of the city in their ongoing response to emerging challenges as well as in their long-term planning. The degree and manner of their inclusion in the strategic documents of cities allows us to conclude about the level of implementation of the smart city concept in them.

In the era of dynamic development of cities and the increase in the number of their inhabitants, the concept of smart city should become a key element of the development strategy of urban centers. The strategy allows you to outline the directions of the city's development and respond appropriately to changes in its surroundings. Without entering into the definitional discourse on development strategy, we will assume that it is a system of medium- and long-

² As Galati points out, the smart city is still more of a vision of the future than a reality. He justifies his judgment by the lack of any example of cities in which all dimensions would be realized (Galati, 2017).

term frameworks of activity, setting the directions of development. In other words, it is a well-thought-out concept of action, thanks to which the city, considered by analogy as an organization, generates a competitive advantage – to attract new (desirable) groups of residents, business entities, investments. The implementation of the strategy results in a diverse level of economic development and quality of life in the city. Although the attractiveness of a city is affected by its resources and the potential for their best use, the strategy is a *sine non* condition for effective management of resources and potential. Formulating urban development strategies is the domain of local authorities, which in their pursuit of implementing the idea of smart city can be supported by local, national and EU authorities.

The concept of a smart city is directly in line with the EU's goals related to the European Green Deal. They impose on local governments the obligation to create strategies to reduce CO₂ emissions, improve energy efficiency and promote sustainable transport. According to Article 174 of the Treaty on the Functioning of the European Union (TFEU), cities are obliged to pursue a cohesion policy that aims to reduce disparities in the development of regions, including the implementation of innovative urban solutions following the principles of sustainable development. In this context, European legislation, such as Regulation (EU) 2021/1058 of the European Parliament and of the Council on the European Regional Development Fund and the Cohesion Fund, stimulates the development of smart cities by funding innovative projects and supporting integrated approaches to urban space management. Also, the Regulation (EU) 2021/1060 of the European Parliament and of the Council sets up rules on the use of structural funds, obliging local governments to develop territorial strategies that combine smart city goals with regional and local priorities.

In addition, the Urban Agenda for the EU, as a voluntary initiative of cooperation between cities and EU institutions, promotes the implementation of smart city solutions that integrate sustainable development with digital technologies, transport and energy efficiency. Strategic planning at local and regional level, supported by instruments such as Integrated Territorial Investments (ITI), is therefore crucial for the success of urban development policy.

Development strategies that consider the assumptions of smart cities allow cities not only to respond more effectively to the challenges of a growing population and environmental problems, but also increase their investment attractiveness and competitiveness in the international arena. The introduction of smart solutions makes it easier to meet the expectations of residents as well as obligations towards European legislation. Local governments that effectively integrate smart city assumptions into their strategies have the opportunity to use EU funds, while improving the quality of life and promoting sustainable urban development.

In recent years, the concept of smart cities has been gaining popularity all over the world. It is based on the use of modern technologies to improve the daily lives of residents and improve the operation of cities. Importantly, this is no longer just a priority for major metropolises such as London, New York and Tokyo. More smaller cities also see the potential in these solutions, introducing intelligent transport, energy or waste management systems. Also in Poland, cities

are beginning to implement the smart city concept, which allows them not only to keep up with global trends, but also to better respond to the needs of residents and challenges related to the development of urban infrastructure. The choice of Polish voivodeship cities as the subject of research on the scope of implementation of the smart city idea in strategic documents is justified for many reasons:

1. Poland, which is one of the leaders in Central and Eastern Europe in terms of urban development, began to integrate the idea of smart city in urban development strategies relatively early. In particular, voivodeship cities, as the largest and most important administrative, economic and cultural centers, play a key role in the formulation and implementation of sustainable development policies and the implementation of modern technologies in urban space management.
2. Voivodeship cities in Poland function as central regional points, which means that not only their own development, but also the development of entire regions depends on their ability to innovate. As the main decision-making centers, these cities have the largest financial, administrative and intellectual resources, which makes them natural leaders in the implementation of smart city strategies. Investments in digitalization, intelligent transport systems, sustainable environmental management and innovative public services contribute to improving the quality of life of citizens and increasing the operational efficiency of cities;
3. Polish voivodeship cities are diverse in terms of scale, nature and challenges, which makes it possible to analyze their strategies from different perspectives. Cities such as Warsaw, Krakow, Wrocław and Poznań, which are metropolises with high economic potential and strong international ties, are implementing smart city projects in a more advanced way, integrating technologies in various areas – from urban mobility to the digitization of public services. On the other hand, smaller voivodeship cities, such as Rzeszów, Opole or Zielona Góra, have unique challenges related to limited resources, but also innovative approaches to local problems, which makes them interesting examples for analyzing the effectiveness of implemented smart city solutions.
4. Voivodeship cities are often beneficiaries of European programs that support the development of smart cities. Thanks to European Union financial programs, such as Horizon 2020, the European Regional Development Fund (ERDF) or the National Recovery Plan, these cities have access to funds for the implementation of projects related to digitization, environmental protection, transport and social innovation. Examples include: the "Smart City Warsaw" Project, the "Integrated Public Transport System" for the City of Krakow, "ITS Wrocław", "Smart City: Gdańsk", the "City Hub Łódź" Project, the "Smart Rzeszów" Project.

Finally, the choice of voivodeship cities makes it possible to compare their development with other European urban centers that include the idea of smart city in development strategies. Polish cities are becoming part of global urban trends, and their development in this area is increasingly noticed in international rankings, such as the IMD Smart City Index – an assessment of the city in terms of innovation, digitization and sustainable development; IESE Cities in Motion Index – evaluates cities in terms of technology, mobility, environment and governance, or Global Smart City Index – evaluates cities in terms of smart city strategy, infrastructure and implemented projects (cf. Table 1).

Table 2.

The place of Polish cities in smart city rankings

Ranking City	IMD Smart City Index				IESE Cities in Motion Index				Global Smart City Index			
	year				year				year			
	2020	2021	2022	2023	2020	2021	2022	2023	2020	2021	2022	2023
Warsaw	75	75	69	63	83	83	77	73	55	55	50	47
Cracow	88	88	82	79	108	108	102	98	N/A	N/A	N/A	N/A
Wroclaw	85	85	80	76	90	90	85	81	60	60	55	51
Gdansk	95	95	89	85	105	105	99	94	95	95	89	85
Poznan	N/A	105	98	93	110	110	105	100	115	115	110	105
Boat	103	103	98	83	120	120	115	110	115	115	108	102
Rzeszow	N/A	N/A	N/A	120	N/A	N/A	N/A	130	N/A	N/A	N/A	125
Katowice	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	120	115
Szczecin	N/A	N/A	N/A	N/A	N/A	N/A	130	125	N/A	N/A	N/A	N/A

Source: In-house analysis based on: IMD Smart City Index, IESE Cities in Motion Index, Global Smart City Index.

The analysis of the position of Polish voivodeship cities in the context of these rankings allows us to assess their progress and shows a systematic improvement in positions. And this emphasizes their dynamic development and increasing competitiveness against the international background.

3. Methods

Since, despite the growing interest in the concept of smart city, there is still a noticeable deficit of publications in the literature that comprehensively combine urban development strategies with the idea of smart city, it is planned to carry out a bibliometric analysis of the literature to confirm it³ available in the Scopus database, in accordance with the principles adopted in this type of research (Orłowska et al., 2017). On the other hand, in order to identify the degree of implementation of the smart city idea in the currently applicable strategies of regional capitals (on the example of Polish voivodeship capitals), we analyzed them using NLP

³ The purpose of this study is not to make a systematic review of the literature, but only to indicate the deficit of scientific publications in this area.

tools (thematic modeling), paying particular attention to morphosyntactic relationships related to the concept of smart city. At the beginning of the bibliometric analysis, we formulated the following research questions – To what extent does the scientific literature take into account the links between urban development strategies and the implementation of the smart city concept, and what are the main areas of research concerning the implementation of the smart city idea in urban development strategies?

Scientific articles from the last ten years were used to develop the review. The research was conducted in September 2024. The following keywords were used at the search stage: *smart city*, *city strategy* and *strategy city planning*. This allowed us to extract 130 publications on smart cities in connection with urban development strategies in the Scopus database.

In order to implement the second strand of the study, an analysis of strategic documents was conducted to find whether local government units fully integrate modern technological and digital solutions in their development plans, and which of these solutions are considered key for individual cities. In particular, they were interested in how individual voivodeship cities treat smart city assumptions in the context of their unique challenges and resources.

To achieve our goal, we were looking for an answer to the question of what specific technologies and digital solutions are considered to be priorities in cities and to what extent individual local government units implement the full spectrum of smart solutions, corresponding to all dimensions of smart city.

The study used thematic modelling tools to find the main themes that fit into the six main dimensions of smart city, as defined by the Technical University of Vienna: smart economy, smart mobility, smart environment, smart people, smart living and smart governance. The strategies of voivodeship cities were examined in terms of the presence of individual dimensions of smart city in their records using NLP (Natural Language Processing) tools, including the extraction of information from texts (Topic). The research procedure consisted of four stages (see figure 2).



Figure 2. The research procedure.

Source: own work.

The first stage consisted in collecting strategic documents of all voivodeship capitals. The strategies were obtained from the official websites of voivodeship cities in the form of pdf documents. Their further processing and analysis were conducted using applications and services available on the CLARIN-PL platform. In the next stage, the documents were

transformed into a lexical corpus with strategies of voivodeship cities using the Korpusomat.eu application⁴.

To extract topics (topics), the Topic HITL application using the LDA algorithm was used⁵. This allowed them to find the coexisting words that make up a given topic. In the course of next reviews of the results, the stop list was supplemented (up to the level of 6326 items) and the number of topics (3, 12, 100, 18, 50, 30, 20) and the level of the λ parameter (0-1) were changed. The interactive nature of Topic HITL allows for online analysis of the obtained results and their modification in next rounds of calculations based on data illustrated with a map of distances between topics and an integrated bar chart. The final results of the analysis are presented in the form of a map of the distances between the topics (see Fig. 3) and – for practical reasons – in a table including the numbers and names of topics assigned to the cities that occurred in a given topic (Table 5). Figure 3 illustrates both parameters for Lublin, as the first city whose name appears on the list of the most important (salient) terms of the entire corpus. "Lublin" is part of the topics (in descending order of relevance of this term, shown by the size of the fields on the map) numbered 15, 1, 12.

The size of the fields illustrating topics on the map depends on their share in the corpus (the marginal distribution of the topic based on *the distinctiveness* and *relevance* of the words in it), while the selection of a word from the bar chart allows you to see the conditional distribution of this term in the topics in which it occurs on the map. This allows for a quick assessment of the distinctiveness of a word (few topics in which it occurs) and its appropriateness in relation to a given topic (the size of the field on the map).

⁴ Korpusomat.eu is a free platform that is an extension of the Polish version of the CLARIN-PL.eu project, which allows you to create and process text corpora. The input document is transformed into a multi-layered (with the help of two high-level programming libraries for natural language processing, spaCy and Stanza) corpus of texts, which can then be analyzed in morphosyntactic terms. The conversion of input files is based on the Universal Dependencies (UD) scheme allowing for consistent cross-language annotation, Karol Saputa, Aleksandra Tomaszewska, Natalia Zawadzka-Palueta, Witold Kieraś, and Łukasz Kobyliński. Korpusomat.eu: A multilingual platform for building and analyzing linguistic corpora. In Jiří Mikyška, Clélia de Mulatier, Maciej Paszynski, Valeria V. Krzhizhanovskaya, Jack J. Dongarra, and Peter M.A. Slood, editors, Computational Science – ICCS 2023. 23rd International Conference, Prague, Czech Republic, July 3–5, 2023, Proceedings, Part II, number 14074 in Lecture Notes in Computer Science, pp. 230-237, Cham, 2023. Springer Nature Switzerland. Source: <https://korpusomat-eu.readthedocs.io/pl/latest/manual/preferences.html>, 21.11.2024.

⁵ The Latent Dirichlet Allocation (LDA) method is used to identify hidden topics as polynomial probability distributions for terms that occur in a corpus dictionary (word list) (Sievert, Shirley, 2014). The method assumes that the corpus is a collection of texts that are 'bags of words', and each text can consist of many topics (<https://www.ibm.com/topics/latent-dirichlet-allocation#f01>). For a given corpus, (1) a model of the coexistence of words in a given fragment (text) and in the entire corpus is determined, and (2) the probabilities of the occurrence of individual words in a random topic to which a given text has been assigned (the same text to many topics) are calculated. On the basis of the calculated probability of the occurrence of a word in a given topic, the content of the topics is determined (fuzzy grouping – *fuzzy clustering*, <https://wiki.clarin-pl.eu/pl/nlp/services/list/topic3>). This is done by using Gibbs sampling in successive iterations of the calculation (100 iterations are set in the CLARIN solution), allowing the result to be gradually sharpened (Murel, Kavlakoglu, What is Latent Dirichlet allocation, 4.22.2024, <https://www.ibm.com/topics/latent-dirichlet-allocation#f01>, 23.11.2024. Assigning words (terms) to topics also means assigning texts in which the terms occur to them.

The selected topics are additionally illustrated in the form of the so-called word cloud, which show the immersion of terms in relation to other terms belonging to a given topic and text in a multidimensional space (up to a maximum of 1000 dimensions). With a sufficiently large number of segments in the corpus (> 1 million), the results obtained allow us to find hidden connections in the corpus texts and assign them to significant topics. Their interpretation requires the participation of a researcher who deciphers the meaning resulting from the word cloud and from the list of the most important words (bar chart).

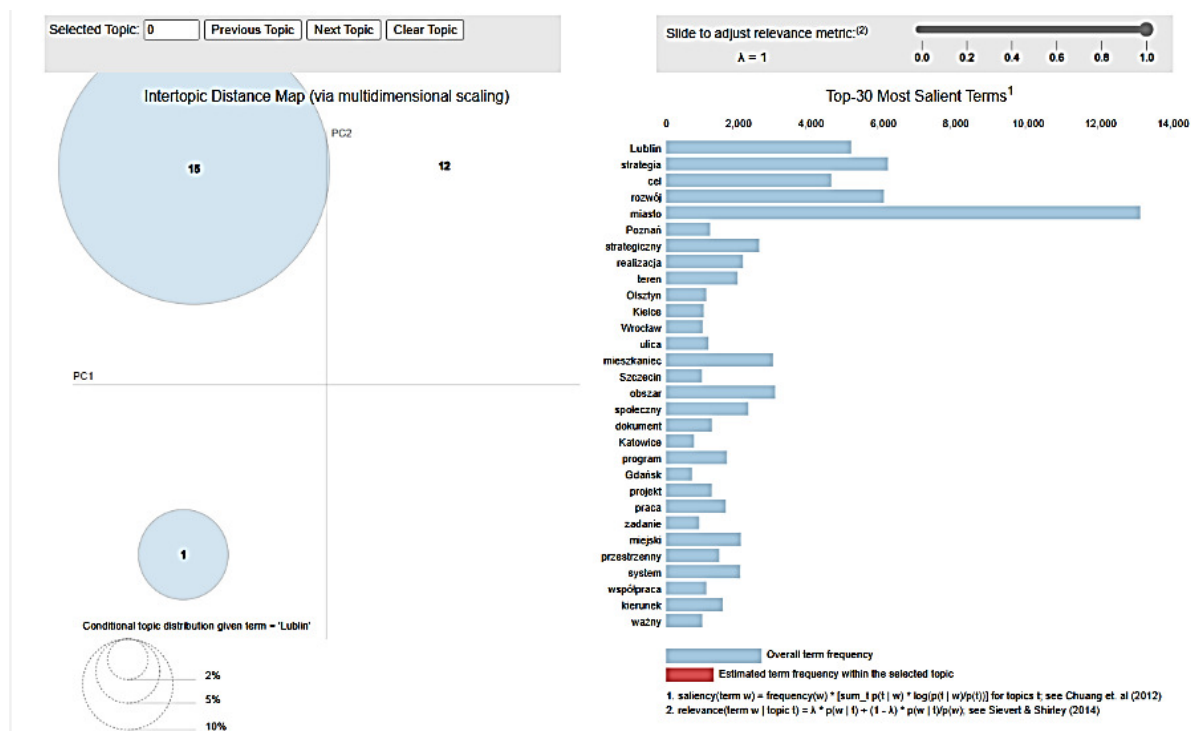


Figure 3. Visualized results of thematic modeling for a selected term in an iteration with twenty topics. *Left:* A distance map between topics with multidimensional scaling of the due date position relative to PC1 and PC2. *Right:* a bar graph of the thirty most important terms for the entire corpus.

Source: own study.

4. Results

4.1. Smart city in the context of urban development strategies – results of the literature review

A literature review shows that there is a distraction among researchers who focus on particular aspects of smart cities, such as technology and sustainable transport, but there is no holistic approach that integrates these elements into the strategic planning of cities. The deficit of studies analyzing in detail the links between urban development strategies and the implementation of the smart city concept is confirmed by the results of a bibliometric analysis of the literature available in the Scopus database, following the principles adopted in this type

of research. The answer to the questions about the degree of consideration in the scientific literature of the links between urban development strategies and the implementation of the smart city concept, as well as about the main areas of research concerning the implementation of the smart city idea in urban development strategies, allowed to distinguish in the collected collection of scientific texts (130 items) the following groups of publications concerning:

1. Theoretical framework of urban development and its connections with the idea of smart city (Albino et al., 2015; Bolici, Mora, 2015; Ders, 2016; Mora et al., 2017).
2. Case studies of cities that integrated smart city concepts with urban planning (Batty, 2018; Hu, 2019; Mancebo, 2020; Tranos, Gertner, 2012).
3. Urban policies and regulations supporting sustainable urban development, including smart technologies (Barber, 2013; Lange, Knieling, 2020; March Yun, Lee, 2019).
4. Various aspects of smart city implementation, such as technologies (IoT, Big Data, AI), urban infrastructure management, digitization of public services (Caragliu et al., 2009; Chourabi et al., 2012; Naphade et al., 2011; Zhang et al., 2020).
5. Examples of the implementation of the smart city idea in the context of urban development policy at the local, regional and global level (Dameri, 2017; Hu, 2019; Lange, Knieling, 2020; Paskaleva, 2011).

Although the number of publications shows an upward trend in 2015-2024, their number is still relatively low (see figure 4). This shows the disproportionality to the needs resulting from increasing urbanization and the requirements of sustainable development, and at the same time signals the need to increase the intensity of research on smart city development strategies. This area has great potential to bring real benefits to the cities of the future.

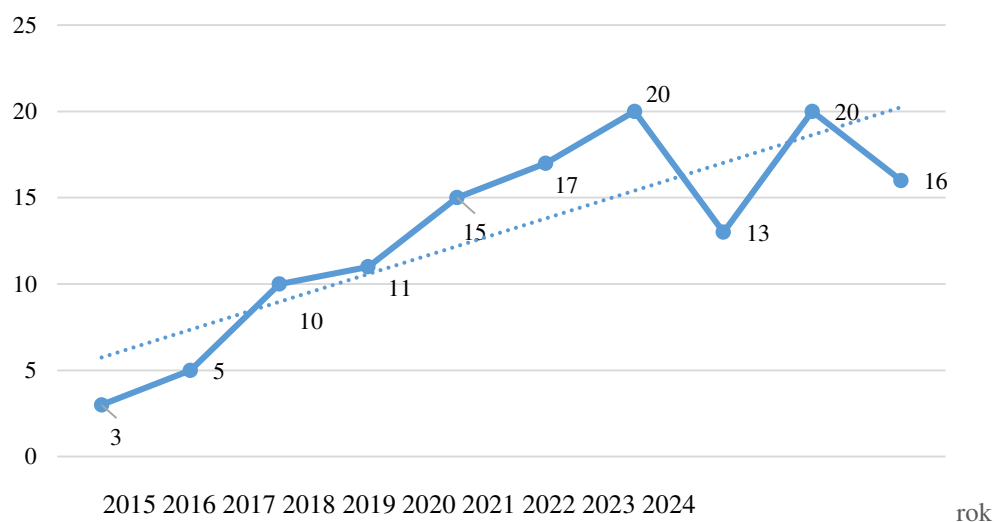


Figure 4. Number of publications on smart city issues in the context of urban development strategies. Source: based on Scopus.com.

Considering the country of publication, there is a significant heterogeneity of literature, with all continents been in the list (in the figure except South America). A total of forty-three countries were found, from which the authors addressed the issue of implementing the idea of smart city in strategic documents as shown on Figure 5.

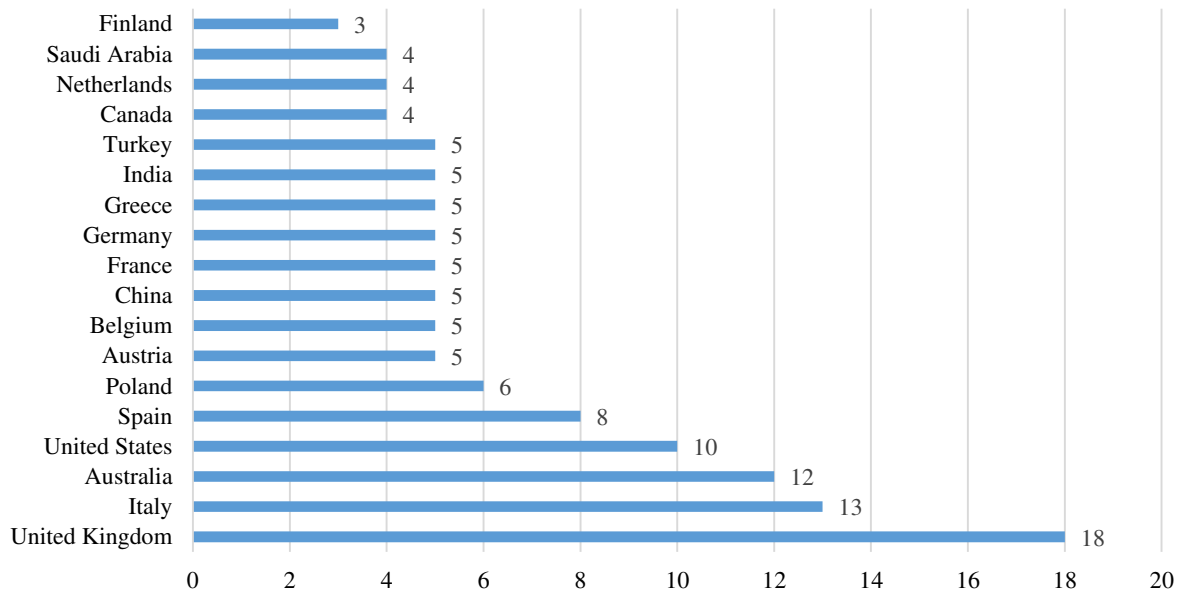


Figure 5. Number of publications by country.

Source based on: Scopus.com.

In the case of multi-author texts, the publication was assigned to the country of the first author, which resulted in the concentration of articles in the United Kingdom (18), Italy (13), and then in Australia (12), the United States (10), Spain (8) and Poland (6). The distribution of publications on smart cities and urban development strategies reflects the level of advancement and scale of implemented urban initiatives. Leading the way are countries such as the United Kingdom, Italy, Australia and the United States, which are investing heavily in the development of smart city technologies. London, Milan and Melbourne are the cities that have become pioneers of intelligent energy, transport and public space management systems. Their projects, such as the "Smart City Plan" in Australia or the "Smart Columbus" in the USA, stimulate academic research, which is reflected in scientific publications. Interestingly, a relatively large number of publications come from Polish, where the implementation of the smart city concept is still in the development phase, and Polish cities are not leaders in smart city rankings. Nevertheless, cities such as m.in. Gdańsk, Warsaw and Wrocław can boast of programs for the implementation of intelligent transport systems or energy and water management.

A large diversity was also noted in the context of assigning publications to scientific disciplines (see fig. 6). It is not surprising that publications in the field of social sciences prevail (91). The development of smart cities is undoubtedly an area strongly related to public management, urban policy, urban planning and interactions between people and technology. Smart cities are not only about technology, but above all about changing the functioning of

cities and communities. The second place was taken by technical sciences (37 publications), which emphasizes the technological and infrastructural side of smart city implementation.

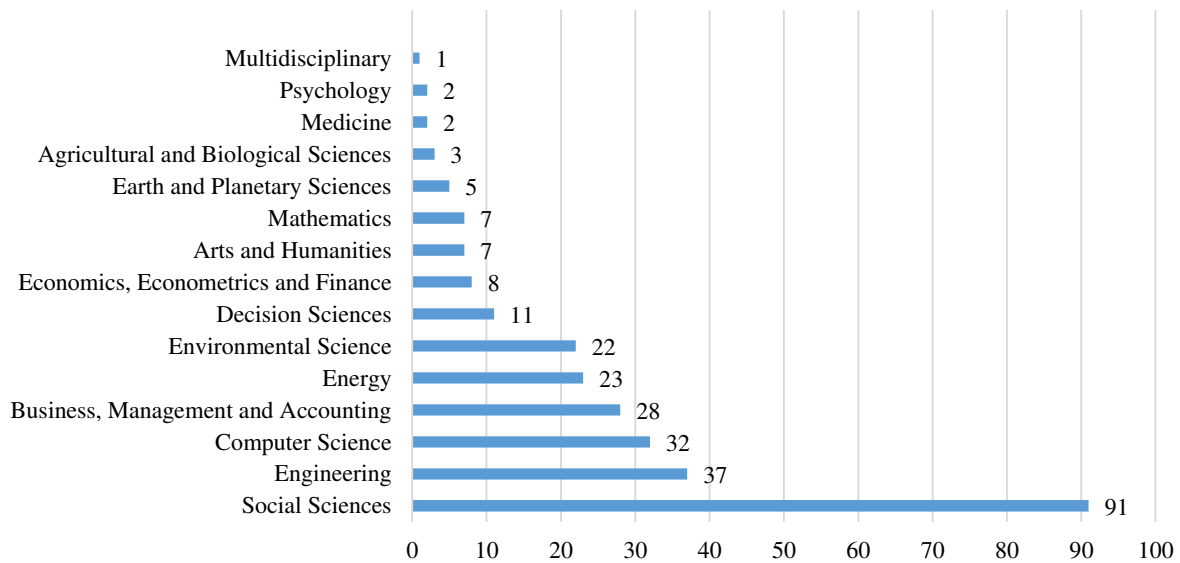


Figure 6. Number of publications by research area.

Source based on: Scopus.com.

Engineers are key in developing intelligent transportation, energy, water, and other aspects of urban infrastructure. It is no different in the case of computer scientists, which so leads to a significant number of publications (32) assigned to this research area. Smart cities are based on modern IT systems, such as IoT (Internet of Things), big data or artificial intelligence, which enable data collection, analysis and optimization of city management. Management sciences (28 publications) and energy sciences (23 publications) occupy an equally important place, as smart cities are designed with sustainable management of energy resources in mind, and effective business models are necessary for financing and implementing these technologies. Environmental sciences also play an important role – smart cities focus on sustainable development and minimizing the negative impact of cities on the environment through CO₂ emission management, waste and sustainable water management.

The institutional perspective (see fig. 7) reveals the main sponsors of research on the idea of smart cities and regional development. Of these, the European Commission is at the forefront, mainly through the Horizon 2020 program and the European Regional Development Fund (ERDF). This reflects the Commission's efforts to implement the concept of sustainable smart growth in the cities of the EU Member States, in response to the challenges of urbanization and climate change. Through Horizon 2020, investments were made in innovations that improve the quality of life and at the same time develop model models of cities of the future. They would be based on the potential of digital technologies, artificial intelligence and the Internet of Things (IoT), but in connection with social and environmental policy. Thanks to this formula, cities would become more efficient, resident-friendly (inclusive) and ecological, and thus more resilient to climate change.

In the next stage, the material was selected in terms of the quality of the presented research – all abstracts and keywords were analyzed. This activity was used to select publications on the basis of which attempts were made to find the main areas of research related to the implementation of the smart city idea in urban development strategies. All those articles in which the issue of the strategy was only a contribution were rejected.

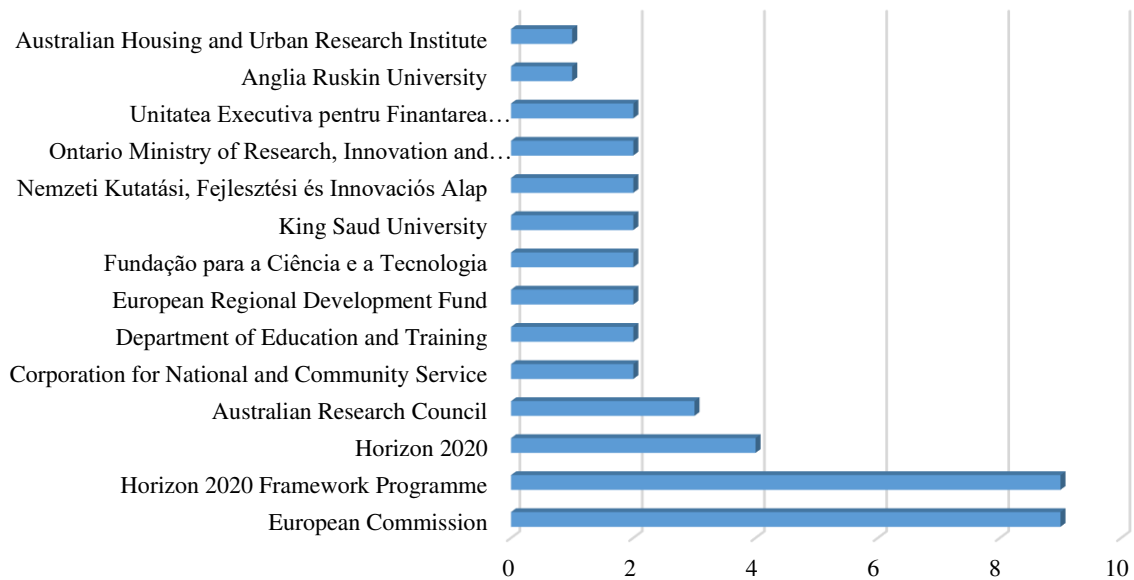


Figure 7. Number of publications by Funding Institution.

Source based on: Scopus.com.

A detailed analysis of the texts, which included thirty-five articles, leads to the conclusion that the idea of a smart city is a holistic approach to solving the problems of modern cities and responds to the needs of their residents. In scientific literature, numerous key areas of research are distinguished, showing the complexity and multifaceted implementation of the smart city idea in urban development strategies. The included publications distinguish areas that correspond to the dimensions of smart cities proposed in the previously cited report of the University of Vienna. Technology and infrastructure are at the forefront, followed by sustainability and the environment, followed by urban governance and social innovation, and research into social inclusion and quality of life. A separate thread related to modern technologies turns out to be the subject of safety in the city and management of intelligent buildings. Finally, the area of research focusing on the challenges related to the management and implementation of smart city strategies in cities should also be mentioned. A discussion on the detailed arrangements for each of the identified areas will be presented in the last point.

4.2. The scope of implementation of the smart city idea in city strategies – the perspective of Polish voivodeship cities

In the field of analysis of the strategy of voivodeship cities, it covered the corpus built of transformed strategic documents. At this stage, the corpus query function was used to detect occurrences of the phrase "smart city" (corpus search formula: [orth="(smart)"] [upos="(NOUN)" & orth="c.*"] - 71 occurrences in the noun form were detected, 11 of which were repetitions. The function of finding the word profile for the lemma "smart" and its connection with other corpus concepts (collocations) was also used. The presence of the concept of "smart city" in strategic documents of Polish voivodeship cities is confirmed by the occurrence of the terms smart and city (with the lemma "cit" 49 times) in the form of a multi-word expression (Table 3).

Table 3.

Collocations of the word "smart" in the noun form detected in the corpus under study

Nature of the speech	The word with which "smart" is used in coordination	Adjective modifiers of the word "smart"	Nominal modifiers of the word "smart"	Words whose modifier is "smart"	Prepositions "smart"	Words with which "smart" creates multi-word expressions
Co-occurring words in relation to "smart" (frequency of occurrence in the corpus)	<ul style="list-style-type: none"> • Linkage (8.404) • Economy (7.072) • Environment (6.654) 	<ul style="list-style-type: none"> • CIT (8.878) 	<ul style="list-style-type: none"> • CIT (11,685) • create (8.678) 	<ul style="list-style-type: none"> • Idea (9.917) • concept (9.356) • build (9.188) • Solution (8.039) • conditions (7.745) • area (6.062) • city (4.672) 	<ul style="list-style-type: none"> • in (4.096) 	<ul style="list-style-type: none"> • CIT (12,907) • mobilite (10.023) • living (10.023) • Economa (9.978) • environme nt (9.642)

Source: own work based on https://korpusomat.eu/word_profiles/3717/, 21.11.2024.

A detailed review of the detected collocations (word combinations here: in the studied corpus) reveals the following properties of the studied strategies of voivodeship cities:

- In terms of form, they are very diverse: stylistically, the volume of the text, the time of its creation (the earliest: in 2011, the latest in 2023) and the way it was designed, as a result – despite the common threads and solutions resulting from the similarity of the features and role of the strategic object, each of the strategies is a separate and specific record of the plans of the authorities of a specific city;
- The creators of the city strategy are aware of the importance and potential of the Smart City concept for their centers, as showed by its reference in documents directly or in the form of a Polish translation (smart city);
- The word smart appears in strategies in multi-word expressions "smart city" (49 co-occurrences), smart mobility (4 co-occurrences), smart living (4), smart economy (4), smart environment (3) which shows the scope of implementation of the concept;

- Smart City occurs eight times in strategies in a prepositional phrase such as "towards" – signaling that it is the target point of the strategy, or "in the area", which is combined in the studied set with a description of the solutions already implemented;
- Smart city is named in strategies as an idea (9 times) or a concept (5 times) that brings with it certain solutions (4 presentations), or is used to build the image of the city (5) or create good living conditions in it (8);
- Finally, smart cities coexist with the category of functional connections in space (4), economy (4), and the environment (3 times).

In response to the question about the degree and scope of implementation of the smart city concept, one may be tempted to point out that this idea is present in the strategies of Polish cities, but rather as a promising direction for improving selected areas of the city's functioning than a comprehensively implemented concept of its transformation. The only exception is Lublin, for which the current strategy directly provides for the continuation of the implementation of the smart city idea started in the earlier strategic period. Some cities, on the other hand, focus on sustainable, innovative, multidimensional (Katowice) or "wise" (Wrocław) development, which is shown in Table 4 as an expression of the city's strategic self-identification. Although these are mutually consistent approaches, the choice of any of them can be interpreted either as a manifestation of distance from the latest global trends in the development of cities, or as an attempt to continue the previously chosen development trajectory, better suited to the identified challenges and potentials of a given city. A solution in this regard will require further research using questionnaires.

The processed corpus consists of fifty-five documents in .txt, .json and .conllu formats, along with a .xlsx frequency list, which were then subjected to thematic modeling (Walkowiak, Gniewkowski, 2020), using the Topic HITL application⁶ made available by CLARIN.PL⁷. The corpus consists of 554013 segments, and the frequency list consists of 25971 lemmas with a frequency of occurrence from 55003 to 1, with the most frequent occurrence being a dot (punctuation mark).

⁶ Topic HITL (Human-in-the-Loop) allows for automatic extraction of information about topics covered in the texts of the corpus being processed. For this purpose, text processing methods appropriate for each stage of thematic modeling are used: 1. Dividing excessively long texts into fragments (max. 20,000 characters), 2. segmentation of texts into sentences, identification of grammatical classes and lemmatization (tool: postagger), 3. generation of topics in graphic form. The researcher has an impact on the preparation of the input data (corpus cleaning, parameterization of the lists of words taken into account – the so-called start list and those not included in the modeling – the so-called stop list), the selection of modeling parameters: the number of topics (4-100), the method of their extraction (LDA, Bertopic), the level of the significance measure ($\lambda \in \{0,1\}$). The method generates results in the form of a graphical intertopic distances map based on the marginal distribution of topics between PC1 (first principal component) and PC2 (second PC), a bar graph with the most appropriate words for the selected topic against the frequency of occurrence of the word in the entire corpus, and a cloud of words illustrating the topic. <https://wiki.clarin-pl.eu/pl/nlp/services/list/topic3>

⁷ <https://services.clarin-pl.eu/>

Table 4.

The degree to which the dimensions of the "smart city" concept are considered in the strategies of Polish voivodeship cities

City	Year of adoption of the strategy	Dimensions of the "smart city" concept						Self-identification of the city in the strategy
		mobility	environment	economy	people	living	governance	
Białystok	2022	v	v	v	v	v	v	Smart
Bydgoszcz	2020	(v)	(v)	(v)		(v)	(v)	Sustainable
Gdańsk	2022	(v)	(v)		(v)	(v)		Compact
Gorzów Wielkopolski	2021	(v)	(v)	(v)	(v)	(v)	(v)	Sustainable, for generations
Katowice	2016	(v)		(v)	(v)	(v)		Smart
Kielce	2021	v	(v)	(v)	(v)	(v)	v	Compact, smart
Cracow	2018	v	v	v	v	v	v	Smart
Lublin	2022	(v)	(v)	(v)	(v)	(v)	v	Smart 3.0
Boat	2021	(v)	(v)	(v)	(v)	(v)	(v)	Creative
Olsztyn	2022		(v)	(v)			(v)	Smart City 3.0
Opole	2019					(v)	(v)	Smart
Poznań	2017	(v)	(v)	(v)	(v)	(v)	(v)	Smart
Rzeszów	2015		(v)	(v)	(v)	(v)	(v)	Smart
Szczecin	2011			(v)		(v)		Innovative
Toruń	2018	(v)	(v)	(v)	(v)			Smart
Warsaw	2018	(v)					(v)	Digital city, compact metropolis
Wrocław	2018	(v)	(v)	(v)		(v)		Sustainable, smart
Zielona Góra	2023			(v)	(v)		(v)	University

() means that a given dimension has been included in the strategy, but with a different modifier than "smart", e.g., smart, innovative, sustainable, ecological, creative.

Source: own study based on current city strategies.

To extract topics, the Topic HITL application including the LDA algorithm was used⁸. This allowed us to find the coexisting words that make up a given topic. In the course of next reviews of the results, the stop list was supplemented (up to the level of 6326 items) and the number of topics (3, 12, 100, 18, 50, 30, 20) and the level of the λ parameter (0-1) were changed. The interactive nature of Topic HITL allows for online analysis of the obtained results and their modification in next rounds of calculations based on data illustrated with a map of distances between topics and an integrated bar chart as shown on Figure 3. The table 5 includes the numbers and names of topics assigned to the cities that occurred in a given topic.

The topic names in Table 5 reflect the key terms they include, based on the calculation of the saliency and relevance measures – the equations are given in Figure 3.

⁸ The Latent Dirichlet Allocation (LDA) method is used to identify hidden topics as polynomial probability distributions for terms that occur in a corpus dictionary (word list) (Sievert, Shirley, 2014). The method assumes that the corpus is a collection of texts that are 'bags of words', and each text can consist of many topics (<https://www.ibm.com/topics/latent-dirichlet-allocation#f01>). For a given corpus, (1) a model of the coexistence of words in a given fragment (text) and in the entire corpus is determined, and (2) the probabilities of the occurrence of individual words in a random topic to which a given text has been assigned (the same text to many topics) are calculated. On the basis of the calculated probability of the occurrence of a word in a given topic, the content of the topics is determined (fuzzy grouping – *fuzzy clustering* <https://wiki.clarin-pl.eu/pl/nlp/services/list/topic3>). This is done by using Gibbs sampling in successive iterations of the calculation (100 iterations are set in the CLARIN solution), allowing the result to be gradually sharpened (Murel, Kavlakoglu, What is Latent Dirichlet allocation, 4.22.2024, <https://www.ibm.com/topics/latent-dirichlet-allocation#f01>, 23.11.2024). Assigning words (terms) to topics also means assigning texts in which the terms occur to them.

Table 5.*Main topics reflecting the provisions of the strategy of Polish voivodeship cities*

No	Topic name	A city whose name is among the 30-most relevant terms for topic
0	Top 30 most salient terms	Gdansk, Katowice, Kielce, Lublin, Olsztyn, Poznań, Szczecin, Wrocław
1.	Urban components and spatial planning	Lublin
2.	Strategic growth dimension	Wrocław
3.	Strategic process	
4.	Items and functions of urban space	
5.	City habitant is important	Opole!, Poznan, Katowice
6.	Activities focused on habitant	Wrocław
7.	Focus on best place to settle	Bydgoszcz
8.	Business and academy cooperation	Lublin
9.	Programming documents for city space planning	
10.	City of degrees and titles – scenario strategy	Wrocław!
11.	City of strategic growth planning	Katowice!, Szczecin
12.	Intelligent and digital city	Kielce!, Krakow, Lublin, Lodz, Zielona Góra
13.	Strategic growth coherence on all levels	Gorzów Wielkopolski*, Zielona Góra*
14.	City of international cooperation and transport modes	Szczecin!
15.	Strategic diagnosis & realization	Lublin!
16.	Demography, economic activity and community	Poznan! Boat!
17.	City of support for people and families	Opole
18.	Cultural heritage of inner city	Gdańsk!
19.	<i>Chaotic topic</i>	Olsztyn!
20.	Media, energy and transport (dis)advantages	

! = the name of the city occurs with the largest marginal distribution in a given topic,

* the topic includes the abbreviation of the name of the regional development strategy of the Lubuskie Voivodeship.

Source: own study.

The topics that have been generated in the Topic tool seem to signal the dominance of the procedural bias to the development strategy. This is evidenced by the terms related to space and its planning (topics 1, 4, 9), strategic process (topics 3, 10, 15), development (topics 2, 11, 13), which are cross-cutting (not related to any particular city) or contextual for specific cities, whose names appear in sets of terms appropriate for a given topic. City residents are a common strategic theme (5, 6, 7, 16, 17) for specific cities. Among the groups of themes, it is also possible to distinguish more cross-cutting (two- and more-dimensional) ones relating to transport in combination with other elements of the city's infrastructure (20 – a cross-cutting theme, present in all strategies) or with international cooperation (14) due to the potential of Szczecin related to this theme. The topic related to Poznań and Łódź (16) is also multidimensional, considering terms referring to demography, economic activity and the community. It is worth noting that these are cities with a strong identity, just like Gdańsk (18), for which the dimension of the heritage of the old town has become the dominant terminology of the topic. Among the topics complementing the richest characteristics of Lublin, there is also the topic of cooperation between business and universities (8). On the other hand, the subject of smart and digital cities (12) has brought out among the part terms the names of cities that have referred to these concepts in their strategies. Due to the suboptimal number of segments in the city strategy corpus, there was also a chaotic topic, which included the name Olsztyn

among the terms. It is difficult to interpret a set of terms that, according to the calculation algorithm, should be assigned to one of the topics, and it is randomly included in topic nineteen.

Summing up the results obtained, it is worth pointing out that the analysis of the surveyed strategies signals that cities retain their autonomy in referring to global ideas, because regardless of the year of adoption, in some strategies the concept of smart city is absent or occurs incidentally (Szczecin, Wrocław, Bydgoszcz, Katowice, Gorzów Wielkopolski, Łódź, Zielona Góra, Warsaw, Gdańsk, Kielce), while in its place the term "smart city" is used as a polonized term. This resulted in assigning some of the cities mentioned to, for example, topic twelve.

Most often, smart activities were planned in strategies for the area of urban, energy and communication infrastructure, especially as the implementation of intelligent traffic management systems (8 strategies), smart grid or metering solutions (5 strategies) or infrastructure monitoring with the use of ICT (5 strategies) and for the area of city management (9 strategies) with the use of smart or intelligent solutions, or ICT, or smart city data management. Therefore, the partial scope of implementation of the smart city idea is noticeable, although in many cases the target strategic self-identification of the city is to achieve the status of a smart city.

5. Discussion

One of the most important dimensions of a smart city is technology and infrastructure. It affects a wide range of stakeholders and is a significant development condition for numerous – especially fast-growing – urban centers. Smart cities are based on the implementation of advanced technologies such as the Internet of Things (IoT), artificial intelligence (AI) and data management systems. These technologies allow for real-time monitoring and management of urban processes, improving transport efficiency, reducing resource consumption and improving public services. Cities, striving to improve the quality of life, implement modern technological platforms that improve communication between residents and administration (Calzada, 2017; Koman et al., 2024; Lange, Knieling, 2020). However, the implementation of such solutions is not without its challenges. In particular, public administrations are faced with rapid technological change, which entails the risk of inadequate adaptation of existing structures to new technological requirements (Astrain et al., 2022; Liang et al., 2021). The research also highlights the need to take into account the growing role of IoT and Big Data in the context of urban planning (Zhang et al., 2020; Zhao, Zhang, 2020; Zhou et al., 2016). Including this smart city area in the city strategy can lead to a number of technical, social and financial consequences. During the period of testing and improvement of the implemented technologies, problems often appear that may generate or worsen existing conflicts of interest between users of these solutions. Therefore, a precise and long-term strategic vision, resilient to political

changes in cities, consistently implemented and effectively communicated to individual stakeholder groups, is of key importance here. It should also be pointed out that there is a need for constant dialogue between the city authorities, residents, and entrepreneurs, who in the smart city concept are co-creators of the strategy, and therefore should be included in its development and modification. The area of modern technologies is particularly susceptible to the phenomenon of digital exclusion. Smart city is a concept in which it should not be an obstacle to the full use of the solutions available in the city. Therefore, this creates an added challenge of finding the needs of groups subject to such exclusion and preparing access to the city's offer for them. The strategies of the surveyed voivodeship cities primarily focus on solutions in the area of mobility – supplementing the missing transport infrastructure or improving it, as well as intelligent management of the network (smart grid), city resources or urban infrastructure. This means that it is necessary to invest significant funds in supplementing the transport infrastructure, which may limit the possibility of developing other dimensions of the smart city (e.g., Warsaw). On the other hand, as part of the already existing infrastructure solutions, cities are also taking actions aimed at perfecting the use of their resources through the use of IoT technologies.

Another important area of research is sustainability and the environment. Cities strive to effectively manage natural resources, including energy and water, while trying to minimize the negative impact on the environment. Reducing CO₂ emissions and improving energy efficiency are key elements of these measures (Christidis et al., 2024; Mutambik, 2024; Sabory et al., 2021). Examples of cities like Barcelona show that information technology can make a significant contribution to reducing emissions and protecting the environment (Astrain et al., 2022; Calzada, 2017; Ferrara, 2015; Mazlum, Ercoşkun, 2024). However, there are also challenges related to urban policy, which can lead to the depoliticization of environmental issues. Cities like Istanbul show that an integrated approach, combining urban and ecological goals, can support the ecological transition and sustainable development. On the other hand, voivodeship cities focus on sustainable development, often understood as increasing the value of natural resources (green spaces in the city) treated as a competitive asset of the city. The protection and development of the urban environment is still not necessarily associated with the harmonious development of urban fabric. Eventually, it is not possible to develop sustainably in a space where islands of greenery are inscribed in the network of concrete communication and residential routes, resulting in an uneven distribution of temperature in the city, with all its consequences.

Urban governance and social innovation (Ehwi et al., 2024; Noennig et al., 2024) This is another important thread of research in the context of smart city. Smart governance involves the use of modern technologies to improve communication between authorities and residents and to improve the quality of public services. The digitalization of city administration and the development of platforms enabling citizen participation are key elements of this process. Cities like Barcelona have a strong focus on inclusivity and citizen engagement in

decision-making processes, which contrasts with the more technocratic approach seen in cities like Singapore (Demirel, 2023; Noennig et al., 2024). Social innovation is a key tool for adapting the city's activities to the real needs of its residents. Also, the strategies of voivodeship cities consider the aspect of smart people in the spirit of activating residents and their creative potential for the development of the city. However, there stays an unresolved doubt as to whether the designed digital solutions will actually lead to the inclusion of all groups of residents in the development of the city. One can sometimes get the impression that enthusiasm for the possibilities of modern technologies leads to a more or less conscious resignation from cooperation with residents who do not use these solutions.

Research devoted directly to social inclusion and the concept of quality of life resonates with these issues. Inclusion assumes ensuring equal access to urban resources and services for all social groups, regardless of their social status, age or abilities. Greater equality in access to resources leads to an improvement in the quality of life – a solution in this area is being implemented, for example, in London. More livable (inclusive) cities are implementing assistive technologies, such as systems to support the elderly or people with disabilities (Neumann et al., 2023; Tekin, Dikmen, 2024) . Another dimension of social inclusion is the involvement of citizens in decision-making processes regarding city management, resulting in more responsive and inclusive urban policies (Tekin, Dikmen, 2024). Reaching such solutions requires setting strategic priorities in cities, considering the existing budget and time constraints. The example of Polish voivodeship cities shows that the area of smart people took the last place among the dimensions of the smart city concept included in the strategies. At the same time, it does not seem possible to generalize this observation to the approach of the city authorities to the residents, it rather seems to be a consequence of the discrepancy between the theoretical distinction of smart city dimensions in the classification of the University of Vienna and the more cross-sectional approach used in the practice of cities. From the perspective of municipal authorities, it is difficult to separate the issues related to the human factor included in the dimensions of smart people and smart living, because they overlap. Urban activists are the ones who exert the greatest influence on the decisions of the authorities, and at the same time they can lead to the overshadowing of groups less participating in the management of the city. That is why it is so important to diagnose the social reality of the city in strategies and to design actions on this basis that will enable the identification of the needs of all social groups present in the city. NLP tools can help here, as they allow you to process information expressed in natural language (Érces et al., 2023) in various forms of expression (from posted on social media, through interviews given orally or in writing, to correspondence conducted by the city with various stakeholders). It is important to be aware of the risk of omitting less or less active groups, which may sometimes stand for a significant percentage of the urban community. This can lead to limited access to relevant information and the design of strategic actions tailored to a small part of the city's population.

Modern technologies in smart cities also support urban security and smart building management (Hick et al., 2017). Advanced monitoring and management systems play a vital role in improving the safety of residents. An example is the projects in Budapest, where smart fire safety systems have been implemented to prevent fire hazards. Technologies such as *Building Information Modeling* (BIM) (In Palos, Shafi-Khah, 2021), which, by monitoring the technical condition of buildings, allow for precise management of infrastructure and forecasting of potential threats. This enables the integration of urban infrastructure management, increasing the safety of residents and the operational efficiency of cities. The use of intelligent safety systems in buildings supports sustainable urban development. They allow for monitoring energy consumption, control of the internal environment, as well as quick response to possible failures or threats, which significantly improves the quality of life of residents and contributes to saving urban resources (Clerici Maestosi, 2021). The strategies of voivodeship cities reveal the importance of this thread, which is in fact related to a wide range of activities focused on smart living, which came second (see Table 7). This is reflected in the recognition of potential savings achieved when cities check their own resources, e.g., housing. The benefits in this respect are also transferred to other residents who use the same buildings as owners of the premises located in them.

Finally, it is necessary to point out as an important area of research the challenges related to the management and implementation of the smart city strategy (Mutambik, 2024; Noennig et al., 2024). The implementation of smart city technology requires managing the diversity of stakeholders and balancing technological goals with social needs. Effective implementation of strategies often requires close cooperation between different sectors and levels of administration. Examples from different cities show that the integration of urban policy with technology can face obstacles related to efficiency and social justice. A key challenge for cities is to strike a balance between the pursuit of innovation and ensuring social equality and meeting the needs of their citizens. In this context, the research of Lange and Knieling (Lange, Knieling, 2020) and Yun to Lee (Yun, Lee, 2019) They present how cross-sectoral cooperation can support the implementation of smart city strategies at the local and global level. Against this background, the strategies of voivodeship cities, which focus on the area of smart governance primarily on data management to make more proper decisions, are interesting.

The picture of the implementation of the smart city concept in city strategies in the light of world literature, as well as Polish voivodeship capitals, seems to be quite similar – despite some details. The solutions described in the literature are often partial and this is also the case in the strategies studied. The postulate of a holistic approach to the issue of introducing the idea of smart city in cities formulated in the literature is justified by the described examples or reviews of actual implementations. The main challenge in this context seems to be the discrepancy between the idea of a smart city as the goal of the strategy and the problems that arise during its implementation. Considering the most important criteria for urban communities, i.e., the scope of smart city implementation and the degree of adaptation of this implementation

to the needs and potential of the city, it is possible to roughly organize the possible implementation options into the following options:

1. striving to implement the smart city concept with the transfer of solutions proven in the world, although not fully adapted to the potential of a given city,
2. implementation of selected smart solutions dictated by the current needs of the general public or selected stakeholder groups, which leads to the extension of the period of achieving the smart city status while being more closely aligned with the city's potential,
3. implementation of typical smart city solutions to achieve the status of a smart city, usually treated as a panacea for the ills of a given city.

In order to fully use the possibilities inherent in the concept of smart cities, it seems that it is necessary to conduct deeper research on the paths of achieving its potential by cities, as well as on the typification of these paths. It also requires an analysis of the effectiveness of the results achieved by cities with the smart city status in terms of matching the needs of various stakeholder groups. Only as a result of comparing data on the city's strategic intentions, in the context of the smart city concept, its actual achievements and their assessment by the interested parties with the way they are achieved by the city authorities, can strategic recommendations be developed describing the best possible development trajectories for those cities that see sense in striving for development in accordance with the idea of a smart city.

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EVALUATION OF ACTIVITIES SUPPORTING THE WORK-LIFE BALANCE CONCEPT IN AN AGILE ORGANIZATION

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Purpose: The aim of this article is to assess the actions supporting the concept of work-life balance (WLB) in agile organizations. Strategies that support a harmonious combination of work and private life while maintaining organizational agility are analyzed.

Design/methodology/approach: The study was conducted using a survey method on a sample of 303 respondents, supplemented by multiple correspondence analysis (MCA), which allowed for a detailed examination of the perception of activities supporting WLB and their mutual relations.

Findings: Key findings indicate that activities related to flexible solutions tailored to employee needs and rapid response to their needs are perceived as the most important elements supporting WLB in agile organizations.

Research limitations/implications: A limitation of the study is that it was conducted in a specific organizational and geographical context, which may affect the generalizability of the results to other sectors or regions.

Practical implications: The study results provide practical guidance for agile organizations on how to effectively implement actions supporting WLB, especially in the area of flexibility and organizational culture.

Social implications: Promoting WLB in organizations contributes to improved employee well-being, reduced stress and increased engagement, which translates into social benefits such as greater employment stability and social life balance.

Originality/value: The originality of the article lies in combining the perspective of agile organizations with the analysis of activities supporting WLB, which fills the gap in the literature and provides new conclusions in the context of a dynamic work environment.

Keywords: organizational agility, work-life balance concept, organization, employees, multiple correspondence analysis (MCA).

Category of the paper: research paper.

1. Introduction

Modern organizations increasingly face the challenge of reconciling the requirements of a dynamically changing business environment with the needs of employees in terms of work-life balance. Work-life balance has become one of the key topics in both scientific research and management practice, because it directly affects the efficiency, well-being and engagement of employees. In agile organizations, which are characterized by flexibility, fast pace of action and openness to change, this topic gains an additional dimension. A work environment that requires constant adaptation and high efficiency must simultaneously support employees in dealing with the challenges related to work-life balance (Nath, Agrawal, 2020).

Taking action in this area is particularly important because the lack of balance can lead to burnout, reduced productivity and increased employee turnover, which has a direct impact on the condition of the organization (Ramadhana, 2021). On the other hand, effective strategies supporting work-life balance can contribute to increased job satisfaction, better use of team potential and building a competitive advantage. This is why this topic is not only current, but also crucial for organizations that want to maintain their agility and adaptability (Prieto, Talukder, 2023).

The aim of the research presented in the article was to identify activities supporting the concept of work-life balance in agile organizations and to determine their importance in the context of building a work environment that promotes balance and efficiency. The added value of the article is to provide specific recommendations based on research results that can be used in management practice. The originality results from combining the perspective of agile organizations with the analysis of activities supporting work-life balance, which allows for a better understanding of this issue in the context of contemporary challenges. The presented research fills a gap in the literature on effective strategies supporting work-life balance in environments with high dynamics and variability.

1.1. The essence of an agile organization

The concept of an agile organization is its ability to quickly and effectively adapt to a dynamically changing environment, both internal and external. A key element of this concept is flexibility, which allows the organization to respond to new challenges, take advantage of emerging opportunities, and minimize the risk associated with uncertainty (Mrugalska, Ahmed, 2021). In agile organizations, the emphasis is on cooperation, decentralization of decision-making, and active involvement of employees at all levels of the organizational structure. Thanks to this, the organization can effectively use the diversity of experiences, skills, and perspectives of its members (Anderson, Wilson, 2017).

Organizational agility also includes the ability to quickly implement innovations and adapt operational processes in such a way as to maximize efficiency and quality of operation (Kt, Sivasubramanian, 2023). The structure of an agile organization is characterized by flatness and flexibility, which allows for shortening the decision-making chain, reducing bureaucracy and faster response to changing market needs. In this context, agility also means the ability to experiment, learn from mistakes and continuously improve both processes and products (Chen, Li, 2021).

Another important aspect of an agile organization is promoting a culture of openness and trust. In such organizations, employees have the freedom to express their opinions, take the initiative, and engage in projects that require an innovative approach. Agile organizations focus on creating a work environment that fosters creativity, cooperation, and internal motivation. Therefore, building teams based on mutual support and autonomy is a priority, which allows employees to develop their competences and effectively achieve goals (Gao et al., 2020).

The essence of an agile organization is also associated with the use of modern technologies and tools supporting management (Kurnia, Chien, 2020). These technologies enable rapid information flow, process automation and effective data analysis, which contributes to making better decisions. In agile organizations, technologies are treated as support for people, not as their replacement, which additionally emphasizes the humanistic aspect of this concept (He, Harris, 2021).

Organizational agility is not limited to the internal sphere, but also encompasses relationships with customers, business partners, and other stakeholders. Agile organizations strive to build long-term, trust-based relationships that allow for effective cooperation and flexible response to market needs (Luo et al., 2020). In this way, agility becomes not only a feature of the organizational structure, but also a philosophy of operation that permeates all aspects of the organization's functioning (Joiner, 2019).

In summary, the essence of an agile organization is based on flexibility, collaboration, innovation, and rapid adaptation to changing conditions. This approach allows organizations to achieve competitive advantage, increase employee and customer satisfaction, and function effectively in an increasingly complex and dynamic business environment.

1.2. Work-life balance concept

The concept of work-life balance is based on the assumption that the balance between professional and private life is a key factor influencing the well-being of an individual and the effectiveness of an organization (Krzyszowska-Dąbrowska, 2020). This idea has gained particular importance in the era of dynamic changes in the labor market, growing demands on employees and advancing digitalization, which has blurred the traditional boundaries between professional duties and private time. The concept of work-life balance does not only refer to

the amount of time spent at work and outside it, but also to the quality of this time and the sense of satisfaction with the implementation of roles in both areas (Blumberga, Pylinskaya, 2019).

One of the foundations of this concept is a holistic approach that takes into account the diversity of an individual's needs in terms of time, energy and resources allocated to different aspects of life. Employees who can effectively manage these areas demonstrate higher levels of engagement, motivation and creativity, which translates into benefits for both themselves and the organisation. For this reason, work-life balance is increasingly treated as a strategic element of human resources management policy, supporting the development of human and social capital (Galli, 2013; Huras, 2021; Jeran, 2016). Work-life balance is not about perfect time allocation, but about flexible adjustment of priorities depending on current needs and circumstances (Kozłowski, 2020). In this context, it is important for organisations to create conditions conducive to achieving both professional and personal goals. The ability to adjust work schedules, remote work, flexible forms of employment or support systems for parents and carers are examples of activities that help employees achieve better balance (Wróbel, 2021).

The concept of work-life balance is gaining particular importance in the context of changing expectations of employees, especially younger generations, who increasingly value flexibility and the ability to pursue passions or family obligations outside of work (Karcz-Napieraj et al., 2019). Employees expect not only appropriate remuneration, but also added value in the form of understanding their needs, support in the field of mental health and the possibility of self-fulfilment (Leoński, 2015). The lack of balance between work and private life can lead to burnout, decreased commitment and increased employee turnover, which negatively affects the effectiveness of the organization. Work-life balance is also an important element of building the employer's image (Czarnecki, 2011). Organizations that promote work-life balance are perceived as more attractive on the labor market, which makes it easier to attract and retain talent. Therefore, companies are increasingly investing in programs supporting balance, such as time management training, mentoring or benefit packages supporting employee health and well-being (Bortkiewicz et al., 2020).

The importance of work-life balance goes beyond the individual needs of employees. It also has a social dimension, contributing to the development of healthy family relationships, social activity and the general well-being of society. Therefore, this concept finds its place in sustainable development strategies, where organizations play a key role in creating an environment that is conducive to both economic efficiency and quality of life (Walentek, 2019).

In summary, work-life balance is a dynamic concept, the effective implementation of which requires cooperation between employees and employers, flexibility and commitment to building a work environment that takes into account the diverse needs of the individual. This balance not only affects individual well-being, but also the long-term success of the organization and its positive impact on the environment.

1.3. Determinants of the work-life balance concept in an agile organization

The determinants of the concept of work-life balance in an agile organization are based on a set of actions and strategies that support both flexibility and harmony between the work and private life of employees. The foundation of this concept is the adaptation of the organizational approach to the dynamically changing needs of employees and the requirements of the work environment. In agile organizations, work-life balance is not only a goal in itself, but also a tool that supports operational efficiency, team engagement and innovation (Dewicka, Trziszka, 2018).

One of the key determinants of this concept is offering flexible solutions that allow employees to manage their time in a way that is tailored to their individual needs (Fabjański, Sroczyńska, 2015). This flexibility can take various forms, such as variable working hours, the possibility of hybrid or remote work, as well as options to adjust the intensity of work to the stage of professional or private life. Such solutions help reduce stress and increase the sense of autonomy, which in turn has a positive effect on motivation and productivity (Sidor-Rządkowska, 2021).

Another determinant is the implementation of technologies that support work-life balance (Messenger, Gschwind, 2016). In agile organizations, technologies are seen as a key tool for optimizing processes, automating routine tasks, and facilitating communication in distributed teams. Tools such as project management platforms, work time monitoring applications, or solutions enabling remote access to organizational resources support not only work efficiency, but also allow employees to better manage their time and responsibilities (Pruchnik, Pruchnik, 2020).

Promoting a culture of openness in agile organizations is an important element of the work-life balance concept. A culture of openness is based on trust, transparency, and supporting employee initiatives (Józwiak, 2018). Employees who feel heard and have the space to express their needs and ideas are more likely to engage in the organization's activities and better cope with the challenges of balancing different aspects of life. Such a culture also promotes building relationships based on mutual support, which strengthens the sense of belonging and job satisfaction (Nowocień, 2020).

Flexible response to employee needs is another determinant of work-life balance in agile organizations (Mikuła, 2015). It means the ability of the organization to dynamically adapt to changing expectations and situations of employees. These reactions may include providing support in crisis situations, introducing additional employee benefits or modifying organizational policies to better meet the needs of teams. The ability to quickly and adequately respond to employee needs strengthens their loyalty and sense of stability, which in turn positively affects the effectiveness of the organization (Mierzejewska, Chomicki, 2020).

These determinants, as integral elements of work-life balance in agile organizations, are interconnected and create a system supporting both individuals and the entire organization. Striving for work-life balance is not only a response to employee expectations, but also a strategic tool that allows organizations to build agility and competitive advantage. Supporting flexibility, implementing appropriate technologies, promoting openness and dynamic response to employee needs are key determinants that should be at the center of the strategy of every organization striving for efficiency and sustainable development (Makulska, 2012).

1.4. Research Methodology

The aim of the research was to identify activities supporting work-life balance in agile organizations and to determine how they are perceived by employees. The research hypothesis was adopted that organizational activities such as offering flexible solutions, implementing new technologies, promoting a culture of openness and flexibly responding to employee needs have a significant impact on supporting work-life balance in the professional environment. The research asked questions about which of these activities are most often positively assessed by respondents and what differences occur in their perception.

The research method was a survey conducted in April-May 2023 on a sample of 303 respondents. Respondents assessed various aspects of organizational activities supporting work-life balance in agile organizations, which allowed for the collection of quantitative data necessary for further analysis.

To deepen the analysis, the multiple correspondence method (MCA) was used, which allowed for examining the mutual relations between the assessed activities and identifying similarities and differences in their perception. MCA analysis allowed for visualizing the results in a multidimensional space, which facilitated the interpretation of data and the indication of key activities for effective support of work-life balance in agile organizations. Thanks to this, it was possible to more precisely determine the hierarchy of importance of individual activities and their impact on the perception of work-life balance by respondents. In the course of the analysis, detailed sociodemographic data were obtained, which allowed for a precise determination of the structure of the studied group. The results regarding gender showed that the majority of respondents were men (58.7%), while women represented 41.3% of the sample. Age analysis indicates that the largest part of the respondents (47.2%) were people under 25 years of age. The next age groups are people aged 26-35 (30.4%), 36-45 (19.5%) and the smallest group, over 45 (3%).

In terms of positions held, the largest group were employees (57.4%), followed by middle management (25.2%), lower management (11.1%) and top management (6.4%). The analysis of seniority showed that the largest group of respondents had professional experience of up to 5 years (47.7%), while the next groups included people with 6-10 years of experience (33.4%), 11-15 years (13.6%), 16-20 years (3.6%) and over 20 years (1.7%).

In terms of the size of the companies in which the respondents worked, the largest number of people were employed in small enterprises (37.5 %), followed by microenterprises (26.4%), medium-sized enterprises (20.1%) and large enterprises (16.1%). In terms of the period of operation of the companies, the largest group were companies operating for 1 to 3 years (34.9%), followed by companies with periods of operation of 4-7 years (27.1%) and over 8 years (26.1%). The smallest category were companies operating for up to a year (11.9 %).

In terms of industries, the largest share was held by companies from the retail sector (54.8%), followed by education (10.4%), automotive industry (5.4%), healthcare (3%) and other industries (26.4%). The scope of the companies' operations indicates that 32.5 % of them operated at the regional level, 31.5% at the national level, 18.3% at the international level and 17.6% operated locally.

The analysis of the financial situation of the companies revealed that the majority of respondents assessed it as good (55.6%), while 19.9% described it as very good. A bad financial situation was indicated by 4.6 % of the respondents, and a very bad one by 3%. 16.9% of the respondents had difficulties in assessing the financial situation of their company. Presentation of Research Findings.

The research aimed to assess organizational activities supporting work-life balance in an agile organization by analyzing respondents' opinions on four key areas (Table 1).

Table 1.

Activities supporting the concept of work-life balance in an agile organization

Variable	Definitely NOT	Rather not	I don't have an opinion	Rather YES	Definitely YES
Offering flexible solutions tailored to the needs of employees (1)	12	18	33	102	138
Implementation of new technologies supporting work-life balance (2)	15	22	40	95	131
Promoting a culture of openness that fosters harmony (3)	9	15	45	110	124
Responsive response to employee needs (4)	10	20	38	98	137

Source: Own study based on research.

The first one was offering flexible solutions tailored to the needs of employees, where 12 people definitely denied the effectiveness of such actions, 18 assessed them rather negatively, 33 had no opinion on this matter, while the majority, i.e. 102 people, assessed them rather positively, and 138 definitely positively.

The second area was the assessment of the implementation of new technologies supporting work-life balance. In this category, 15 people strongly denied their impact, 22 assessed them rather negatively, 40 people remained neutral, while 95 respondents tended to assess them positively and 131 expressed strongly positive opinions.

The third theme was promoting a culture of openness that supports work-life balance. In this case, 9 people strongly disagreed with such actions, 15 considered them rather unsupportive, 45 had no opinion, 110 people assessed them rather positively, and 124 strongly

positively. The last element analyzed was flexible response to employee needs. In this respect, 10 respondents strongly disagreed with such actions, 20 assessed them rather negatively, 38 people remained neutral, 98 assessed them rather positively, and 137 expressed strongly positive opinions. In order to examine the interrelationships between activities supporting work-life balance in an agile organization, a multiple correspondence analysis (MCA) was conducted. Figure 1 presents the results of this analysis, showing the relationships between four key activities: offering flexible solutions tailored to employee needs, implementing new technologies supporting work-life balance, promoting a culture of openness supporting harmony, and flexibly responding to employee needs.

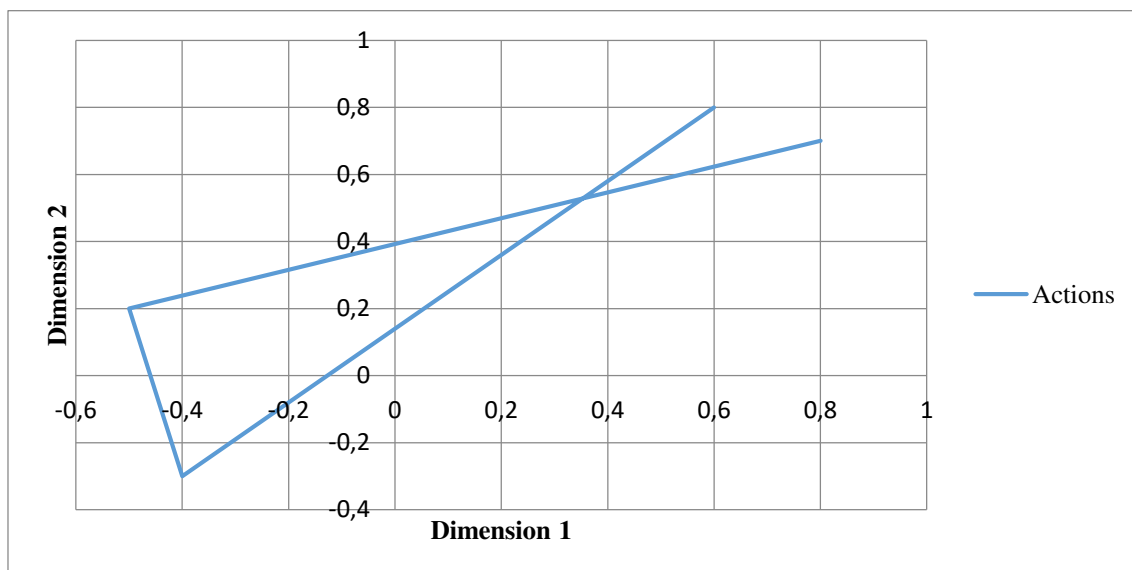


Figure 1. MCA analysis: Actions supporting work-life balance.

Source: Own study.

The horizontal (Dimension 1) and vertical (Dimension 2) axes show coordinates illustrating the positioning of individual activities in the research space. Activities such as “Offering flexible solutions” and “Responding flexibly to needs” are located in the upper right quadrant of the graph, which indicates their mutual similarity and positive perception by respondents as key to supporting work-life balance.

In turn, “Promoting a culture of openness supporting harmony” and “Implementing new technologies supporting work-life balance” were placed closer to the center of the graph and in the quadrants on the negative side of the Dimension 1 and/or Dimension 2 axis. This placement suggests that these activities may be perceived more neutrally or have a slightly less direct impact on work-life balance.

The chart allows for the identification of activities that are most similar in terms of perception and those that are distinguished by a different nature in the perception of respondents. Spatial analysis allows for the possibility of drawing conclusions about the hierarchy of activities in the context of their effectiveness in building work-life balance in agile organizations.

2. Discussion

Based on the research results presented in the table and the multiple correspondence analysis (MCA), several important conclusions can be drawn regarding activities supporting the concept of work-life balance in an agile organization. Activities related to flexibility, such as adapting solutions to the needs of employees and responding to their individual requirements, have been identified as key elements supporting work-life balance. They are seen as fundamental in building a work environment that supports both employee efficiency and well-being.

Promoting a culture of openness that supports harmony between different aspects of life is an important factor, although it requires additional actions to respond more effectively to employee expectations. Openness in an organization that encourages dialogue and the free exchange of ideas, supports positive relationships and increases the sense of community, which contributes to improving work-life balance. The implementation of technologies supporting work-life balance, although assessed as important, seems to be more diverse in its perception. This may indicate differences in their availability, effectiveness or adaptation to the specific needs of employees in different organizations. Technological activities therefore require precise adaptation to organizational conditions and appropriate support in implementation.

The MCA analysis indicated strong links between flexibility-related activities, which highlights their synergistic importance in creating an environment that supports work-life balance. These activities are seen as central to agile organizations that emphasize rapid response to employee needs and adaptation to dynamically changing conditions. In contrast, activities related to technology and open culture, although also important, seem to be more dependent on the organizational context and may require more support in the implementation process.

In summary, the research emphasizes that effective support for work-life balance requires prioritizing activities based on flexibility and an individual approach to employee needs. At the same time, it is important to build an organizational culture based on openness and implement appropriate technologies that harmoniously support the goals of both employees and the organization.

Based on the research results, companies are recommended to focus on creating a work environment that supports flexibility and responds to the individual needs of employees. The priority should be to introduce solutions that allow for adapting working conditions to changing employee expectations, such as flexible working hours or the possibility of remote work. Such activities not only support work-life balance, but also build engagement and increase job satisfaction.

It is also recommended to intensify activities in the area of promoting an organizational culture based on openness and mutual understanding. Implementing strategies that support dialogue, free exchange of ideas and mutual support in teams can contribute to building an atmosphere of trust and cooperation. Creating a space for open communication and involving employees in decision-making processes strengthens their sense of belonging and influence on the functioning of the organization.

In the context of technologies supporting work-life balance, it is recommended that they be carefully tailored to the specifics of the organization and the needs of employees. The implementation of tools facilitating the organization of work, such as planning systems or communication platforms, should be combined with appropriate technical support and training to ensure their effectiveness and widespread use. It is also crucial to take into account the individual preferences of users so that technologies really support them in their daily duties.

Organizations should also regularly monitor the effectiveness of their work-life balance support activities and collect feedback from employees. Based on this data, strategies and activities can be flexibly adjusted to better respond to changing needs. Building work-life balance requires constant commitment and openness to change, which is why it is important for companies to treat it as a dynamic and long-term process. Integrating activities in the field of flexibility, technology and organizational culture with business goals can contribute to both improving the quality of life of employees and increasing the operational efficiency of the organization.

3. Conclusions

The results of the research included in the article can be compared with the results of other researchers who also analyzed activities supporting the concept of work-life balance in organizations. Research conducted by the Polish Economic Institute indicates that flexible forms of work, such as the possibility of working different hours or schedule management, play an important role in building a balance between work and private life. The growing importance of the adaptability of organizations in this area is indicated (Polish Economic Institute, 2024).

Similar conclusions can be drawn from analyses of the HRK SA Employer Branding team, which emphasize the importance of strategies such as flexible working hours and remote work. These activities are indicated as key to creating a work environment conducive to employee well-being. Promoting work-life balance as an element of organizational strategy contributes to strengthening the positive image of the employer on the labor market, while improving the quality of life of employees (HRK SA, 2023). The results of these studies are consistent with the findings contained in the article, which emphasize the importance of flexibility and a culture of openness in agile organizations. In both cases, attention is drawn to the need for an individual

approach to employee needs, as well as the role of activities supporting the balance between different aspects of life as a key element of the human resources management strategy.

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ORGANIZATIONAL ANOMIE AS A CAUSE OF COUNTERPRODUCTIVE WORK BEHAVIOR IN THE ORGANIZATION

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Purpose: The article concerns the phenomenon of an organizational anomie which can lead to counterproductive or unethical employee behavior. The article was created by the diversity of definitions of anomie, which, as the cause of the occurrence of negative behaviors of employees, is very often confused with its effects, which are counterproductive work behaviors.

Design/methodology/approach: The desk research technique and ChatGPT interview were used to explain the phenomenon of an organizational anomie as well as the relationship between anomie and counterproductive work behavior.

Findings: The phenomenon of an organizational anomie is still the subject of few studies and has not yet been comprehensively discussed from the perspective of management sciences. Anomie is very often confused with counterproductive work behaviors.

Research limitations/implications: Reliable research on the phenomenon of an organizational anomie is difficult to conduct because the use of a survey questionnaire does not guarantee getting true answers. Conducting interviews, on the other hand, requires cooperation with sociologists and psychologists.

Practical implications: There is a need to intensify research on organizational anomie as a state that can lead to counterproductive and unethical employee behavior, which can be also encouraged by the recent popularization of the home-office mode of work. The article is addressed to researchers, but also to employees and managers to make them aware of seemingly harmless unfair behavior that should be eliminated or minimized in the workplace.

Social implications: The phenomenon of organizational anomie is an important and complex problem to be solved in enterprises, especially since it is conducive to other negative pathological phenomena, such as mobbing and discrimination. Diagnosing of the occurrence of an organizational anomie is the first step to eliminate or reduce the effects of it.

Originality/value: The paper draws attention to the need for further research on this phenomenon, especially from the point of view of entering the labor market by a new generation Z, the most stressed and vulnerable to depression and anxiety. The article explains the relationship between anomie and counterproductive work behaviors, with which it is confused.

Keywords: organizational anomie, counterproductive work behaviors, CWB.

Category of the paper: Viewpoint.

1. Introduction

Although research on an anomie has a long history, the phenomenon of organizational anomie in the literature is still the subject of few studies and has not yet been comprehensively discussed from the point of view of management sciences. The ambiguity is visible even in the name, because in the literature there are studies concerning: “employee anomie”, “organizational anomie”, “institutional anomie”, “staff anomie”, “work anomie”, “coworkers’ anomie”, etc. According to the responses generated by the ChatGPT some people confuse anomie with counterproductive work behavior (CWB), because both concepts refer to situations in which there are deviations from expected or normative behavior which can bring many problems to the organization, such as reduced efficiency, chaos or conflicts (OpenAI, 2024). The concept of anomie is more abstract and requires an understanding of the concept of social norms, their impact on the behavior of individuals and groups, as opposed to counterproductive work behaviors, which are concrete actions (OpenAI, 2024). Perhaps the reason for all the terminological confusion is the fact that anomie is a phenomenon and a subject of study by sociologists, while counterproductive work behavior is mainly dealt with by psychologists and managers in the organization. Anomie can occur in an organization for a variety of reasons, i.e. due to a perceived lack of affiliation with the organization, the lack of, non-compliance with, or enforcement of social norms within the organization, inappropriate communication, or unclear standards of conduct, which favors actions that are inconsistent with the interests of the group and the organization. It is worth noting that anomie in a workplace contributes to the occurrence of other pathological phenomena such as mobbing or discrimination.

The aim of the article is to describe examples of behaviors that are symptoms of the phenomenon of organizational anomie, in the context of its possible intensification, resulting from the recently popularized home-office mode of work and the entry into the labor market of a new generation of employees, called “Generation Z”. The goal was achieved by using the desk research technique (analysis of existing data on described employee abuses and definition of anomie and CWB) and ChatGPT interview.

2. Organizational anomie vs. counterproductive work behaviors

The term “anomie” comes from the Greek “á-nomos” and means lawlessness, no rules. The concept of anomie was developed by Emile Durkheim and used to describe a societal condition of normlessness, a lack of solidarity and regulation in the social structure, and a general lack of integration between people and groups (Zoghbi-Manrique-de-Lara, Espino-Rodríguez, 2007, p. 847). The theory was expanded by Robert K. Merton who tried to

explain why some people engage in deviant behavior, like crime, suggesting it often arises from a disjunction between societal goals and the legitimate means to achieve them (Nickerson, 2023). It is worth adding that the term anomie has a long history and was used not only in sociology. The biblical usage of anomia was partly influenced by relevant Greek philosophical writings because it entered the biblical tradition when the Old Testament was translated into Greek (Deflem, 2015, p. 718). Initially, the word anomia was used for about 20 Hebrew words, referring to various aspects of wickedness, evil, injustice, ungodliness, wrongdoing, depravity, transgressions, and sin (Deflem, 2015, p. 718). In the latter meaning of sin, anomia was used interchangeably with the Greek term 'hamartia' which refers to a fatal flaw (Deflem, 2015, p. 718). Anomie is a concept that deals with both social and individual mental health, as it deeply shakes the understanding that it is possible for individuals in the society to achieve individual goals together and by looking after each other, isolating the individual from the society by isolating them from the society, or derating and making them reckless (Yarim, Çelik, 2021, p. 163). Within the sociological tradition, different authors have tended to define anomie in different ways, oscillating between a focus on the social system and a focus on individual values and beliefs systems (Teymoori, Bastian, Jetten, 2017, p. 1011). In Polish literature, the most common position is to focus on the individual and define anomie as a phenomenon concerning an employee. Among the definitions of an anomie in a workplace, the most common reference is to the dishonesty of employees towards their employers, exposing them to large financial losses. However, it is worth emphasizing that negative behaviors can also apply to actions taken by and towards co-workers. Because the negative behaviors of employees can be only symptoms of the occurrence of an anomie phenomenon in the workplace, it seems reasonable to use the term "organizational anomie", and the behavior of employees should be classified rather as counterproductive. In one of the few books in Polish, employee anomie is defined as a social phenomenon consisting in the systematic occurrence of behaviors in employees or (more often) in employee groups that lead to financial losses (Ambroziak, Maj, 2013, p. 13). A feature of employee anomie is the operation of psychological mechanisms that allow for embezzlement, theft, falsification of documents and other unethical activities without a sense of guilt or remorse on the part of the employee (Ambroziak, Maj, 2013, p. 13). The source of this phenomenon is inadequate organizational structure, mismanagement, and systems and processes that force employees to behave in an anomic way, which have become binding norms of behavior in the organization (Ambroziak, Maj, 2013, p. 13). According to this approach, employee anomie is a phenomenon that is affected by three powerful forces (Fig. 1) (Ambroziak, Maj, 2013, p. 93):

- Environment within which the organization operates.
- Human behavior in the organization.
- Management, i.e. the way the organization's resources are operated.

The phenomenon of employee anomie is the result of the action of these three forces, and each of them has a significant impact on the activation and maintenance of anomic behavior in the organization (Ambroziak, Maj, 2013, p. 93).

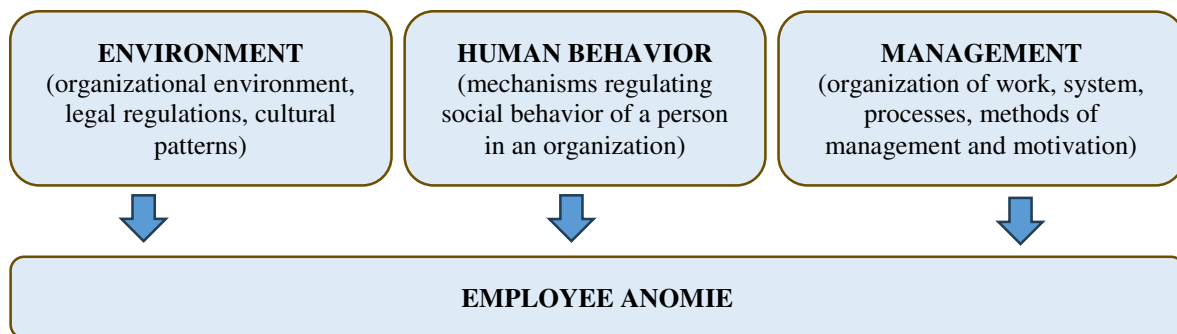


Figure 1. Model of three forces of an organizational anomie.

Source: Ambroziak, Maj, 2013, p. 93.

Diagnosing employee anomie and then controlling it must consider the simultaneous analysis of the three forces and the relationship between them for a specific organization or a specific department (Ambroziak, Maj, 2013, p. 93).

According to Sypniewska (2017, p. 239) anomie at work is an unwritten social agreement based on which it is acceptable to steal from the employees who feel that under some circumstances, one may steal from a company at the same time not calling themselves thieves, but people who use certain available opportunities. Such actions can be classified as counterproductive work behavior. There are various definitions of them. According to one of them, there are voluntary behavior that violates significant organizational norms and in so doing threatens the well-being of an organization, its members, or both (Robinson, Bennett, 1995, p. 556). This kind of behavior (Stepanek, Paul, 2022):

- goes against organizational social norms and harms an organization or its employees,
- is moderately and negatively related to job performance, customer satisfaction, profitability, and productivity,
- is more common among males than females, as well as among those who are young and those who have less work experience,
- is associated with negative personality traits such as neuroticism, negative affectivity, narcissism,
- has a negative impact on the perception of the entire organization,
- increases the risk of the appearance of burnout and turnover of employees.

Anomie is not directly a counterproductive work behavior, but it can create conditions conducive to such behavior. Considering the approach that anomie is a social state in which norms and values are unclear, poorly defined or not followed, the model (Fig. 1) should be modified, in accordance with the relationship that anomie, as a state, can lead to the occurrence of counterproductive work behaviors (Fig. 2).

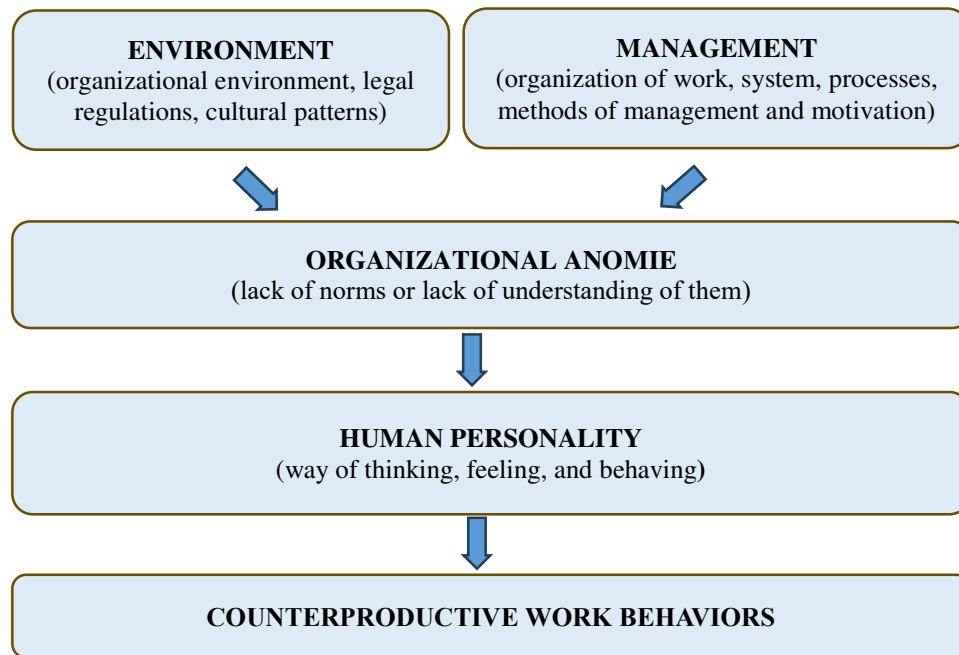


Figure 2. Model of organizational anomie and counterproductive work behavior relationships.

Source: Own elaboration.

The above model is a modification of the previously described model of the three forces of employee anomie, in which it was considered important to take into account the personality of employees, which determines whether counterproductive behavior at work will occur even under conditions of organizational anomie. Anomie is a potential causative factor in the occurrence of CWB rather than its result.

3. Intentionally negative results of organizational anomie

As previously indicated, counterproductive work behaviors can be the result of organizational anomie. Using desk research technique, research reports and other information on counterproductive work behaviors were analyzed, both in scientific sources, press articles and police reports, concerning abuses by employees, which, due to the scale of the phenomenon, have often been recognized as crimes. Examples of these abuse can be divided into three groups:

- theft of money, e.g. charging a normal fee for a transaction, while accruing an undue high discount, and then paying the difference for oneself, making fictitious sales of goods and their returns, and then appropriating money from the operations performed, or issuing false invoices,
- theft of property or improper use of company resources for private purposes, e.g. theft of work tools or office equipment, goods, fictitious purchase with deferred payment, or use of the company telephone and other company equipment for private purposes, etc.

- cheating the employer of working time, e.g. overestimating the permissible break time, simulating illness to take sick leave, performing tasks unrelated to work, deliberately inflating working time to obtain additional remuneration, etc.

The analysis of the identified examples was also considered from the point of view of the growing interest in remote and hybrid work, which create more "opportunities" for unfair settlement of employee working time. This also contributed to the creation of many product innovations aimed at both deceiving the employer and, on the other hand, the ability to verify the employees' commitment to their duties.

According to the results of a survey conducted in Poland by the LiveCareer portal, with the participation of 1374 people, as many as 42% of respondents who do not believe in the meaning of their work and 31% of those who do not like it are considered dishonest (Spadło, 2022). Of the respondents, nearly 28% simulated illness at least once to go on sick leave (young employees under 26 years of age were most often dishonest, and as many as 39% of respondents in this group admitted to cheating). Over 39% of respondents admit that they have left work early, giving a false reason, e.g. a visit to the doctor, illness or malaise, an appointment with a professional, the child's illness, the need to pick up the child from school or kindergarten (Spadło, 2022). Unfair settlement of working time also consists in performing work for another or even several other employers during the work performed for the original employer.

The results of other studies in the area of inappropriate employee behavior indicate unfair practices also used against co-workers, such as seemingly trivial theft of food from the company fridge, to which respondents are reluctant to admit. In a survey conducted by Wirtualna Polska in 2017 entitled "Have you ever stolen food from someone's fridge?", out of 6800 people who participated in it, only 4.2% admitted that they did it frequently, and 3.1% that they stole it, but told the "victim" about it (SmartLunch Blog, 2021). From the point of view of the definition of counterproductive work behavior, although this type of behavior does not expose the employer to losses, it may violate the norms in force in the company. This type of behavior has again contributed to the development of innovative products such as food bags with mold or cockroach prints, food containers with padlocks, padlocks with a 110 dB audible alarm, or a digital bottle lock. The development of artificial intelligence and the possibility of its improper use, combined with the form of remote work, are conducive to dishonest behavior of employees towards the employer or co-workers. Responsible management and care for employees can counteract these phenomena. The implementation of the Corporate Sustainability Due Diligence Directive Directive (CSDDD) gives great hope for the interest of entrepreneurs and leaders of organizations in responsible practices. By implementation of responsible business conduct (RBC), organizations can prevent and address negative impacts of their activities, while contributing to the sustainable development (OECD, 2024). There is certainly still a lot to do in this area, as according to the analysis of environmental, social, and governance (ESG) reports on Polish enterprises, the least activity is recorded in the "social" area.

4. Summary and conclusion

The aim of the article was to describe examples of behaviors that are symptoms of the phenomenon of organizational anomie, in the context of its possible intensification, resulting from the recently popularized home-office mode of work and the entry into the labor market of a new generation of employees, called “Generation Z”. To achieve this goal, qualitative research methods were used, such as literature research, content analysis and observational research. The main research techniques used in this article include the secondary research and the ChatGPT interview.

The results of the research indicate that the phenomenon of organizational anomie and its results is a complex issue that is difficult to eliminate. Since most people are motivated to seek justification for their actions, beliefs, and feelings (Aronson, 2005), this can be a daunting task for organizational leaders. However, once again, it is worth emphasizing that the occurrence of anomie can contribute to the appearance of other negative phenomena in the workplace, such as mobbing or discrimination, which is why it is important to prevent its occurrence. The factors that should be eliminated to prevent the appearance of CWB include (OpenAI, 2024):

- excessive stress (can lead to feelings of confusion and lack of meaning),
- lack of career prospects (when employees don't see opportunities for advancement or career advancement in the workplace, they may feel pointless and meaningless),
- interpersonal conflicts (negative relationships with coworkers or superiors can disrupt team cohesion and make it difficult to achieve career goals),
- over-supervision and control (employees who feel over-supervised by their superiors or monitored at their work may feel uncomfortable and deprived of autonomy),
- low job satisfaction (when employees are not satisfied with their own work, they may feel dissatisfied and unfulfilled in their duties),
- poor work-life balance (a lack of work-life balance can lead to a sense of social disintegration as employees don't have time to develop family or social relationships),
- lack of clear goals and values in the organization (when an organization does not have clearly defined goals, missions, and values, employees may feel a lack of consistency and meaning in their work),
- inadequate communication and lack of engagement (when employees don't receive the right information or participate in their company's decision-making process, they can feel isolated and disengaged),
- overload of duties (too many duties and the inability to perform them effectively can lead to lose control of their work),
- lack of social support (collaboration with other employees and social support in the workplace are important for a sense of belonging and cohesion).

Anomie and counterproductive work behavior should be interpreted as separate phenomena, and it is worth noting that organizational anomie may contribute to the occurrence of counterproductive work behavior. Another important issue not covered in this article is unintentional anomic behavior, which precisely because of this “non-intention” cannot be confused with counterproductive work behavior and may result from normative chaos and ambiguity of the applicable rules. In a situation where employees feel disoriented and meaningless at work, they may exhibit counterproductive behaviors, e.g., sabotage the organization's activities, deliberately reduce work efficiency, or ignore responsibilities (OpenAI, 2024). It is worth emphasizing, however, that not every counterproductive behavior is the result of organizational anomie, as they can only result from the personality traits of employees, e.g. personal hostility towards co-workers or the entire organization.

According to the presented model of the relationship between organizational anomie and counterproductive work behavior, the occurrence of this type of negative behavior depends also on individual personality traits. Counterproductive work behaviors, on the other hand, can occur regardless of the anomic work environment. Undoubtedly, however, one cannot equate anomie and consider it as a synonym for counterproductive activities.

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NAVIGATING HYPER-INDIVIDUALIZATION: BUILDING RESILIENCE SYSTEMS THROUGH PROCESS SIMULATION

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Purpose: The primary objective of this research is to provide empirical evidence supporting the application of simulation as a strategic tool for bolstering operational resilience.

Design/methodology/approach: This paper employs the simulation and the case study method.

Findings: Simulation is a pivotal tool for manufacturers seeking to enhance operational resilience. Through meticulous analysis of real-world production systems and translating these insights into sophisticated simulation models, manufacturers can significantly bolster their resilience. This methodology enables organizations to anticipate and mitigate potential disruptions, thereby ensuring uninterrupted operations and maintaining a competitive edge.

Practical implications: This study proposes simulation research as a means of enhancing performance and informing investment choices. Notably, simulation modelling fosters a proactive perspective, allowing organizations to not only endure and recover from adversity but to also emerge fortified and reinvigorated, rather than simply reverting to pre-crisis states.

Originality/value: The article underscores the strategic significance of simulation modelling in fortifying an organization's operational resilience.

Keywords: operational resilience, simulation, production, material flow, organizational improvement.

Category of the paper: Research paper.

1. Introduction

The confluence of global challenges, including the COVID-19 pandemic (Schleper et al., 2021), the Russian invasion of Ukraine (Srai et al., 2023), escalating trade tensions, and the European Union's concerted drive towards a sustainable and competitive economic model, has underscored the imperative for contemporary organizations to cultivate a robust capacity for resilience (Banaszyk, 2022).

What is more, resilience is also one of critical aspects of Industry 5.0, driving the trend of hyper-individualization by allowing for the production of goods tailored to specific user needs. This rising demand for personalized products introduces the need for developing flexible systems for manufacturing (Khan et al., 2023; Maddikunta et al., 2022). Thus Industry 5.0 prioritizes flexibility to enable hyper-individualization. The growing trend of individualization necessitates a paradigm shift in manufacturing, moving beyond rigid production lines towards adaptable and responsive systems that can cater to diverse customer preferences (Koren et al., 2015). Building resilience through increased flexibility is a key part of Industry 5.0. (Sheffi, Rice, 2005). Given these circumstances the Fifth Industrial Revolution might heavily rely on simulations for its success (Asmaa Seyam May EI Barachi, Mathew, 2024; Maddikunta et al., 2022).

The task of constructing business workflows within a dynamic environment presents a formidable challenge. Beyond a comprehensive understanding of the workflow itself, it is imperative to contemplate its broader context and the prerequisites for its effective functioning and the realization of its intended outcomes (Malega et al., 2022). The management of operations during periods of upheaval becomes a formidable undertaking. A multitude of potential actions must be carefully considered. Simulations, facilitating an understanding of the implications of potential decisions prior to their implementation, empower the strategic planning of material flow processes to optimize efficiency while accommodating the unique requirements of individual production environments. Through this endeavor, it is feasible to devise actions that can be successfully executed even in the face of unforeseen circumstances.

2. Literature review: resilience and simulation

2.1. Resilience

The notion of resilience has been examined within three primary disciplines of the social sciences: sociology, psychology, and economics. To date, research has investigated organizational resilience from various viewpoints. Hepfer and Lawrence (2022) posit three primary conceptualizations of resilience:

- absorption and recovery: This perspective emphasizes the sustained functioning of an individual or system in the face of adversity, without necessarily reverting to a previous state or progressing to a new one;
- anticipation, coping, and adaptation: This conceptualization highlights reactive and adaptive behaviors, suggesting that resilience involves the ability to anticipate challenges, cope effectively, and adapt to changing circumstances;
- bouncing back and bouncing forward: This framework differentiates between returning to an original position (or ‘bouncing back’) and positive development (or ‘bouncing forward’) following a setback.

A recent study by Hepfer and Lawrence (2022) identified three key dimensions of organizational resilience:

- strategic resilience refers to an organization's ability to foresee and counteract potential threats that could jeopardize its long-term goals and overall strategy;
- operational resilience concerns an organization's capacity to respond effectively to adverse events that affect the entire entity and may disrupt its ongoing operations;
- functional resilience pertains to a specific organizational department or process, with the majority of existing research concentrating on localized disruptions within the supply chain and information systems sectors.

The notion of resilience within supply chain management (SCRES) is a comparatively recent development. Rice and Caniato's (2003) work represents an early contribution to this field. A notable advancement was made by Christopher and Peck in (2004), who introduced a preliminary framework for supply chain resilience (SCRES) (Shi et al., 2023). They defined SCRES as the capacity of a system to revert to its original condition or progress towards a more advantageous state following a disruption, thereby establishing a fundamental definition for future research.

As outlined by Hohenstein et al. in (2015), supply chain resilience is defined as the ability of a supply chain to be prepared for unforeseen risk events, to respond and recover promptly from potential disruptions, and to return to its original state or even advance to a new, more advantageous position (Asmaa Seyam May EI Barachi, Mathew, 2024). It is noteworthy that both disruptions in general and, specifically, the COVID-19 pandemic have spurred increased academic and practical attention on supply chain resilience as a means of gaining a competitive edge (Irfan et al., 2022).

Resilience, within the context of this study, is defined as the adaptive capacity to mitigate the likelihood of unforeseen internal or external disruptions, to anticipate and prepare for such occurrences, to react promptly to them, to contain their spread, to recover from their effects, and ultimately to reinstate the original state or transition to a more advantageous position (Ali et al., 2017; Gunasekaran et al., 2015; Maryniak et al., 2021; Ocicka et al., 2022; Szymczak, 2015).

2.2. The essence of simulation

The term ‘simulation’ originates from the Latin language (simulo, similis, similo, similar, simulacrum) and signifies: to feign, represent, imitate, mimic, similar, similarity. Its significance can be assessed in diverse contexts. In previous scientific research and the accompanying literature, this issue has been examined in the following contexts (Diakun, 2023):

- in the context of a research method (simulation method),
- in the context of a technical-organizational undertaking (simulation study, simulation project),
- in the context of a computational process (simulation run).

Table 1 presents the definitions of simulation.

Table 1.
Simulation Definitions

Item	lowercase letters
G. Gordon	a method of problem-solving that monitors temporal variations in a dynamic system model
T.H. Naylor	a numerical technique for conducting experiments on certain types of mathematical models, which use a digital machine to describe the behavior of a complex system over a long period
G.S. Fishman	collection of techniques that, when applied to the study of a discrete-event dynamical system, generates sequences called sample paths that characterize its behavior
J. Winkowski	time-ordered reproduction of consecutive process runs
G.W. Evans, G.F. Wallace, G.L. Surtherland	the process of chronologically constructing a sequence of state representations, forming a state trajectory
R.F. Barton	the targeted operation of a subject system model
J. Banks, J.S. Carson II, B.L. Nelson, D.M. Nicol	the imitation of the operation of a real-world process or system over time
S. Robinson	experimentation with a simplified imitation (on a computer) of an operations system as it progresses through time, for the purpose of better understanding and/or improving that system
M. Beaverstock, A. Greenwood, W. Nordgren	to experimentally reproduce the behavior of a real-world system through the use of a model

Source: Developed on the basis of: (Banks et al., 2010; Barton, 1974; Beaverstock et al., 2017; Evans et al., 1967; Fishman, 2001; Gordon, 1974; Naylor, 1975; Robinson, 2004; Winkowski, 1974).

Considering the preceding points, it is evident that computer simulation, as defined by Latuszynska (2011) and Mielczarek (2009), constitutes:

- an experimental methodology,
- a numerical technique,
- an implementation on dynamic models that mirror real-world systems,
- a tool for comprehending the temporal behavior of the system under analysis.

Simulation studies, combining knowledge from statistics, computer science, and the specific domain, are currently being employed to develop cyberphysical supply chains (Fig. 1).

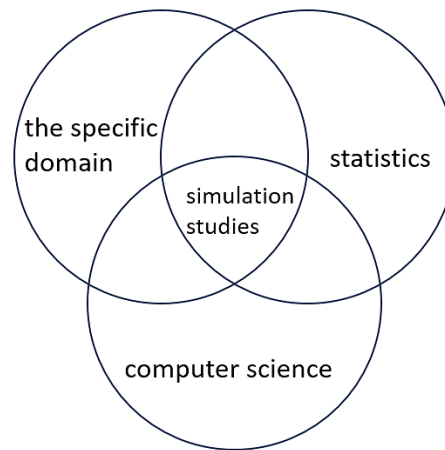


Figure 1. Cross-disciplinary nature of simulation methods.

Source: Developed on the basis of Diakun (2023).

Consequently, this approach may enhance the resilience of these chains operating within a network of intricate and dynamic process and economic interdependencies (Nowicka, Szymczak, 2020). In contemporary research, computer software is typically employed to execute simulations. The sequential stages within simulation studies are commonly delineated as steps or illustrated graphically in the form of block diagrams within relevant academic literature. The simulation study comprises several distinct stages. Firstly, the problem to be addressed is clearly defined. Subsequently, a specific goal or objective is established for the study. The scope of the investigation and the required level of detail for the simulation model are then determined. Input data is collected and analyzed to inform the model construction. A simulation model is subsequently developed, followed by rigorous verification and validation processes. A simulation experiment is meticulously planned, executed, and analyzed to extract meaningful data. Finally, comprehensive documentation is prepared, and the simulation results are effectively implemented.

Simulation constitutes a compelling analytical instrument owing to its multifaceted benefits (Fishman, 1981). Simulation studies are a valuable tool for investigating complex processes, both existing and hypothetical. They are particularly useful for analyzing hazardous processes or those involving unavailable resources. When analytical methods fail to provide solutions for real systems, simulations can offer a means of understanding their behavior and dependencies. By creating virtual representations of these systems, simulations can facilitate decision-making and promote a deeper understanding of their inner workings (Jackson et al., 2024). Moreover, simulations allow for the manipulation of time, enabling users to accelerate or decelerate processes to study their dynamics in detail. Analyzing the relationships between system inputs and outputs, as well as the sources of variability, is a key benefit of simulation studies. The ability to replicate simulations multiple times provides researchers with a robust foundation for drawing conclusions. Furthermore, the simulation's measurement error can be significantly reduced. The study's continuity is also ensured, allowing for repeated and complete interruptions to conduct analyses and then resume, with the capability of examining all states.

Additionally, simulation computations are more cost-effective and time-efficient than direct observations.

2.3. Research gap

Among the three facets of organizational resilience, operational resilience has received the least attention within the fields of management and organizational studies (Holgado et al., 2024). Essuman et al. (2020) assert that our academic comprehension of operational resilience is restricted, given that the preponderance of research focuses on the firm and supply chain levels.

3. Discussion

In examining the evolution of production paradigms, a noteworthy shift emerges: the transition from mass production to mass customization, ultimately culminating in the nascent concept of mass individualization. While all three paradigms share the core functions of design, manufacturing, and sales, they diverge in two key aspects: the sequencing of these operations and the level of customer influence within the purchasing process. A key feature of the mass-individualization paradigm is active customer involvement in product design. This presents a unique challenge for manufacturers. Customers can now personalize their products by selecting from a range of certified modules offered by various vendors, or even design and build their own modules. Companies implementing product portfolio control strategies must strike a delicate balance between the variety of offerings and the resulting operational complexity (Buzacott, Mandelbaum, 2008; Koren et al., 2015).

This strategic equilibrium achieves a balance between optimized operational efficiency, profitable customer relationships, enhanced product quality, and reduced costs. Research conducted by Desai, Kekre, Srinivasan, Meeker, Meyer, and Mugge demonstrates that the introduction of additional product and service variants can lead to increased profitability (Desai et al., 2001; Meeker et al., 2009). However, the research also highlights the critical importance of effective management in mitigating the complexities associated with such diversification. Without appropriate control measures, the potential benefits of offering a wider range of products and services may be compromised (Meyer, Mugge, 2001).

Today's focus on individualization requires a fundamental change in how things are made. Manufacturers must abandon the limitations of traditional production lines and adopt responsive systems that can meet the diverse needs of their customers. In the analyzed case at the plant in the end of line area (EOL) there are twenty-nine packaging machines arranged in series in two rows opposite each other, with one common pathway used to collect homogeneous pallets with the finished product (Fig. 2). In the place where pallets with finished products are

received, just behind the packaging machines, there is so little space that only one forklift can move there without the possibility of turning around.

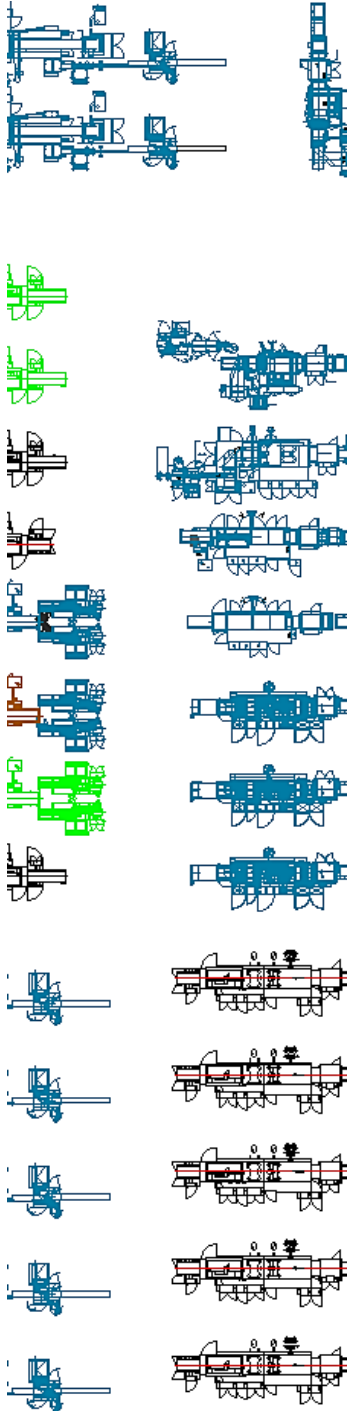


Figure 2. Twenty-nine packaging machines arranged in series in two rows opposite each other, with one common pathway used to collect homogeneous pallets with the finished product.

Twenty-nine packaging machines operate in the plant, staffed by two workers each. One packs the packages into cartons and sends them for sealing and labelling. At the end of the packaging machine, the second operator picks up the cartons and puts the packages on a pallet according to a previously established pattern (Fig. 3). In this variant, a total of fifty-eight employees work.

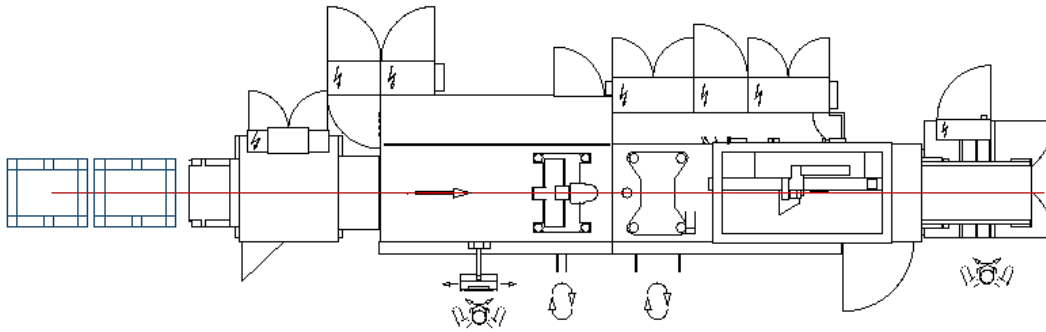


Figure 3. Packaging machine staffed by two workers each.

In the current production variant, there is a situation where the operator has a full pallet with the product, more packages arrive to be placed on the pallet, but the forklift operator cannot collect the pallet with the product due to narrowing the pathway. It is not possible to add a second forklift. This causes downtime and the need to stop packaging machines, and thus reduces the efficiency of the line.

The client stipulated the creation of an internal transportation system within the EOL area designed to maintain uninterrupted process flow, minimize operational disruptions, and avoid bottlenecks. Additionally, the system should reduce material losses, equalize workload across workstations, and expedite customer order fulfillment.

Considering the first proposed solution, a conveyor can be installed behind the packaging machines (Fig. 4). This conveyor will then direct product packages to another hall for sorting.

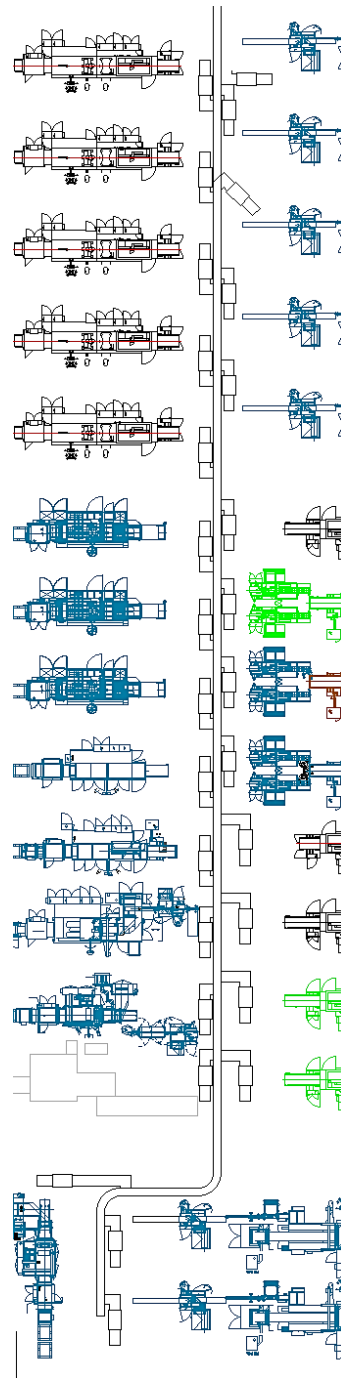


Figure 4. A conveyor installed behind the packaging machines.

In this dedicated sorting area, employees will take the packages off the conveyor and place them on pallets.

This solution necessitates twenty-nine factory floor workers and twenty sorters in a separate hall, connected by a conveyor.

The next considered solution variant suggests, similarly to the previous case, adding a conveyor behind the packaging machines and directing products through this conveyor to another hall. However, in the second variant, the variety of offerings products are redirected to a conveyor where they are automatically detected and sorted using a vision system that recognizes packages and sends to previously defined storage fields.

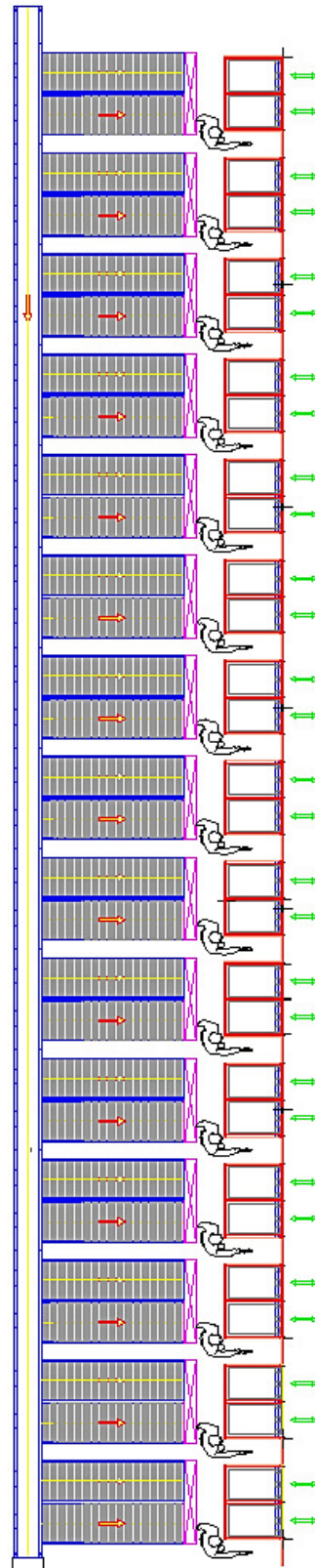


Figure 5. Automatic Detection and Sorting System with Vision Technology.

After the product reaches the storage place, the product is taken from conveyor and placed on a pallet by a factory floor worker (Fig. 5). This solution necessitates twenty-nine factory floor workers and fifteen sorters in a separate hall, where collision-free collection by several forklifts is possible.

The last scenario assumes, similarly to the previous case, adding a conveyor behind the packaging machines and directing products through this conveyor to another hall. However, in the third variant, the variety of offerings products are redirected to a conveyor where they are automatically detected using a vision system that recognizes packages and then, unlike the previous variants, sent to previously defined places (pick points) for collection by the robot.

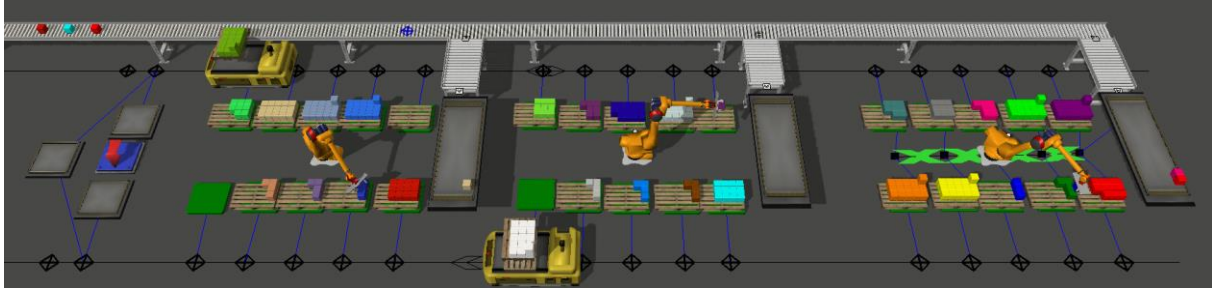


Figure 6. The developed investment scenario.

The entire system uses six collection points and three robots (Fig. 6). Each robot supports two collection points. After the product reaches the appropriate collection point, the product is picked up from the conveyor by the robot and placed on a previously defined pallet. Each robot places products on ten pallets. After filling the pallet with the appropriate number of packages, one of two transport cars (T-car) arrives, depending on the location of the pallet (Fig. 7). This solution necessitates twenty-nine factory floor workers, no sorters are needed.

Two pallets fit on a single T-car. The empty pallet comes first. The second place is intended for downloading a full pallet. After the robot has completed the entire pallet, a T-car is called.

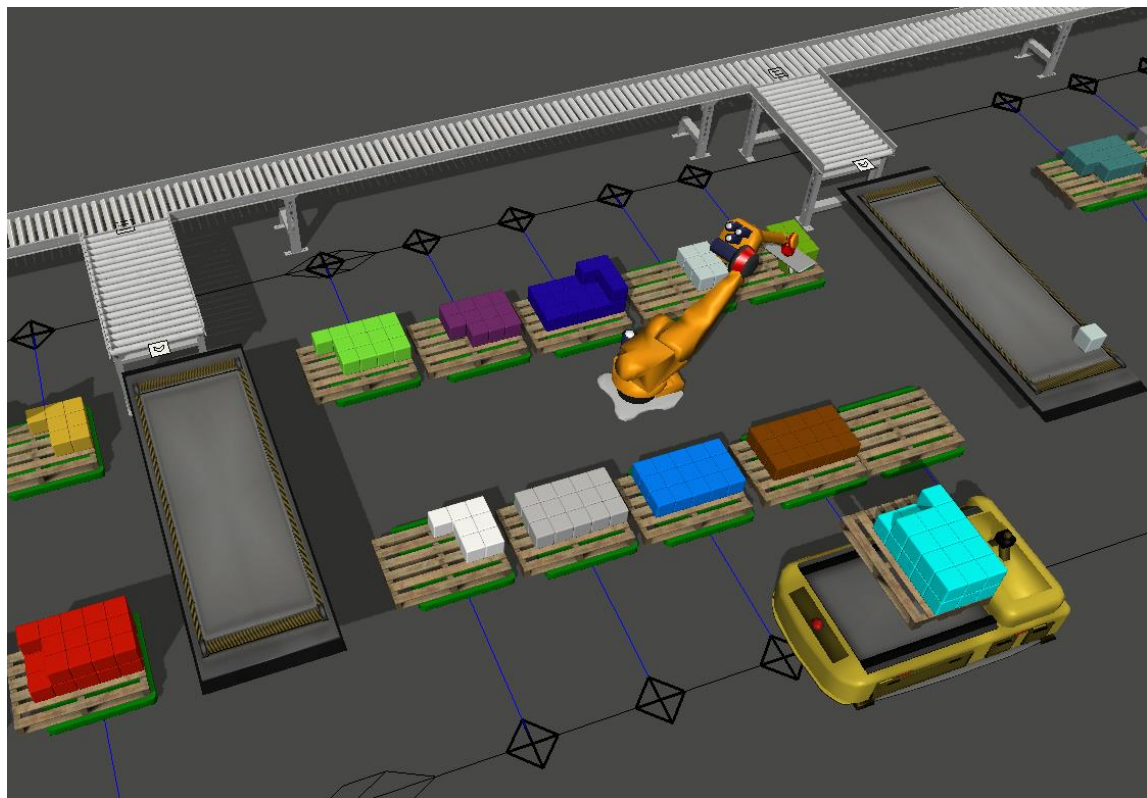


Figure 7. T-car.

It starts from a parking space, where a full pallet is always delivered and an empty one is picked up. Once the T-car arrives at the location with the full pallet, the pallet is loaded onto the T-car. The T-car replaces the full pallet with an empty one and returns to the parking space. The cycle is then repeated. After unloading the full pallet from the T-car, it is transported via a system of conveyors to the finished products buffer, then retrieved by the operator for redirection to the finished products warehouse. Empty pallets are delivered to the system via destackers and then transported via a conveyor system to the T-car. In order to achieve greater efficiency of the entire system, two T-cars are used, located on the left and right side of the pallet loading system, each adapted to unload/load full pallets and load/unload empty pallets.

The developed investment scenario presenting the new concept along with the method of its implementation was presented to the investor in material flow simulation software FlexSim. The FlexSim language leverages the combined power of 3D animations and graphical representations, enhancing its visual appeal for users. FlexSim empowers users to develop and utilize dynamic 3D animation models, providing a comprehensive library of standardized elements to streamline the modelling process. This library comprises a rich set of elements including: sources, sinks, combiners, robots, processors, workers, conveyors. Every element within FlexSim is defined by a set of characteristics, including properties, states, events, appearance, and logic. Properties store user-defined input values, whereas states represent dynamic values that can change throughout the simulation. With the model finalized, FlexSim empowers users to explore various scenarios, enhancing decision-making. These scenarios allow different parameters to be analyzed simultaneously and their combined effects on the system to be observed (Poloczek, Oleksiak, 2023).

The simulation model, built within the FlexSim software environment, replicated the architectural layout of the company's production facility. Through a meticulously detailed description, the machine layout achieved realistic dimensions that seamlessly integrated with transport routes and storage fields. Drawing upon the floor plan of the production hall, the specific locations of operational workstations were identified and subsequently incorporated into the model, utilizing the previously established dimensions. Figure 9 shows the input data defining the parameters for quantifying the final result and determining average throughput ranges.

	No	Cartons/hour	Min number of boxes on a pallet	Number of pallets per hour	Cardboard every sec	Cardboard every min
Row 8	21	48.49	28	1.73	74.25	1.24
Row 9	27	34.15	24	1.42	105.43	1.76
Row 10	29	34.15	24	1.42	105.43	1.76
Row 11	10	19.80	16	1.24	181.77	3.03
Row 12	24	19.80	16	1.24	181.77	3.03
Row 13	20	19.80	16	1.24	181.77	3.03
Row 14	19	19.80	16	1.24	181.77	3.03
Row 15	7	9.56	16	0.60	376.53	6.28
Row 16	2	11.61	20	0.58	310.08	5.17
Row 17	1	10.24	24	0.43	351.43	5.86
Row 18	22	48.49	28	1.73	74.25	1.24
Row 19	16	34.15	24	1.42	105.43	1.76
Row 20	26	34.15	24	1.42	105.43	1.76
Row 21	28	34.15	24	1.42	105.43	1.76
Row 22	18	19.80	16	1.24	181.77	3.03
Row 23	17	19.80	16	1.24	181.77	3.03
Row 24	14	19.80	16	1.24	181.77	3.03
Row 25	3	17.07	24	0.71	210.86	3.51
Row 26	8	9.56	16	0.60	376.53	6.28
Row 27	4	11.61	24	0.48	310.08	5.17
Row 28	23	48.49	28	1.73	74.25	1.24
Row 29	5	19.12	12	1.59	188.27	3.14
Row 30	15	34.15	24	1.42	105.43	1.76
Row 1	25	34.15	24	1.42	105.43	1.76
Row 2	13	19.80	16	1.24	181.77	3.03
Row 3	12	19.80	16	1.24	181.77	3.03
Row 4	11	19.80	16	1.24	181.77	3.03
Row 5	6	19.12	16	1.20	188.27	3.14
Row 6	9	9.56	16	0.60	376.53	6.28
Row 7	30	700	28	25	5.14	0.09

Figure 8. Input parameters.

By feeding the FlexSim system with input data, their impact on the output data is observed (Fig. 10). Dashboards generated based on dynamic process parameters provide insights into system utilization (Fig. 9).

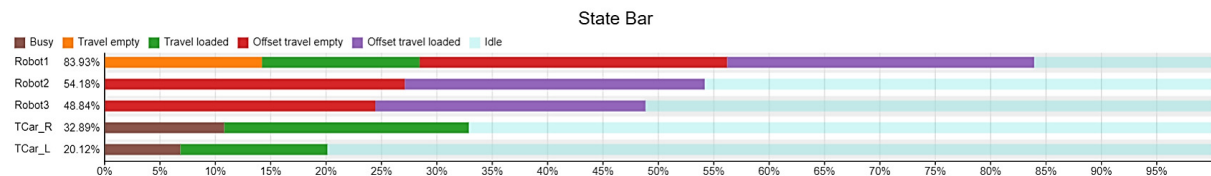


Figure 9. Optimization of infrastructure and resources.

In subsequent iterations, in accordance with the frequency of occurrences and the established pattern, the system assigns pick points to which the products are sent. It then determines the place where the robot built the pallet cargo unit and then the appropriate T-car for pickup.

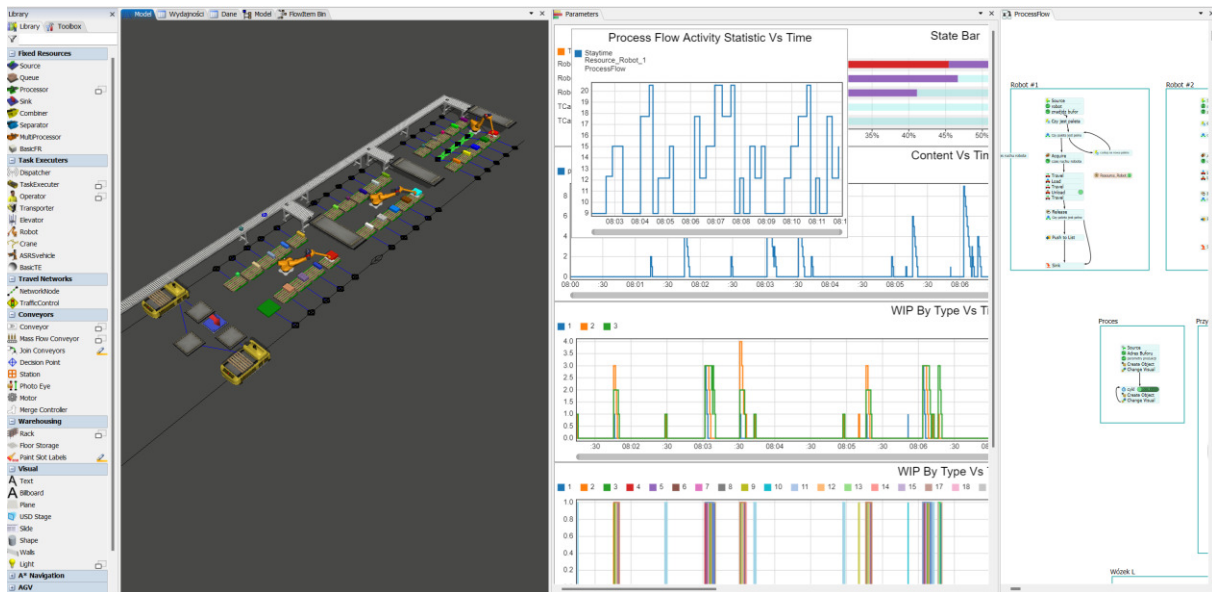


Figure 10. Verification of process and operations.

A shift towards adaptable and responsive systems is crucial to meet the diverse preferences of today's consumers. The choice of FlexSim simulation software for developing a solution was based on the potential advantages it could offer at various stages of the business project implementation (Beaverstock et al., 2017). These benefits were anticipated to contribute to feasibility assessment, cost reduction, detailed design refinement, and the validation of existing processes and operations.

Business process simulation studies provide valuable tools for problem-solving and investment decision-making. The requisite model accuracy varies contingent upon the particular task, whether it be production simulation, production process optimization, or the resolution of economic challenges (Eberle, 2020; Lidberg et al., 2020).

The proposed solution sought to:

- optimize process continuity by eliminating downtime, disruptions, and bottlenecks,
- minimize losses throughout the production process,
- balance workload distribution across workstations,
- reduce process variability and ensure consistent performance,
- accelerate order fulfilment by decreasing the overall processing time.

Given the aforementioned assumptions, a comprehensive analysis of the entire system was required, encompassing potential scenarios and interrelationships. The system should not be regarded as a collection of autonomous subsystems but rather as an integrated entity (Goldratt, Cox, 2016). A holistic perspective enables a thorough understanding of how interconnected elements contribute to the overall system's efficacy (Hamrol et al., 2015).

The primary objective of any organization is to achieve success. However, in any business endeavor, limitations can hinder the system from reaching its optimal performance. These constraints act as bottlenecks, restricting the system's throughput (Bilinovics-Sipos, Reicher, 2023).

The Theory of Constraints (TOC) acknowledges the interdependence of various elements within a system, analogous to the chain network theory (Moore, Scheinkopf, 1998), wherein the overall system's strength is determined by its weakest component (Hamrol et al., 2015). TOC concentrates on identifying and addressing these constraints, ensuring a harmonious flow of materials, products, information, and human resources. This approach empowers organizations to optimize their effectiveness, ultimately leading to enduring success.

4. Conclusions

The convergence of mass customization presents a transformative opportunity for the manufacturing sector, enabling the production of highly personalized goods. However, the successful realization of this vision hinges upon the implementation of robust and efficient product sorting systems. A three-dimensional model of the actual internal transportation system was developed through simulation, enabling a comprehensive analysis of its operational characteristics. The simulation experiments conducted facilitated the investor's comprehension of the potential outcomes of various decisions prior to their implementation. The "what-if" feature provided valuable insights into viable solutions for recognized challenges. The simulation employed for this purpose evolved into a tool for illustrating how the throughput of the designed system can be modified through iterative computational processes, continuous monitoring of the system, and ongoing interpretation of its behavior.

The article emphasizes the strategic value of simulation modeling in enhancing an organization's operational resilience. By establishing a simulated environment to identify potential vulnerabilities, optimize resource distribution, and devise contingency plans, this methodology empowers businesses to anticipate and mitigate the impact of disruptive occurrences. This proactive approach enables organizations to enhance their resilience and minimize the adverse effects of unforeseen challenges.

This paper advocates for simulation research as a methodological framework to elevate performance and guide investment decisions. Importantly, simulation modeling cultivates a forward-thinking perspective, enabling organizations not merely to withstand and recover from challenges but to undergo transformative evolution, transcending the status quo that preceded such difficulties.

As the need for customization and personalization increases, production system optimization becomes crucial. Simulation offers a cost-effective means of analyzing systems. This approach provides a distinct advantage by enabling the prediction of potential outcomes within the production system, thereby mitigating financial risks associated with actual implementation.

Although the case study has limitations, the results convincingly demonstrate the growing role of business process simulation as a tool for optimizing production systems and effective variant management in the face of the growing demand for customized and personalized products.

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EXPECTATIONS TOWARD EMPLOYERS OF YOUNG PROFESSIONALS ENTERING THE LABOR MARKET

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Purpose: The paper aims to test the tool – the EmpAt scale to analyze how young professionals who enter the labor market perceive employers and what are their expectations towards them. The paper is another part of the discussion on employer value proposition and its adjustment to the expectations of young talents.

Design/methodology/approach: The research was carried on in a group of Czestochowa University of Technology and the University of Applied Science in Nysa students who attend a Business English bachelor full-time course. The research included the methodology called the EmpAt scale.

Findings: The research revealed that the students' preferences towards potential employers are mainly related to the economic value of their potential job, followed by the development value (including satisfying needs regarding confidence, career-enhancing, and opportunities for further development). When individual factors are analyzed, the most important for students are: gaining career-enhancing experience, job security within the organization, and a fun working environment.

Research limitations/implications: The study's main limitation can be indicated in its limited sampling, but the research population is also limited (150). The sample though meets statistical restraints, and the methodology may be implemented to research other groups of Gen Z representatives.

Practical implications: The results of the study may add some new information to the discussion of Gen Z expectations towards employers, especially in the context of tailoring employer value propositions that this group can find appealing. Businesses, including local entrepreneurs, searching for specialists, should find any voice in discussion on expectations of their potential employees beneficial.

Originality/value: The paper is related to the discussion on employer branding and its very different dimensions. Its originality can be analyzed mainly through the group it is aimed at. Young professionals entering the labor market should not be perceived as a homogenous group and each research that is aimed at a specific part of it can add some value to the discussion on the upcoming shape of the labor market. Also, the EmpAt scale used for the research was not widely discussed in Polish literature, so combining the specific research group with the method makes the research valuable and original.

Keywords: young talents, employer value proposition, the EmpAt scale.

Category of the paper: Research paper.

1. Introduction

Generation Z representatives have been looked into from many perspectives as ones who will shape the future of businesses, societies, and different types of communities very soon. Their characteristics, discussed from various points of view enable companies and different kinds of organizations to prepare for new internal and external customers who, as brought up in very different circumstances and influenced by very different factors to the range that is not fully discovered yet, will create a reality far different from the present one.

Although the representatives of Gen Z are nowadays mostly researched as potential customers (i.e. Salim et al., 2024; Ghouse et al., 2024; Scoti, 2024; Bailey et al., 2024; Meyerding, Ahrens, 2024; Seyfi et al., 2024), some researchers have also discussed their behavior in the work environment (Ozkan, Solmaz, 2015; Schroth, 2019; Perses, 2019; Ly-Le et al., 2024; Seyfi et al., 2024) or expectations towards potential employers (e.g. Osorio, Madero, 2024; Lssleben, Hofman, 2023; Sillero, 2023; Karasek, 2022). Their role in the labor market is crucial for companies to be recognized, especially as employers have been analyzed as a key group of stakeholders of organizations since their role was defined by R.E. Freeman, the author of the stakeholder theory who stated that “the key thing for an organization is to create value not for the organization's owners (shareholders), but for the organization's stakeholders” (Wierzbic, 2024, p. 649). That perception of employees' significance for organizations fosters various discussions on employees and patterns of their behavior. The deeper they are recognized, the more effective the internal marketing efforts can be, and generally management of these groups becomes more efficient.

Recently, as the discussion on employer branding has arisen, employees are also perceived as representatives of attributes related to an organization as an employer. Employee advocacy as an element of employer branding is perceived as a tool to support talent acquisition, attract shareholders, and increase the self-perception of employees. Another related concept – the EVP (employer value proposition) defines employees not only as target markets of the strategy but also as brand members, co-creators, influencers, and representatives (Kozłowski, 2016; Näppä et al., 2023; Benazić, Ruzić, 2023). In consequence, employees are set not only a competitive advantage of a business by their skills and involvement in the job they perform, but they have become perceived as a medium of communication with external audiences.

Recognition of Gen Z representatives' attitudes towards employers has become so important mainly because the generation who enters the labor market is expected to outnumber baby boomers at work soon. At the moment, they set 24% of the global workforce to rise to 30% in 2030 (Osorio, Madero, 2024). Different tools are used to reach that goal (Caputo et al., 2023), and one of them is the EmpAt scale developed by Berthon et al. (2005), which was tested in the study to analyze expectations toward potential employees of groups of young professionals.

2. Method

The research was conducted in groups of students participating in the Business English bachelor programs at the Faculty of Management at Czestochowa University of Technology and the University of Applied Science in Nysa. In total, 73 students filled in the questionnaire – 41 representing the CUT, and 32 representing the UAS, studying at the second (39) and the third (34) year. The sample meets the desired statistical constraints (confidence level of 95%, 5% margin error).

The students of the Business English course were chosen for the study because they represent some specific characteristics that make them unique and worth close analysis. First of all, they mostly have some work experience and they have worked in sectors of the economy related to the course of their studies (tourism, education, etc.) so their work experience is not only the way to provide them with some extra money to cover costs of living but it can also be interpreted as job experience enriching their knowledge and experience for further jobs.

Moreover, they represent the segment of the economy that has been recently affected by modern technological development. The knowledge of tools, access to international sources of information, skills in AI tools usage, and growing up in the internet environment make that group of young professionals competitive in the market that has been constantly growing since online retail has been ever-increasing, e-commerce share has reached 20,1% of total global retail sales (Statista, 2024) and 57% of clients shop internationally (PayPal, 2022). At the same time, as global research by CSA Research indicates, 65% of customers prefer the content in their native language, 73% expect product reviews in their languages, and 40% would not buy in other languages (DePalma, O'Mara, 2020). In consequence, the market of translation strongly orientates toward machine translation post-editing (MTPE) (Mraczný, 2024) which increases Gen Z's chances in the labor market due to their digital nativeness.

The research was conducted in the form of an online survey. The questionnaire included 31 questions divided into four parts:

1. General questions regarding previous work experience (closed, warm-up questions).
2. Questions following the Berthon et al., (2005) EmpAt scale to research 25 items in 5 dimensions of employer attractiveness.
3. Open questions concerning expectations towards employers and factors associated with satisfaction with job.
4. 2 metric questions (year of study and university)

and it was distributed among students by sharing the link to the questionnaire.

The 25 factors indicated by Berthon et al. (2005) were translated into Polish, but also in the questionnaire, the original versions of the items were left due to the fact, that students participating in the study could easily read the original versions which enabled a better understanding of the original scale. Although some authors (Eget et al., 2019; Benazić, Ružić,

2023; Caputo et al., 2023) translated the scale, keeping the English version of the scale, in the case of Business English students, was reasoned and reduced the risk of possible misunderstanding of questions. Following the methodology, the Likert scale was used to research the perception of elements indicated in the EmpAt.

3. Results

As assumed, the students mostly have some job experience. 16,4% haven't worked so far, but the rest have worked. Nearly one-third of students used to have one employer, 20% had two employers, and the rest had three employers or more.

Most of the students performed jobs not related to their field of study, so far. Only every fourth's job was associated with their major.

When asked to what extent their last job met their expectations (a scale from 1-10), the average rating was 6,26.

4. To what extent did your last job meet your expectations?

66 odpowiedzi

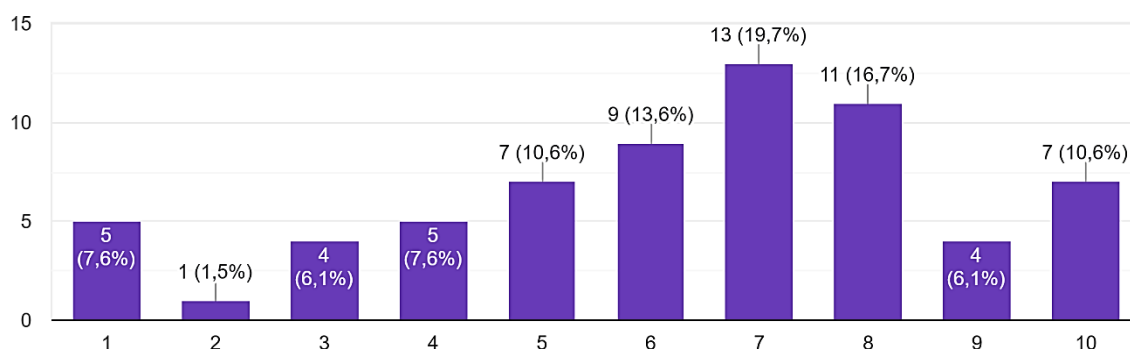


Figure 1. The answers to the question regarding the level of satisfaction from previous jobs.

Source: retrieved from: Google Forms on 10.10.24.

To deepen the discussion on that topic the students were asked (in open question) to provide their own opinion on former places of work, and to indicate which factors influenced their job satisfaction. Among the most frequent answers, the payments were shown the most frequently, followed by good relations with colleagues and a good atmosphere at work.

In the second part of the questionnaire, the students were asked how important different factors of employer attractiveness were to them. They were provided the 1-7 Likert scale to indicate the significance of the factors. The calculated averages from their responses are presented in Table 1.

Table 1.*Average rating of importance of analyzed factors of the EmpAt scale*

	Factor	Average
1	Recognition/appreciation from management	5,68
2	A fun working environment	6,12
3	A springboard for future employment	5,07
4	Feeling good about yourself as a result of working for a particular organisation	5,40
5	Feeling more self-confident as a result of working for a particular organisation	5,27
6	Gaining career-enhancing experience	6,38
7	Having a good relationship with your superiors	4,41
8	Having a good relationship with your colleagues	5,44
9	Supportive and encouraging colleagues	5,45
10	Working in an exciting environment	4,37
11	Innovative employer – novel work practices/forward-thinking	4,82
12	The organization both values and makes use of your creativity	5,66
13	The organization produces high-quality products and service	5,40
14	The organization produces innovative products and services	4,41
15	Good promotion opportunities within the organization	5,93
16	Humanitarian organization – gives back to society	3,95
17	Opportunity to apply what was learned during education	4,89
18	Opportunity to teach others what you have learned	4,84
19	Acceptance from coworkers and belonging to the organization	5,66
20	The organization is customer-oriented	4,88
21	Job security within the organization	6,14
22	Hands-on inter-departmental experience	5,30
23	Happy work environment	6,19
24	An above-average basic salary	5,73
25	An attractive overall compensation package (basic salary plus commission plus holiday cash grant plus other benefits)	5,32

The elements analyzed in the EmpAt scale were classified into 5 factors by Berthon et al. (2005, p. 159):

- Factor 1 – interest value – the extent to which potential employees are attracted to potential employees by the exciting work environment, novel work, and use of employee's creativity to produce innovative and high-quality products (factors 10-14).
- Factor 2 – social value – the extent to which a person is attracted to a potential employer that provides a happy working environment, good interpersonal relations, and a team atmosphere (factors 2, 7, 8, 9, 23).
- Factor 3- economic value – the extent to which a potential employee is attracted to an employer that provides a higher salary, job security, compensation package, and promotional opportunities (factors 15, 22, 23, 24, 25).
- Factor 4 -development value – the extent to which potential employee is attracted by satisfying needs regarding confidence, career-enhancing, a giving opportunities for further development (factors 1, 3, 4, 5, 6).
- Factor 5 – application value - the extent to which potential employee is attracted to an employer that gives employees to apply what they have learned, to teach others, in both customer-orientated and humanitarian organizations (Berthon et al., 162) (factors 16, 17, 18, 19, 20).

When the average of different factors is analyzed, in the case of students of Business English course in Czestochowa and Nysa, the different factors reached the following averages:

- Factor 1, Interest value – 4,932.
- Factor 2, Social value – 5,522.
- Factor 3, Economic value – 5,694.
- Factor 4, Development value – 5,56.
- Factor 5, Application value – 4,844.

After conducting factor analysis, the average rates of importance were measured for individual factors. When the individual factors are analyzed, the most important for the students are (in order of importance):

1. Gaining career-enhancing experience (6,38).
2. Job security within an organization (6,14).
3. A fun working environment (6,12).

The factors that are perceived as the less important (out of the defined 25) are: working in an exciting and innovative environment, as well as, having good relations with superiors (although that factor indicated a high level of standard deviation).

The last question of the questionnaire was the open one, and students were asked to indicate what are their expectations towards future employers. Here, the most frequent answers were *respect, understanding, appreciation, and providing possibilities for further development*. Generally, the answers were focused mainly on the personal features of potential employers.

4. Summary and discussion

The students who participated in the study represent a specific group of Gen Z. Although they study, most of them have some work experience and have already cooperated with at least two employers. They usually work using the skills and knowledge they acquire during their studies. The perspectives of Business English specialists are quite optimistic. They use their knowledge regularly and cooperate with people from all over the world. Although Polish representatives of Gen Z have been researched from various perspectives as potential employees (e.g. Mazurek, 2019; Ratajczak, 2020; Kupczyk, et al., 2021; Karasek, 2022), a narrower approach towards researching their expectations seems increasingly substantiated, especially when the study aims to recognize expectations for more effective employer branding efforts. To attract new employees, as research results reveal, not only salaries are important but also elements related to work atmosphere (surprisingly none of the respondents mentioned working conditions). What the students expect from their colleagues and superiors is respect as well as understanding and support.

As mentioned, there are several studies on students aimed at researching their expectations towards potential employers and also their role in a working environment. Literature provides many studies and discussions on that topic but there is a problem of research comparison mainly due to different perspectives from which the topic is analyzed as well as different methodologies. For example, the EmpAt scale, used for that study, although at the beginning created to research some ideal concept of a company, was also, later, decided to be useful for researching potential employees, i.e., students (Caputo et al., 2023), was implemented in research of Czech (Eger et al., 2019), Croatian (Benazić, Ružić, 2023) or Italian (Caputo et al., 2023) students. Nevertheless, any comparison between the results could be interpreted as misuse, due to different samples (sizes and structures) and groups of students represented in the research.

The paper presents the tool that can be used to analyze the attractiveness of employers in the eyes of students, and potential employees. It shows only one perspective of analyzing Gen Z representatives' features as potential employees and opens new opportunities for further research, especially since the topic still requires further research and an interdisciplinary approach.

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CHALLENGES IN HUMANITARIAN SUPPLY CHAINS MANAGEMENT: THE CASE OF POLAND

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Purpose: The aim of the research was to identify key challenges and best practices in managing humanitarian supply chains in Poland.

Design/methodology/approach: The research method was CATI (computer-assisted telephone interviewing). The research was conducted throughout Poland in 40 Crisis Management Centres at the provincial and district level.

Findings: Majority of respondents highlighted unpredictable demand as a prevalent issue, while weak supply chain visibility was also noted as a barrier to effective management. While technology is considered a positive influence on HSCH management, with 95% affirming its benefits, only 5% believe the current level of technology usage is adequate, indicating a need for greater technological investment. Furthermore, cooperation among HSCH actors appears satisfactory to most respondents, yet there are concerns about coordination and connectivity, as nearly one-third are uncertain about consistent communication between operational units and crisis management centres. The main findings from respondent recommendations emphasize the importance of collaboration, effective coordination and communication, involvement of skilled personnel, comprehensive planning, regular equipment updates, volunteer support and needs assessment.

Originality/value: The results of research can be addressed to those involved in public crisis management, both local authorities and public entities as well as blue light organisations and non-governmental organisations involved in humanitarian aid.

Keywords: humanitarian logistics, humanitarian supply chain, crisis situation, crisis management.

Category of the paper: research paper.

1. Introduction

Humanitarian supply chain (HSCH) management takes place in very complex and changing conditions. The parameters of a humanitarian supply chain are difficult to plan because the course of each emergency is individual, requires the involvement of multiple services, in each case different resources, to a different extent and quantity, and, moreover, these chains need to be adapted on an ongoing basis to emerging circumstances (Sienkiewicz-Małyjurek,

2014). Thus, the humanitarian supply chain is characterised by unpredictable demand, which is difficult to estimate based only on an analysis of the characteristics of the disaster, its type, size, location, and timing. Inventory is also difficult to plan for, and reliance must be placed on experience and probability analysis (Pokusa, Grzybowski, 2010).

Bag, Gupta, and Wood (2020) emphasize that the management of humanitarian supply chains is significantly challenged by the stochastic nature of demand. They further highlight that limited visibility within these supply chains, combined with prevailing uncertainty, exacerbates these difficulties (Bag et al., 2020). Visibility of a supply chain is the ability to track its individual components, subcomponents and final products from supplier through producer to consumer (Biel, 2021).

Uncertainty in the context of humanitarian supply chains, on the other hand, refers to the difficulties associated with anticipating and planning emergency response in dynamic and unpredictable conditions (natural disasters, armed conflicts or pandemics). Uncertainty is made up of changing factors such as the changing needs of the affected population, restrictions on access to crisis areas and logistical difficulties associated with damaged infrastructure (Shrivastav, Bag, 2023). Moreover, emerging information in humanitarian supply chains is uncertain, lacking much of the necessary data to plan and execute logistics operations (Agostinho, 2013). Information on required relief supplies, equipment, location and conditions at the scene plays a decisive role (Blecken, 2010).

Dubey, Luo, Gunasekaran, Akter, Hazen, and Douglas (2018) also highlight the issue of excess donations, which frequently fail to align with the actual needs of the affected population. With this kind of problem, information systems that help collect accurate information are important, and also support performance measurement and donation control. Thus, technology will positively impact the efficiency of the humanitarian supply chain by integrating operations and reducing uncertainty (Singh, Gupta, Gunasekaran, 2018).

Fiorini, Jabbour, de Sousa Jabbour and Ramsden (2021) state that managing the humanitarian supply chain is difficult because it involves critical timeframes that require the immediate mobilisation of all team members from different organisations and the need to coordinate multiple resources as quickly as possible. To this end, it is essential to ensure high-quality and reliable communication, especially during the response phase, when it has a real impact on saving lives and property, by effectively coordinating emergency services with other stakeholders (Carreras-Coch, Navarro, Sans, Zaballos, 2022). Communication between stakeholders ensures transparency and proactivity towards the emergency (Jabbour, Mendonça, De Camargo, Jabbour, Oliveira, 2019).

To respond quickly to hazards, governments have begun to implement early warning systems. In India, for instance, early warning systems are implemented to enable rescue teams to monitor the system's information while maintaining effective communication with one another. Communication must take place at regular intervals to have access to the most up-to-date information on the onset and progress of a disaster (eGyanKosh, 2007).

It is also important to inform at-risk communities immediately. The Federal Emergency Management Agency (FEMA) with the Federal Communications Commission (FCC) and various wireless service providers in the United States use the Integrated Public Alert and Warning System (IPAWS) to disseminate warning messages (Bennett Gayle, 2019). The Wireless Emergency Alerts (WEA) system allows geotargeted dissemination of messages to mobile phones in the area of imminent and direct threat (Federal Communications Commission, 2024). Such systems are also beginning to be launched in Poland. Early Warning Systems (EWS) enable the warning of residents about threats to life, health, and property or immediate evacuation, and enable cooperation with the police, municipal police, fire brigade, ambulance service and other security services (Walek, 2013).

The area at risk, the level of urbanisation or the scale of the damaged infrastructure also plays a significant role in the conduct of logistical operations (Sienkiewicz-Małyjurek, 2012). As Nowak (2008) adds, the factors determining the organisation of logistical security are problematic due to the following considerations:

- extreme conditions,
- blockade or isolation of affected areas,
- difficulties in reaching the injured (difficult terrain),
- rationing,
- the phenomenon of dichotomy.

Considering the identified challenges in managing HSCH, it is essential to identify key challenges and best practices in managing humanitarian supply chains in Poland.

This will be achieved by seeking answers to the following research questions:

1. What are the difficulties in managing HSCH in Poland?
2. What is the role of technology and information systems in supporting HSCH management in Poland?
3. What is the level of cooperation and coordination between the actors involved in providing assistance, as well as their communication with the emergency management centers?
4. What is the scope for investment and innovation in the area of humanitarian supply chains?
5. What are good practices and recommendations that can improve the effectiveness of HSCH in emergencies?

The answer to the above research questions is based on the 2024 CATI survey of the Crisis Management Centers in Poland.

2. Challenges facing humanitarian supply chains

Challenges in humanitarian supply chains include underdeveloped interorganisational networks, including intergovernmental cooperation (Silvia, McGuire, 2010) and associated coordination problems (Bag et al., 2020). The actors involved in relief operations are separate entities, functioning independently, which makes communication and coordination of activities very difficult. Dubey (2018) also points to limited coordination and ineffective cooperation between actors participating in HSCH activities. Sienkiewicz-Małyjurek (2012) also draws attention to the inconsistency of rescue procedures. Members of the National Fire Service, Volunteer Fire Service and ambulance service should have clearly defined responsibilities and procedures should be formalised and standardised, which could improve cooperation.

Waugh, Streib and William (2006) analyse the organisational structure of emergency management in the United States and the collaborative model of emergency response networks and highlight the importance of collaboration in emergency management. Kozuch and Sienkiewicz-Małyjurek (2015) also highlight the importance of interorganisational cooperation, pointing out the importance of cooperation between the state administration and executive units, the civic field and non-governmental organisations.

Leadership at local government levels is also a challenge in humanitarian supply chains. McGuire (2006) points out that the person in charge of emergency management in local government should have the right qualifications and aptitude and perceive threats as serious, not downplay them. Logistics operations in humanitarian operations are characterised by rapidity of response. When an emergency occurs, it is necessary to act automatically and decisions must be made quickly, even without much of the information needed. Van Wassenhove (2006) points out the lack of experienced logisticians, which hinders cooperation and coordination throughout the humanitarian supply chain.

During HSCH operations, it is important that everyone knows who the coordinator is and understands that this person has the authority to make decisions in emergencies (U.S. Department of Labor Occupational Safety and Health Administration, 2001). The issue of coordination is one of the main challenges of managing humanitarian supply chains, not least because each disaster is different in terms of the actors involved, the needs of the victims and the extent of damage (Balcik, Beamon, Krejci, Muramatsu, Ramirez, 2010). Coordination is defined as the process of consistency between activities in the correct, efficient and consistent delivery of relief resources and essential medical, transport, and evacuation services (Nikkhoo, Bozorgi-Amiri, Heydari, 2018). Interorganisational coordination, on the other hand, is the synchronisation of system elements into a coherent, integrated whole, which is not understood in terms of its outcomes, but attempts to integrate and design the system's operation (Sienkiewicz-Małyjurek, Owczarek, 2021). This definition allows the complexity of crisis management networks to be addressed by including both the formalised

rules of cooperation between organisations and the informal relationships that exist within these networks (Sienkiewicz-Małjurek, Owczarek, 2021).

Contracts are among the popular mechanisms in achieving coordination between members of the supply chain, some of which involve, for example, revenue sharing or volume discounts (Nikkhoo et al., 2018). Balcik et al. (2010) investigated the challenges of coordinating humanitarian supply chains and found that the complexity of crisis management networks, increasing donor demands, funding structures, competition for grants, volatility, as well as scarcity or surplus of assets are the primary factors of coordination challenges.

Noham and Tzur (2017) indicate that experience and knowledge condition decision-making agility. However, research by Safarpour, Fooladlou, Safi-Keykaleh, Mousavipour, Pirani, Sahebi, Ghodsi, Farahi-Ashtiani and Dehghani (2020) points to a problem with the lack of knowledge – of volunteers, decision-makers, governmental and non-governmental organisation staff. Researchers also point to a lack of public and organisational education, people are not aware of ways to help, they are not informed about what type of donation, to whom, when and how to donate (Safarpour et al., 2020). In addition, volunteers and staff are not well versed in how to identify the needs of the affected and in making and distributing donations (Safarpour et al., 2020).

Knowledge can be drawn from the experience of past emergencies. Many studies on specific disasters can be found in the literature. From such studies, it is possible to find out what are the most common mistakes or good practices in the context of humanitarian supply chain operations. Costa, Campos and Bandeira (2012) analysed, from a logistical perspective, large-scale natural disasters. It turns out that during the situations studied, there were numerous lapses and irregularities in humanitarian supply chain management.

In the first event described, which occurred in the Indian Ocean in 2004, 14 countries bordering the Indian Ocean were severely and extensively damaged as a result of the earthquake and tsunami. A feature of the relief efforts during this disaster was the excess of NGOs involved and the overwhelming number of donations made available. The poor quality of operations and the surplus donated as unnecessary goods resulted in an overloaded supply chain (Costa et al., 2012). Inadequate methods, programmes and tools and little commitment to process management and coordination. The consequences were blocked airports, overcrowded warehouses, and materials and equipment damaged in the sun and rain (Costa et al., 2012). In addition, insufficient staff keeping records of resources, poor logistics reports, losses, theft, and sale of donations were a problem (Costa et al., 2012). Inadequate planning contributed to poor resource utilisation, as well as a limited ability to deliver resources quickly. Lack of professionalism led to incomplete lists of affected people and needed goods, often resulting in haphazard distribution of donations (Costa et al., 2012).

The second case discussed concerns the 2005 earthquake in the region north of Pakistan and Indian Kashmir. This is one of the largest natural disasters in the world, affecting around 3.5 million people. Due to the difficult terrain (high altitude area), the high poverty level of the

population, the approaching winter, and the constant state of armed conflict in the region, the operation was very difficult (Costa et al., 2012). Despite the success, due to the onset of winter, some regions did not receive the three main groups of supplies (food and water, shelter and clothing; construction materials and tools) due to deficiencies in the application of distribution models. This shows the lack of adequate mechanisms to track and control resource flows from source to end user (aid recipient) (Costa et al., 2012).

Kumar, Singh, Shahgholian (2022) describe issues and challenges in humanitarian supply chain management during the COVID-19 pandemic. The COVID-19 pandemic affected over 214 countries worldwide, disrupting the supply of essential commodities (Joshi, Sharma, Das, Muduli, Raut, Narkhede, Shee, Misra, 2022). COVID-19 is a pandemic with unique logistics management challenges (Durugbo, Almahamid, Budalamah, Al-Jayyousi, BendiMerad, 2022). Millions of lives were lost due to unpreparedness and ineffective strategies for managing humanitarian supply chains (Kumar et al., 2022). During the pandemic, many problems emerged such as (Kumar et al., 2022): lack of planning and preparation; prolonged shortages of essential relief supplies; insufficient number of laboratories; lack of visibility in the supply chain; inefficient distribution network; prolonged response time; dependence on a single supply for medical equipment and drugs; lack of adequate information; lack of knowledge of the protocol for treating viral illness.

This can be summarised by an analysis by Ozdemir, Erol, Ar, Peker, Iskender, Asgary, Medeni and Medeni (2020), which provides information on the constraints to humanitarian supply chains worldwide in the following areas: organisational barriers, interorganisational barriers, donation barriers and legal barriers. The author of this article extended the barriers identified by Ozdemir et al. (2020) to include distribution barriers (Table 1).

Table 1.

Organisations in the operation of humanitarian supply chains

Barriers	Related operations	Research
Organisational	Poor monitoring of operations	McEntire (2002), Balcik, Beamon (2008), Kovács, Spens (2009), Willner, Zafeiridis (2013), Petrucci, Tavana, Abdi (2020)
	Purchasing problems during the reconstruction phase	
	Poor use of technology	
	Lack of integrated systems for obtaining aid funds	
	Problems with accountability for organisational activities	
Interorganisational	Short delivery times and immediate response to emergencies	McEntire (2002), Stephenson, Schnitzer (2006), Balcik, Beamon (2008), Kovács, Spens (2009), Willner, Zafeiridis (2013), Agosthino (2013), Kabra, Ramesh (2015)
	Coordination problems in crisis management networks	
	Trust issues in the crisis management network	
	Problems with the dissemination of information by the media	
In the area of donations	Unethical behaviour (theft, corruption, embezzlement)	Willner, Zafeiridis (2013), Kabra, Ramesh (2015), Petrucci et al. (2020)
	Problems with donor responsibility for disposing of money	
	Greater donor demands for transparency in operations	

Cont. table 1.

Regulation and standardisation	Lack of regulation and support measures	Kovács, Spens (2009); Willner, Zafeiridis (2013), Agosthino (2013), Petrucci et al. (2020)
	Customs clearance problems	
	Differences in the operational procedures of the different organisations in the crisis management network	
	Difficulties in enforcing standards	
Distribution	Surplus or inadequate supply of aid resources causing bottlenecks	Chen (2021), Nodoust, Pishvaei, Seyedhosseini (2021), Agarwal, Kant, Shankar (2020), Cankaya, Ekici, Ozener (2019)
	Convergence of incoming aid	
	Destruction of resources and aid measures due to inadequate security	
	Theft of aid funds	
	Lack of necessary data to plan deliveries	
	Unfair allocation of supplies	

Source: adapted from: Ozdemir et al. (2020).

The role of the humanitarian supply chain is sometimes unrecognised in organisations involved in crisis management. Even when humanitarian supply chain management is implemented in these entities it is rarely integrated into the organisation's system of operations (Kamau, 2013). The implementation of logistical principles and proper management of the humanitarian supply chain will guarantee a more efficient flow of aid resources in the right quantities and in response to real needs. Figure 1 depicts a possible path forward, i.e. proposed solutions to the problems found in humanitarian supply chains.

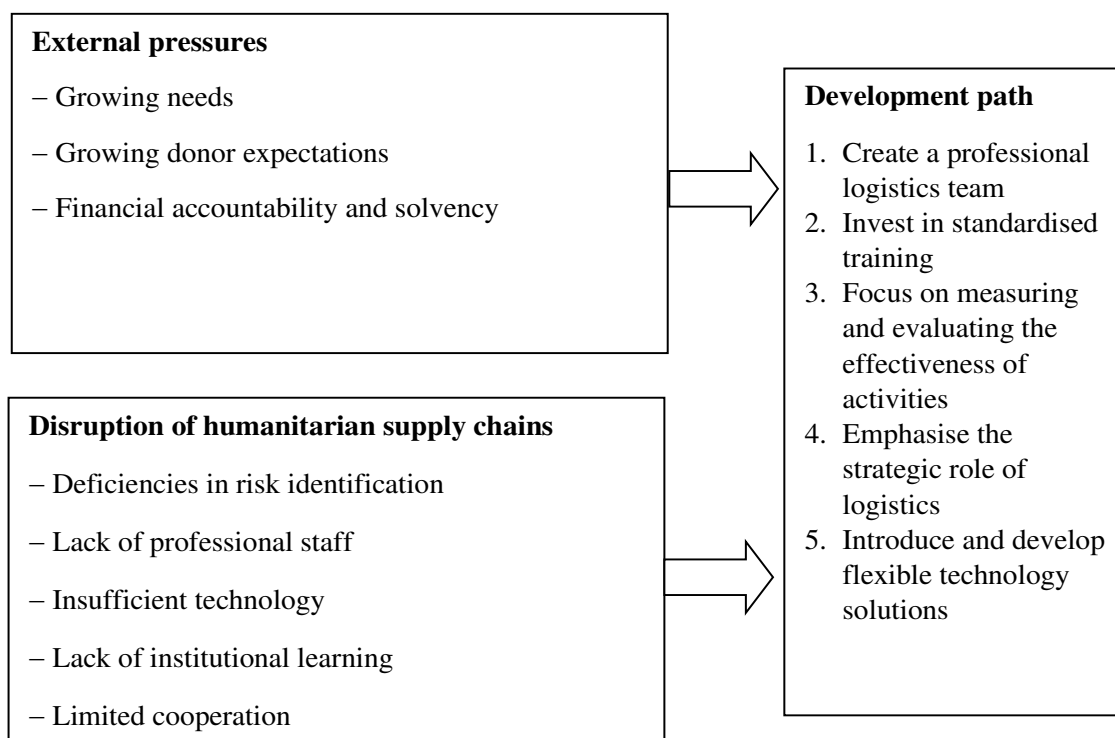


Figure 1. Possible development path

Source: adapted from: Thomas, Kopczak, 2005.

In addition to the proposals listed in Figure 1, at the Humanitarian Logistics 2009 Conference at the Georgia Institute of Technology, opportunities for improving humanitarian supply chain performance were developed. From the conference proceedings prepared by Stamm and Villarreal (2009), it appears that higher efficiency in humanitarian supply chains can be achieved through:

- indicators for evaluating performance, decision-making and operational improvement,
- cooperation between stakeholders (cooperation positively influences the outcome, but this is difficult to achieve),
- formalisation and standardisation of terminology, technology, and practices across the industry,
- logistics, which should occur in both immediate response and long-term development.

Proper and efficient handling of logistics operations is crucial (Negi, 2022). While none of the disaster situations can be prevented, their impact can be minimised through adequate preparation and proper response (Negi, 2022).

3. Methodology

The aim of this article is to identify key challenges and best practices in managing humanitarian supply chains in Poland. The research objective is detailed by the following research questions:

1. What are the difficulties in managing HSCH in Poland?
2. What is the role of technology and information systems in supporting HSCH management in Poland?
3. What is the level of cooperation and coordination between the actors involved in providing assistance, as well as their communication with the emergency management centers?
4. What is the scope for investment and innovation in the area of humanitarian supply chains?
5. What are good practices and recommendations that can improve the efficiency and effectiveness of HSCH in emergencies?

A telephone interview was used as the research method. The quality of data obtained by the telephone interview technique is as high as during a face-to-face interview; respondents are even more willing to share their opinions over the phone (Szreder, 2010, pp. 161-162). Often, a face-to-face interview is difficult or impossible, e.g. due to geographical distance or other specific conditions (Czakon, Glinka, 2021, p. 102).

The research was conducted throughout Poland in 40 Crisis Management Centres at provincial (7 CZK) and district (33 CZK) levels. The respondents were individuals holding senior positions in their organisations or delegated by their superiors as competent for the research. The Crisis Management Centre was chosen as the research unit because it is the organisational structure that is responsible for the coordination and management of activities related to the response to threats and crisis (gov.pl). It is the place where information on hazards and crisis is collected, decisions on preventive actions are taken, and the activities of the various public administration bodies, emergency services, the military and other entities involved in crisis management and HSCH management are coordinated. The aim of the Crisis Management Centre is to ensure a rapid and effective response to crisis to minimise damage and protect the life, health, and property of the population (gov.pl; Sienkiewicz-Małyjurek, Krynojewski, 2010, pp. 51-53).

The survey used a 5-point Likert scale, where 1 means 'strongly disagree' and 5 means 'strongly agree'. The Likert scale is used as one of the most commonly used psychometric tools in pedagogical and social research (Joshi, Kale, Chandel, Pal, 2015). The data obtained in the study were subjected to descriptive statistics. The measures used for analysis were the dominant, median, first quartile (Q1), third quartile (Q3) and mean. These measures allowed an objective assessment of the information obtained.

4. Results

Descriptive statistics formed the basis for the interpretation of the research results obtained. For each issue studied, statistical analysis was carried out individually. For clarity in describing the research, as well as throughout the text, the abbreviation HSCH - humanitarian supply chains - is used. The results obtained are presented in Tables 1-9. The first question concerned the problem of unpredictable demand in HSCHs.

Table 1.

The problem of unpredictable demand in humanitarian supply chains

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
1. Do you think managing humanitarian supply chains during emergencies and humanitarian aid is difficult due to unpredictable demand?										
0,00%	2,50%	25,00%	62,50%	10,00%	3	4	4	4	0,64	3,80

Source: own research.

The data in Table 1 shows that the majority of respondents confirm the problem of unpredictable demand at HSCH. There were 72.5% positive answers ('yes' and 'definitely yes'). A neutral position was maintained by 1/4 of the respondents, and 2.5% do not see such a problem.

Respondents then addressed the visibility of HSCH (Table 2).

Table 2.

Poor visibility of humanitarian supply chains

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
2. Do you think that poor visibility of humanitarian supply chains makes it difficult to manage them?										
0,00%	5,00%	15,00%	57,50%	22,50%	4	4	4	4	0,76	3,97

Source: own research.

Based on the data in Table 2, it can be concluded that respondents confirm the problem of poor visibility of HSCHs, which cause difficulties in their management. Such a problem is noted by 80% of respondents, 15% remained neutral and 5% believe that this factor does not cause difficulties.

Another issue examined was the impact of technology on HSCH management (Table 3).

Table 3.

Impact of technology on the management of HSCH

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
3. In your opinion, does the use of information systems and other technologies support the management of humanitarian supply chains?										
0,00%	0,00%	5,00%	62,50%	32,50%	4	4	5	4	0,55	4,27

Source: own research.

The data presented in Table 3 shows that almost all respondents (95%) confirm the positive impact of IT systems and modern technological solutions on HSCH management.

Another question asked about the level of use of IT systems and modern technological solutions in the surveyed organisations (Table 4).

Table 4.*Level of technology usage in HSCH management*

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
4. Are the information systems and technological solutions currently used in your organisation in the field of humanitarian supply chains sufficient?										
20,00%	47,50%	27,50%	5,00%	0,00%	2	2,00	3	2	0.81	2,17

Source: own research.

The data in Table 4 shows that 67.50% of respondents believe that the current level of use of information systems and modern technological solutions is insufficient. Only 5% believe that the technologies used are at a sufficient level, and 27.5% of respondents maintained a neutral stance towards the issue under study.

The next issue examined was the level of cooperation between the actors involved in HSCH activities (Table 5).

Table 5.*Level of cooperation between actors participating in HSCH activities*

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
5. In your opinion, do the organisations involved in humanitarian supply chains activities cooperate with each other to a sufficient extent?										
0,00%	7,50%	2,50%	57,50%	32,50%	4	4	5	4	0,80	4,15

Source: own research.

The data presented in Table 5 shows that 90% of respondents indicate a sufficient level of cooperation. However 7.5% respondents perceive a problem of poor cooperation between the units involved in HSCH activities.

This was followed by consideration of HSCH coordination issues (Table 6).

Table 6.*Coordination of HSCH activities*

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
6. Do you think that coordination of activities in the management of humanitarian supply chains is implemented adequately?										
0,00%	10,00%	22,50%	57,50%	10,00%	3	4	4	4	0,79	3,67

Source: own research.

Based on the data in Table 6, it can be concluded that 67.50% of respondents have a good opinion of the coordination of activities. However, a neutral position was maintained by almost 1/4 of the respondents, and one in ten respondents agreed that the extent of coordination of activities was inadequate.

Another issue examined relates to the maintenance of communication between the executive units and the Crisis Management Centre during HSCH operations (Table 7).

Table 7.

Maintenance of communication between the executive units and the Crisis Management Centre during HSCH operations

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
7. Is communication between executive units and Crisis Management Centre maintained during the implementation of humanitarian supply chains activities?										
5,00%	5,00%	30,00%	57,50%	2,50%	3	4	4	4	0,84	3,47

Source: own research.

According to the information presented in Table 7, more than half of the respondents (60%) indicate that communication is maintained between the executive units and the Emergency Management Centre during HSCH operations. However, almost a third of respondents do not know if such liaison is maintained and one in ten respondents admit that liaison is not maintained.

Respondents then referred to the extent of investment and innovation in the HSCH area (Table 8).

Table 8.

Extent of investment and innovation in the HSCH area

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
8. Do you believe that the current level of investment and innovation in humanitarian supply chains is adequate?										
0,00%	35,00%	57,50%	7,50%	0,00%	2	3	3	3	0,59	2,75

Source: own research.

The data presented in Table 8 shows that more than one third of respondents (35%) believe that the extent of investment and innovation in the HSCH area is insufficient. In addition, 57.50% of respondents maintained a neutral attitude towards the issue under study, with only 7.5% of responses indicating sufficient levels of investment and innovation.

Another issue examined concerned rationality and economy in the use of financial resources in the context of HSCH management (Table 9).

Table 9.*Rational and economical usage of financial resources in the context of HSCH management*

Multiple choice questions [%]					Position measures					
definitely not (1)	not (2)	Neutral/undecided (3)	yes (4)	definitely yes (5)	Q1	Median	Q3	Mode	Standard deviation	Mean
9. In your opinion, are financial resources being used rationally and economically in the context of managing humanitarian supply chains?										
0,00%	2,50%	50,00%	47,50%	0,00%	3	3	4	3	0,55	3,45

Source: own research.

The data in Table 9 shows that 47.50% of respondents indicate that funds in the context of HSCH management are used judiciously and economically. However, half of the respondents indicated that they do not know whether funds in the context of HSCH management are used thoughtfully and efficiently, and 2.5% believe that funds are wasted. The dominant, or most frequent response, is 3, indicating that respondents do not know whether funds are used rationally and economically in the context of humanitarian supply chain management.

The last issue surveyed concerned good practice in the management of HSCH. Recommendations from respondents are below:

1. Cooperation with NGOs (11 responses).
2. Effective coordination of activities and communication (9 responses).
3. Involvement of appropriate and competent people (8 responses).
4. Extensive cooperation at county level and between counties (7 responses).
5. Detailed preparation of the crisis management plan and its regular updating (6 responses).
6. Regularly upgrade equipment and check stock (5 responses).
7. Selection of appropriate collection and distribution sites (4 responses).
8. Volunteer assistance in sorting and distributing donations (3 responses).
9. Needs analysis and avoiding the collection of unnecessary donations (3 responses).
10. Establishment of an action coordination team (2 responses).

The numbers in brackets exceed the total number of respondents, as participants provided multiple recommendations. Effective management of humanitarian supply chains in Poland is based on cooperation with NGOs, effective coordination and communication, and the involvement of competent people. Detailed preparation of emergency plans, their regular updating and good organisation of collections and distribution of aid, supported by volunteers and proper needs analysis, are crucial.

5. Summary

In response to disasters, actors must quickly build complex supply chains to distribute the necessary and appropriate resources (Pokusa, Duczmal, 2009). In addition to the drive for timely and reliable service delivery, professionalisation is being pushed by increasing host government requirements to improve logistics and work to certain standards and regulations (Dube, Broekhuis, 2018). Such regulations can facilitate humanitarian supply chains by, for example, establishing clear lines of command in disaster response, reducing the flow of unwanted donations and regulating the activities of organisations that may cause disruption (Kunz, Gold, 2017). Interest in the topic of standardisation in humanitarian logistics is also evidenced by the launch in 2019 of the Development of Best Practice and Universal Standards for Humanitarian Transport and Logistics project, which aims to develop common principles and guidelines and promote good practice in logistics (Paciarotti, Piotrowicz, Fenton, 2021).

The stated aim of the article has been achieved. Based on literature research and own research, key challenges and good practices in managing humanitarian supply chains in Poland were identified. The own research indicates that respondents perceive unpredictable demand (almost 3/4 of respondents) and poor visibility (more than 3/4 of respondents) as challenges in HSC management. Furthermore, almost all surveyed HSCs confirm the positive impact of information systems and modern technological solutions on the management of HSCs. However, modern technologies are not sufficiently used by them.

Issues of cooperation and coordination were also rated positively by the majority of respondents. Almost all respondents (90%) indicated that the level of cooperation was sufficient, and 67.5% confirmed that the coordination of activities was appropriate. Although in the case of coordination of activities, one in ten respondents indicated that the coordination of activities was inadequate, and almost 1/4 of respondents maintained a neutral position on this issue. Crisis and the need for a collective response mobilise collaboration, whereby actors representing different organisations come together in a joint effort to address what they cannot solve alone (Guerrero, Bodin, Nohrstedt, Plummer, Baird, Summers, 2023, p. 2). To collaborate effectively, it is necessary to initiate contact with others, share information, resolve conflicts and seek agreement on work goals and procedures (Guerrero et al., 2023, p. 2). Which governmental and local government administrative structures are responsible for planning, coordinating and responding to crises is important for action. Clear lines of responsibility and coordination between different actors are crucial (Chodynski, 2021; Carreras-Coch et al., 2022; Sienkiewicz-Małyjurek, Owczarek, 2021).

Own research also shows that more than half of the respondents believe that liaison is maintained between the executive units and the crisis management centre. However, almost a third of respondents do not know whether such liaison is maintained and one in ten respondents admit that liaison is not maintained.

Own research found that more than one-third of respondents felt that the extent of investment and innovation in the HSCH area was insufficient, only 7.5% of respondents indicated a satisfactory level, and the majority abstained from expressing an opinion.

Issues of rationality and thriftiness in the management of HSCHs were also raised in own research. Respondents do not know whether financial resources are used rationally in the context of managing humanitarian supply chains, indicating a lack of control activities and a lack of thriftiness. The dominant response in this case is 3, i.e. a response of 'I have no opinion'. Such disregard for public funds, especially when people's lives and health depend on these funds, is unacceptable. For this question, a minority of respondents (47.50%) indicated that funds are used rationally. As Kmiecik (2015) and Marjanski (2015) argue, distribution in HSCH must respect the principles of norming and limiting, conditional rationing and in accordance with the principle of economy. According to the principles of new public management, ensuring the economy, efficiency, and effectiveness of public organisations becomes a priority (Kauf, 2015, p. 52).

The own research also addressed the topic of good practices in HSCH management. Respondents emphasised the role of cooperation between public institutions, NGOs and residents. In the context of cooperation with foundations and NGOs - these should have adequate logistical and staffing facilities, which allows for the smooth distribution of aid. In addition, regular collections, adequate communication with donors and monitoring of the situation at district and provincial level are important to ensure that aid is organised effectively and reaches those in need. Moreover, effective HSCH operations rely on collaborative efforts, prompt and efficient communication of information, and precise planning. Regular monitoring, needs analysis and updating of plans are also important.

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REMUNERATION OF MANAGEMENT BOARDS OF PRODUCTION COMPANIES LISTED ON THE WARSAW STOCK EXCHANGE

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Purpose: The research objective of this article was to analyze and evaluate the formation of the relationship between the salaries of those who make up the management body of manufacturing companies.

Design/methodology/approach: The study used selected statistical methods to achieve the purpose of the study and to verify the research hypothesis. Measures of descriptive statistics allowed comparison of CEO salary and average board member salary. Spearman's rho correlation coefficient was used to determine the strength of the relationship between these quantities. The quotient between CEO compensation and average board member compensation was used to determine the inequality that exists. The Kruskal-Wallis test, on the other hand, was used to diagnose differences between the populations of manufacturing companies in the levels of inequality in CEO-member compensation.

Findings: The analyses conducted achieved the intended purpose of the study and verified the research hypothesis. It was observed that the compensation of the CEO and board members is the least unequal in high-tech companies. It was diagnosed that the inequality of remuneration along the CEO-board member line is the smallest in the group of high-technology enterprises. Thus, there are no grounds to reject the research hypothesis.

Research limitations/implications: A difficulty and limitation of salary surveys is obtaining complete information about them. This is due to the nature of this type of data, which is subject to legal protection. The research carried out in this article is based on information about the salaries of people employed in the management bodies of public companies. In further work, attempts will be made to study inequalities in entities that are not listed on the Warsaw Stock Exchange.

Social implications: The study indicates which group of manufacturing enterprises should be supported by the state to reduce excessive vertical wage inequality.

Originality/value: The originality of the study stems from the fact of examining the relationship occurring between CEO and board member salaries and their inequality. Previous analyses have focused on the relationship occurring between - on the one hand - those employed in management bodies and - on the other hand - operational employees.

Keywords: inequality of wages, CEO, board member, manufacturing industry, single line spacing.

Category of the paper: Research paper.

1. Introduction

The remuneration of people employed on the boards of public companies is unique from that of operational employees. The differences between the two are in: the amount paid; the determinants affecting their formation; the systems used to calculate them; and the approach to their disclosure. This issue has been widely reported in the literature, mainly due to the fact that there are very large inequalities between the CEO's salary and the median or average value of operating employees' salaries. Nevertheless, it is difficult to find research results that have been devoted to the relationship occurring between CEO and board member compensation. Thus, the existence of a research gap has been diagnosed, which is at the same time a research problem framed in the form of a question: how are the salaries of board members in relation to the salary of the CEO? The research objective of this article was to analyze and evaluate the formation of the relationship between the salaries of those who make up the governing body of the company. Given the research made earlier and the desire to supplement it with further aspects, the analysis was carried out on the basis of data from manufacturing enterprises, divided by the level of technological advancement (Mazurkiewicz, Staszal, 2024, pp. 329-336). For the purpose of this article, the hypothesis was that the least inequality between the remuneration of the CEO and the average remuneration of board members occurs in the group of high-tech enterprises. The originality of the research is that it focuses on the analysis of remuneration inequalities between those employed on corporate boards. Previously published research has mainly focused on the CEO-employee pay ratio.

2. Literature review

According to Polish Commercial Companies Code, one of the organs of a joint-stock company is the Management Board. Its tasks include managing the company's affairs and representing it before other entities and institutions. Persons may be appointed to the Board of Directors from among the shareholders or from outside their ranks. The Code does not specify the maximum composition of its members, indicating only that it may consist of one or more members (KSH, 2000, art. 368). The board of directors most often consists of a chairman and board members. In the literature, they are referred to as top managers. The chairman is the person with the most authority and is responsible for all matters related to the operation of the company (Lafley, 2009, pp. 54-62). Board members, on the other hand, are most often responsible for a specific slice of the business. Although in most cases boards of directors are composed of several people, there are also situations where the management of a business entity is entrusted to only one person. Top managers are counted as stakeholders of the first order.

They exert a very strong influence on the activities of the enterprise, deciding on the most important aspects of its operation (Friedman, Miles, 2002, pp. 3-17). The nature of the work of the CEO and board members is very similar. This situation translates into the identity of the factors determining their remuneration, which are mainly included in the theory of agency and managerial authority (Aluchna, 2003, pp. 156-175).

An important issue affecting the salaries of top managers is the fact of separation of ownership and management. This issue is the subject of agency theory. The owners of the company view compensation as a way to enable them to shape the behavior and attitudes of top managers (Aluchna, 2007, pp. 27-66). Thus, they realize the motivational function of compensation. Owners, by paying managers sufficiently high amounts, aim to reduce the occurrence of: potential conflict between the principal-agent owner, information asymmetry, and the manager taking risky opportunistic actions. Managers, on the other hand - when they receive high, satisfactory salaries - should perform the function entrusted to them in accordance with the owners' expectations. Then they should not seek other ways, incompatible with the goals of the capitalists and often also with the law, to enrich themselves while performing management functions (Stępień, 2013, p. 389). The remuneration of top managers should discourage them from, among other things: dishonestly appropriating assets, making decisions that are not fully thought out, failing to fulfill the obligations contained in the contract, acting only in the short-term horizon; keeping the position despite incompetence and in order to pursue their own ambitions (Aluchna, 2007, pp. 27-66).

A very important determinant of top managers' compensation is their level of managerial power (Bebchuk, Fried, Walker, 2002, pp. 783-794). Top managers' power stems from: (1) their placement at the top of the company's decision-making and organizational hierarchy; (2) their stake in the ownership of the business entity they manage; (3) their possession of critical skills used in managing the entity; and (4) their perceived and established contacts in the professional community (Finkelstein, 1992, pp. 511-516). The more managerial power the CEO and board members have, the more influence they have over their compensation. Moreover, it should be noted that the power of top managers increases in the following situations: the presence of a submissive and ineffective board of directors, the absence of a dominant shareholder in the ownership structure, a small number of institutional shareholders and the provisions of the management contract (Grabke-Rundell, Gomez-Mejia, 2002, pp. 3-23; Stępień, 2013, p. 389).

The shape of top managers' pay is also influenced by behavioral aspects. People employed in a management body formulate their salary demands in relation to that of others employed in similar positions or in similar companies. They strive to achieve a sense that their compensation is fair. This issue is at the core of J.S. Adams' theory of pay equity (Sweeney, 1990, pp. 329-341; Juchnowicz, Kinowska, 2018, pp. 107-116; Michalkiewicz, 2009, pp. 3-16).

The above description synthetically characterizes the remuneration of those who make up the boards of public companies. The determinants and methods of calculating salaries are significantly equal to those used in determining the salaries of operational employees (Mazurkiewicz, 2014, pp. 44-51). This results in the uniqueness of the salaries of CEOs and board members compared to other employees.

3. Methods

The subject of the study was the remuneration of the members of the management boards of manufacturing companies listed on the regulated market of the Warsaw Stock Exchange. The formation of the remuneration of CEOs and board members was analyzed. In the case of CEOs, information on their individual salaries was used, while in the case of board members, the average of their salaries was calculated. The necessary data were obtained from reports published by companies, including financial statements and reports on the remuneration of board members and supervisory boards. The research sample of manufacturing companies was divided according to the level of technology used. For this purpose, information on the dominant activity of a given enterprise's PKD was used, which was obtained from the REGON Internet Database and the classification published by the Central Statistical Office in the statistical yearbook "Science and Technology" (Science and Technology in 2022, pp. 203-204). Four groups of enterprises with technological advancement were obtained: high (hereinafter: HT), medium-high (hereinafter: MHT); medium-low (hereinafter: MLT) and low (hereinafter: LT). The time scope of the study was 2016-2022. The study was conducted on a sample of 480 observations, including from the group: HT-40, MHT-149, MLT-187, LT-104. During the study, statistical tests and methods were used to verify the hypotheses. The Shapiro-Wilk test was used to test the normality of the distribution. The Kruskal-Wallis test was used to determine differences between groups of manufacturing companies. The inequality between the CEO's salary and the average board member's salary was determined using the quotient of these quantities. A similar method was used by S. Kiatpongsan and M.I. Norton (Kiatpongsan, Norton, 2014, pp. 588). In addition, descriptive statistics indicators were used in the analyses. Interpretation of the results obtained was carried out using the median.

4. Results

The study of the CEO's and board members' salaries began with an analysis of their amounts. Descriptive statistics were used for this purpose. In addition, to test the normality of the distribution, the Shapiro-Wilk test was performed. Analyses were carried out with the population divided by level of technological advancement. Table 1 presents the results of the study.

Table 1.

Distribution of the value of CEOs' and board members' salaries

Specification	HT		MHT		MLT		LT	
	CEO	BM	CEO	BM	CEO	BM	CEO	BM
N	40		149		187		104	
Mean in PLN '000	729,2	609,2	1327,6	992,7	933,7	623,2	1346,3	635,0
Median in PLN '000	708,4	626,7	<u>656,4</u>	<u>442,5</u>	736,4	492,0	833,7	456,4
Coefficient of variation	0,56	0,51	2,74	3,13	0,79	0,78	1,18	0,71
Skewness	1,4	0,2	10,6	10,6	1,7	1,7	2,5	1,1
Kurtosis	4,3	-1,1	121,0	122,3	3,6	3,5	5,8	0,3
Shapiro-Wilk								
Statistic	0,9	0,945	0,211	0,201	0,847	0,853	0,637	0,877
Sig.	0,002	0,051	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001

CEO - CEO, BM - board member, bold - highest value, underline - lowest value.

Source: own compilation based on financial statements.

The highest CEO salary was diagnosed in LT companies, the lowest in MHT companies. The difference between the extremes was PLN 177.3 thousand. The most diverse group of enterprises by CEO salary was the MHT population, the calculated coefficient of variation was 2.74. In turn, the least diverse group was the one into which HT entities were classified, where the coefficient of variation was 0.56. The observed variation was respectively strong in MHT and moderate in HT. In the case of board members, their highest average salary was observed in HT, while the lowest in MHT. The difference between the values from HT and MHT was 184.2 thousand zlotys. The population with the highest differentiation in terms of the average salary of board members was the group of MHT entities, where the coefficient of variation was 3.13. With the least differentiation were HT companies, for which the coefficient of variation was 0.56. The diagnosed differentiation was strong in MHT and moderate in HT.

This was followed by an analysis of the development of CEO remuneration and the average remuneration of board members over the period 2016-2022. The results, including a breakdown of manufacturing companies by level of technological sophistication, are shown in Figure 1.

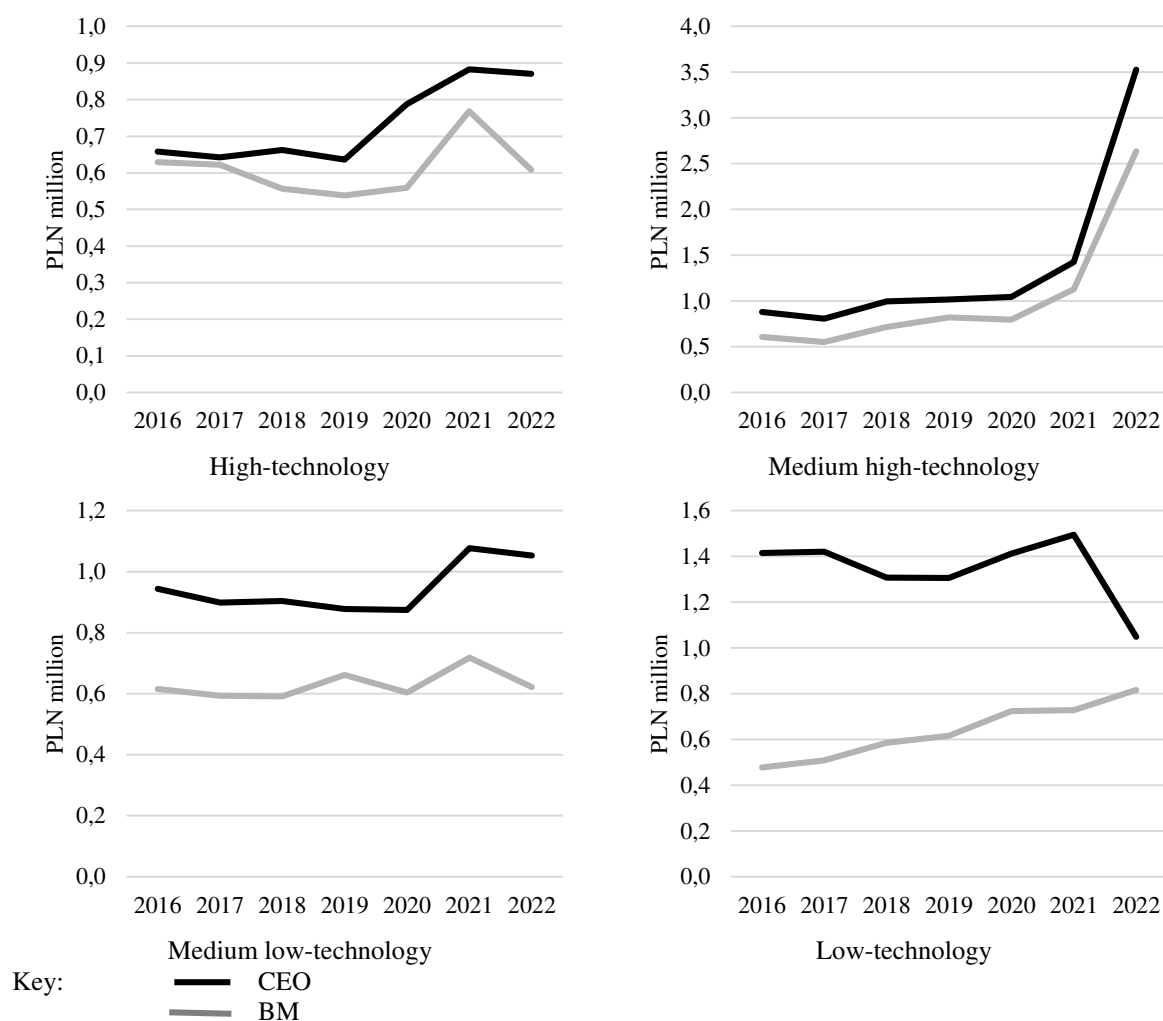


Figure 1. The evolution of CEO and board member remuneration from 2016 to 2022.

Based on the analysis of the curves, it can be concluded that the trend of CEO compensation and average compensation of board members in the 2016-2022 period was similar in HT, MHT and MLT companies. Only in the NT group such conformity was not observed. Deepening the above analysis was an examination of the correlation between these salaries. Due to the unequal nature of the groups and Shapiro-Wilk's $p < 0.05$ - according to which the distribution of variables is not normal - Spearman's non-parametric rho correlation was used. The results of the correlation analysis are presented in Table 2.

Table 2.

Correlation between CEO compensation and average board compensation

Spearman's rho	HT	MHT	MLT	LT
Correlation Coefficient	0,815	0,739	0,808	0,588
Statistical significance	<0,001	<0,001	<0,001	<0,001

Statistical significance $p < 0.01$.

Source: own elaboration.

The analysis carried out confirmed the diagnosis made on the basis of the formation of the curves. A strong positive correlation between the studied values was present in the HT, MHT and MLT enterprise groups, only in the case of LT was it moderate.

The next stage of the study focused on determining the level of inequality between the CEO's salary and the average board member's salary. For this purpose, the quotient between these values was used. The results are presented in Table 3.

Table 3.

Inequality of remuneration between CEO and board member

Specification	HT	MHT	MLT	LT
N	40	104	149	187
Mean	1,25	4,19	1,80	2,79
Median	1,17	1,40	1,42	1,36
Coefficient of variation	0,33	5,47	1,08	1,44
Skewness	1,82	11,60	7,53	3,21
Kurtosis	5,27	138,68	64,49	10,09
Shapiro-Wilk				
Statistic	0,825	0,505	0,107	0,364
Sig.	<0,001	<0,001	<0,001	<0,001

Source: own study.

The highest level of inequality between the CEO's salary and the average board member's salary was diagnosed in the MLT group of companies, while the lowest in the HT group. The population with the highest inequality in terms of the considered relationship was the one comprising MHT entities, while the least was HT.

The study of inequality along the CEO-member line was deepened with an analysis of the statistical significance of the differences. Due to the unequal nature of the groups and a Shapiro-Wilk p-value of less than 0.05, the null hypothesis (stating the normality of the distributions) was rejected and the alternative hypothesis, according to which the distribution is extremely asymmetric, was accepted. This allowed the selection of an alternative to parametric univariate analysis of variance, the non-parametric Kruskal-Wallis test. On the basis of this, it was found that there were grounds for rejecting the null hypothesis that there was no inequality in CEO- board member remuneration in a group of companies with different levels of technological sophistication: Kruskal-Wallis test value = 12.373; $p < 0.006$. This means that at least one group differs from another. To detect between which groups of companies there are significant differences, multiple comparison tests were used. The results are presented in Table 4.

Table 4.*Multiple (two-way) comparisons on pay inequality CEO - board member*

Specification	Test Statistic	Significant
HT-MHT	-75,224	0,002
HT-MLT	-77,580	0,001
HT-LT	-87,002	<0,001
MHT-MLT	-2,356	0,877
MHT-LT	11,778	0,506
MLT-LT	9,422	0,579

Source: own study.

Analysis of the results revealed significant differences between the HT group of companies and all other groups, i.e. MHT ($p = 0.002$), MLT ($p = 0.001$) and LT ($p = < 0.001$). In this case, the median inequality between CEO compensation and average board member compensation in the HT group was lower than in the other groups

On the basis of the research carried out, it was observed that CEO and board member remuneration is the least differentiated in high-tech companies. It was also diagnosed that the inequality of remuneration between CEO and board member is the smallest in the group of high-tech companies.

5. Conclusions

This article presents the results of original research - focusing on the study of the formation of the salaries of persons appointed to management positions in public companies, as well as being an extension of those already made - on the impact of technological advancement on salary inequality. In order to achieve the intended research goal and answer the research question, the research hypothesis was verified. It assumed that the smallest inequality between the CEO's salary and the average salary of board members occurs in the group of high-tech companies. The research conducted did not provide a basis for rejecting this hypothesis. The obtained result of hypothesis testing is the same as in the case of the study of salary inequality between CEO and employee and board member and employee. This allows us to conclude that the lowest inequality of wages in manufacturing companies - regardless of the parties that were compared - is found in high-technology entities.

Due to the level of originality of the research, it is difficult to make comparisons with the results of other authors. As a result, it was established how the remuneration of the management boards of manufacturing companies with different levels of technological advancement. It was also indicated how the level of this sophistication interacts with the existing inequality in remuneration between CEO and board members.

In addition to the above, in the group of highly technological advancement companies - based on the coefficient of variation - it was diagnosed that CEOs are paid at a similar level. A similar situation also applies to board members. Among the analyzed populations of enterprises, HT was also diagnosed with the strongest positive correlation between CEO remuneration and average board member remuneration. This means that, along with the fact that board members' salaries follow those of CEOs. The situation in the HT group, confirms the validity of J.S. Adams' theory of pay equity.

The research carried out makes it possible to confirm the recommendations made earlier (Mazurkiewicz, Staszal, 2024, pp. 329-336). Decision-makers should support the development of entrepreneurship focused on high-tech production. In this group of enterprises, the occurrence of the smallest wage inequalities was diagnosed. This support can take the form of fiscal policy instruments (tax breaks), monetary policy instruments (preferential loans) and educational policy instruments (ordered majors).

A limitation of the present research is the use of data from companies listed on the Warsaw Stock Exchange. However, conducting it on broader data is difficult due to issues concerning the protection of salary information. The results presented here are a contribution to the development of knowledge on the evolution of pay inequalities. They complement previous research on the relationship between CEOs and board members. At the same time, they demonstrate the existence of a positive effect of advanced technology on a different socio-economic aspect than usual. Nevertheless, this is an area where many problems have not been posed and solved.

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ANALYSIS OF PROFITABILITY OF RAW MILK PRODUCTION IN DIFFERENT TYPES OF FARMS

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Purpose: The purpose of the lower paper was to analyze the profitability of milk production in different types of dairy farms. The economic aspects of milk production in different types of cow farming were presented. The profitability of milk production was analyzed on the basis of the financial results obtained by dairy farms as a result of selling raw material to the dairy plant.

Design/methodology/approach: The results were collected using a face-to-face interview method with the owners of the farms participating in the survey. The information obtained from the farmers included general data about the farm (e.g., size, owner's education, number of dairy cows) and detailed data underlying the milk payment for the two study periods, i.e., 2019 and 2020.

Findings: Profits received on intensive farms were several times higher than on other farms (11 times higher than income from milk sales on relict farms, 9 times higher than on low-budget farms, and 5 times higher than that received on traditional farms).

Research limitations: The stoping of operations on extensive farms is the most important limitation in further research work, due to the inability to obtain data to perform analyses on the economics of milk production in traditional and low-cost milk production systems.

Practical implications: Analyze the actual state of profitability of different types of experimental farms and identify corrective measures that can be taken on the farms participating in the study to improve the economics of production. Among the most important measures that can be taken by owners of low-budget farms are the improvement of the basic distinguishing features of milk quality, which are also the determinants of charging for milk. The work is addressed to both dairy farmers and processing plants, buying raw material.

Originality/value: Analysis of the economics of milk production on very small farms, which are not usually the focus of research teams. The analysis made it possible to point out to breeders of animals kept in the system of extensive production, opportunities to improve the quality of the raw material (milk). Useful forms of support were indicated, such as programs from which funding can be obtained (EU Funds).

Keywords: economics of milk production, dairy farm types, raw milk.

Category of the paper: Research paper.

1. Introduction

The changes taking place in the dairy industry are in response to the growing expectations of consumers, who are increasingly interested in the composition of food and its potential impact on health (Schultz, 2016). As a result, a variety of dairy products are appearing on the market, such as high-protein, lactose-free, probiotic-enhanced, reduced sugar/salt, fat, high calcium and magnesium products (Ahmandi et al., 2019, Ranadheer et al., 2018; Bousbia et al., 2017; Trajenr, 2018). When choosing food products, consumers are also increasingly considering the origin of food and sustainable production, both at the farm level and at processing plants (Scozzafava et al., 2020; Kalač et al., 2011). Currently, there is a global trend of increasing importance of local food origin (Brodziak, Król, 2017) and organic products (Merlino et al., 2021; Dabrowska et al., 2018; Harwood et al., 2018). This trend is in contrast to the earlier emphasis on high agricultural productivity and intensive animal husbandry, which were often associated with the industrialization of the agrifood sector.

Biological advances in dairy farming, as well as technological advances in cattle feeding and maintenance, have increased milk yields in dairy cows (Ziętara, 2010). In addition, increased milk production has translated into a favorable Euro exchange rate, encouraging exports. The abolition of milk quotas and the acquisition of European Union (EU) funding for restructuring and rational use of farm resources also led to an increase in raw milk production (Bórawski, Zalewski, 2018).

In the context of the volume of milk production in the (EU), Poland ranks fourth in terms of milk production in EU countries. There was an increase in the share from 8,07 to 8,87% after the UK's exit from the EU. A study by Stanuch and Firley (2021) found that the average increase in milk production in Poland over the 2015-2019 period was 2,3%. According to the National Center for Agricultural Support (KOWR), Poland is among the top EU countries in terms of the size of its dairy herd - just after Germany and France (KOWR, 2023).

Milk production is also important for national agricultural production. During the coronavirus pandemic, which was particularly difficult for the economy, there was an increase of about 3% in dairy production and milk purchases, as well as maintenance of dairy exports from the previous year. The progress in the milk production market was noted in the context of an 8,2% decrease in gross domestic product (GDP) in the second quarter of 2020 (with an increase of 4,6% in the same period of 2019) (CSO, 2021). According to Rutkowski (2020), Polish dairying had a real impact on mitigating the decline in GDP. The work of Kobialka and Nowak (2022) proved that the dairy industry proved resilient to the past pandemic crisis. At the same time, it was pointed out that the conflict in Ukraine had a direct impact on the volume of exports, since before the outbreak of war in 2021, countries involved in hostilities, such as Ukraine, Belarus and Russia, absorbed 5% of the value of dairy exports worth almost 130 million euros. Now there are new challenges that the dairy industry will have

to face, namely: the implementation of the Green Deal in agriculture and the global economic crisis (IPCC, 2023). Therefore, there is an expectation, dictated by the reduction of CO_{2e} emissions directed additionally at intensifying herd milk yields to protect the climate (Sorley et al., 2024). This is the most important method of reducing the carbon footprint on dairy farms, even on organic farms where animal nutrition is based on a pasture-based diet (Taube et al., 2024). The introduction of the aforementioned measures, combined with the increase in the economics of dairy production in Poland, is leading to the cessation of operations in small farming units. According to Szajder (2024), the number of dairy farms keeping cows fell from 180.8 thousand in 2022 to 173,3 thousand in 2023.

Among these farms, it's worth taking a special look at farms that produce milk, similar to hay milk. In 2016, the European Union recognized hay milk product as a “traditional specialty guaranteed” (TSG) under the names Heumilch/Haymilk/Latte fieno/Lait de foin/Leche de heno (Europex Commission, 2016). Fermented feeds such as grass or corn silage and genetically modified feeds are prohibited in the innovative hay milk production chain. Hay milk comes from cows fed only fresh grass or hay and a limited proportion of concentrated feeds in the ration (max 25%) (Rizzo, Hack, 2019). Supplemental feeds fed on pasture or hay include forage and/or leaves from rapeseed, corn, rye and fodder beets, hay, alfalfa and corn pellets (Agropolska, 2023). In a study by Alothman et al. (2019) and Palmieri et al. (2021) showed that respondents are interested in the local origin of food, and that environmental issues play an important role in hay milk consumption motives.

In addition, the researchers emphasize that the respondents had a positive opinion of hay milk and highlighted some needs for marketing implications of a product based on said milk for the Italian dairy sector. According to van den Oever et al. (2021) in Austria, about 15% of milk is produced on farms using hay milk standards for hard cheese production, mainly due to the low content of spores of butyric fermentation bacteria. Hay milk producers are also found in Australia, Ireland, Italy. In Poland, hay milk is produced only by the Agricultural Company of Juchów, which creates a production niche in this area. According to the owners of the farm, hay milk is characterized by better taste, without the smell of silage, and has a high content of health-promoting FAs from the omega-3 group, CLA and vitamins A and E (Agropolska, 2023). In some Western European countries, such as Germany, Italy, Ireland, Australia, the Netherlands, and the United States (US), there are already legal regulations for labelling milk as “pasture milk” (Kühl et al., 2017; Elgersma, 2012). This type of certified milk is of great interest to consumers and also to farmers who raise dairy cows on pasture. Hay milk is also a raw material for the production of long-ripened cheeses (Brändle et al., 2016; McSweeney, 2007).

Information on the management of dairy farms in the traditional system of milk production, also in systems similar to hay milk production, can provide a basis for the resumption of such farms, just as organic production is currently experiencing a renaissance. According to the authors of the presented paper, the analysis of economic data, obtained from all dairy farms,

is necessary because it allows the comparison of economic returns in different types of dairy farming. Farms that feed animals with food obtained from grazing animals as well as, hay or straw as the only roughage, are unfortunately slowly ceasing their activities. There is therefore a basis for research in the area of the economics of milk production on different types of farms. This is a contribution that can be the basis for improving techniques for obtaining such milk, ensuring its high physicochemical, microbiological and health quality, among other things, in terms of the presence of fatty acids positively acting on the human body (Kowalska et al., 2024).

Verification of management efficiency in agriculture and the dairy industry is relatively most objective in 2019-2020, prior to the pandemic and the outbreak of war in Ukraine, as these events have severely disrupted the Polish economy. Currently, the number of farms producing milk similar to “hay milk” limits the time of comparison, due to the negligible number of prosperous farms in 2024 that do not feed animals with fermented feed.

Taking into account the above presented aspects, the authors of the paper directed their research towards presenting the role, legitimacy, need and benefits that come from obtaining and producing milk from different types of farming, including extensive farming. Obtaining raw material from such a product has always been in line with consumer preferences. Taking this aspect into account and at the same time presenting the needs of dairy farmers and processors, the authors presented the problems to be confronted in the coming years.

2. Characteristics of the experimental farms included in the study

The differentiating factor between the farms that participated in the study, i.e. the experimental farms, was the type of roughage. The experimental farms were divided into research groups (A, B, C, D) with respect to the presence of pasture feeding, or TMR monodiet, and with respect to the presence and type of fermented fodder in the animal's feed ration (Table 1) On Group A (relict) farms, cows were fed without silage in the feed, on Group B (low-budget farms) grass haylage was present, and on Group C (traditional) and D (industrialized), corn silage was additionally present. On Group A, B, C farms, animals were fed in the traditional manner, along with summer pasture, while on highly industrialized (milk production of more than 400 thousand/year) Group D farms, balanced TMR feeding was used, in addition, herds were under the care of a zootechnician.

Table 1.
Characteristics of farms

Animal housing system	Alkali-pasture,						Alkali	
Feeding system	traditional		traditional		traditional		TMR	
Name of food group	relic		Low buget		traditional		industrialized	
Farm designation	A1	A2	B1	B2	C1	C2	D1	D2
Components of roughage								
Pasture greens	+	+	+	+	+	+	-	-
Haylage	-	-	+	+	+	+	+	+
Maize silage	-	-	-	-	+	+	+	+

Information on the volume of milk sales in a given year, milk yield, annual income, the amount of the protein surcharge and fat was obtained from the owners of the experimental farms by direct interview. The method of calculating the milk payment was a mapping of the Dairy Cooperative's Price List Regulations for 2019, 2020 and 2022, shown in Table 2.

Table 2.
Components of the milk price in relation to the Regulations on pricing raw milk from purchase at the Dairy Cooperative to which milk from the farms participating in the study is sold

Base components of the milk price in 2019 i 2020		Value [PLN/L]	Base components of the milk price in 2022*		Value [PLN/L]
Chemical composition surcharges	per unit of fat (max 4,6%)	0,04	Surcharges or deductions for chemical composition	for a change in fat content $\pm 0.1\%$ from a level of 4.1%	$\pm 0,013$
	per unit of protein (max 3,6%)	0,11		for a change in fat content $\pm 0.1\%$ from a level of 3.4%	$\pm 0,028$
EXTRA quality surcharges	SCC <400.000/mL and/or TBC <100.000 cfu/mL	0,28	Deductions for out-of-class milk	SCC >400.000/mL and/or TBC >100 000 cfu/mL	0,74
Quantity surcharges	3-4,5 tys. l	0,10	Quantitative deductions	1-5 000 L	0,23
	>4,5-6,5.000 L	0,16		>5-10.000 L	0,13
	>6,5-9,5.000 L	0,18		>10-25.000 L	0,08
	>9,5-15.000 L	0,20		>25-50.000 L	0,07
	>15-30.000 L	0,22		>50-70.000 L	0,06
	>30-50.000 L	0,24		>70-100.000 L	0,04
	>50-100.000 L	0,26		>100-150.000 L	0,02
	>100.000 L	0,28		>150.000 L	-
Deductions for milk temperature	>6°C	0,02	Deductions for milk temperature	>6°C	0,02
Deductions for lack of up-to-date documentation		0,02	Deductions for lack of up-to-date documentation		0,02
			Deductions for chemical composition	Content of fat fat <3,1%	0,10
				Content of protein <2,8%	0,10

Cont. Table 2.

			Surcharge resulting from a cultivation contract		0,02
			Surcharge for continuity of milk supply		0,13
			Surcharge for control of milk performance		0,02
			Surcharge for the use of GMO-free feed		0,07
			Surcharge for kosher milk		0,02

* The base price of 1 l of raw milk calculated according to the GUS.

3. Analysis of the financial results obtained from the sale of milk to a dairy cooperative by experimental farms

The survey showed that farms belonging to specific categories (relict, low-budget, traditional, industrialized) differed in terms of farmland size. The average area of relict, low-budget and traditional farms ranged from 20 to 30 hectares. In contrast, industrialized farms were about 7 times larger, with an area of more than 150 hectares. As farm acreage increased, an increase in the size of dairy herds on farms was observed. The number of cattle in each group was as follows: group A - an average of 13,33 heads, group B - an average of 15 heads, group C - an average of 17 heads, group D - an average of 54 heads. The increase in the size of the dairy cattle herd also contributed to the occurrence of higher milk yields per dairy cow. Average daily milk yields per cow were: group A – 12,20 liters, group B – 13,20 liters, group C – 14,90 liters, group D – 24,90 liters. In addition, farms in group C sold 30% more raw milk than farms in groups A and B, which amounted to about 83.000 liters per year. Group D farms sold 8-9 times more raw milk than Group A and B farms, reaching sales of 429 thousand liters per year (Table 3).

Table 3.

*Selected determinants of profitability of experimental farm**

Characteristic of farms	Food group			
	A	B	C	D
Farm size (ha)	22,67	20,00	26,00	150,00
Age of farmers (years)	58,00	59,00	31,33	51,67
Number of people working on the farm	3,33	2,00	2,33	4,67
Income per person (PLN/person/year)	17.135,83	37.244,50	53.686,12	143.852,46
Number of milking cows on the farm (pcs)	13,33	15,00	17,00	54,00
Average daily milk yield per cow (L)	12,20	13,20	14,90	24,90

Cont. Table 3.

Average quantity of milk on the day of collection of raw material (L)	275,00	322,50	459,17	2373,33
Quantity of milk purchased during the year (L)	45.946,00	51.727,00	83.556,67	429.405,00
Average quantity of milk purchased per month (L)	3.828,83	4.310,58	6.963,06	35.783,75
Annual income (PLN)	57.062,33	74.489,00	125.088,67	671.791,67
Purchase price of milk (PLN/L)	1,22	1,44	1,49	1,56
Quantity of out-of-class milk (L)	23.788,67	1.529,67	2.293,67	0,00
Share of out-of-class milk (%)	57,05	3,00	3,33	0,00
Amount of deduction for out-of-class milk (PLN)	6.422,94	413,01	619,29	0,00
Fat content of milk (%)	4,00	4,18	4,25	4,14
Amount of aid per fat (PLN)	16.606,00	18.419,00	28.914,00	153.871,33
Protein content of milk (%)	3,28	3,24	3,14	3,25
Amount of aid per protein (PLN/L)	7.375,67	8.649,33	14.200,67	71.134,00

* Calculations for food groups were made using the arithmetic mean of the data, using data from individual farms in 2019 and 2020.

The results obtained are consistent with the conclusions presented by Wysokiński and Jarzębowski (2013) and Skarżyńska (2020). The researchers proved that the more Polish farms are specialized in milk production, the higher the herd density, the higher the milk yield of animals, the greater the scale of milk production and the higher the prices obtained from sales. The work of Koloshych (2012) confirms that the lowest risk of decline in profitability of dairy farms occurs when the stocking density of dairy cattle is increased. Similar correlations between price and quantity of milk sold were also observed in the study. The lowest price for milk was obtained on farms in feeding group A. This was mainly due to the lack of a premium for the extra quality class and the weakest results in the physicochemical quality of milk, especially in terms of fat content (4,00%).

The highest prices and consistent high microbiological and hygienic quality of milk were obtained on industrialized farms, where the highest base price for milk sold was PLN 1,00/L (2019) and PLN 1,06/L (2020) (Table 2; Figures 1, 2).

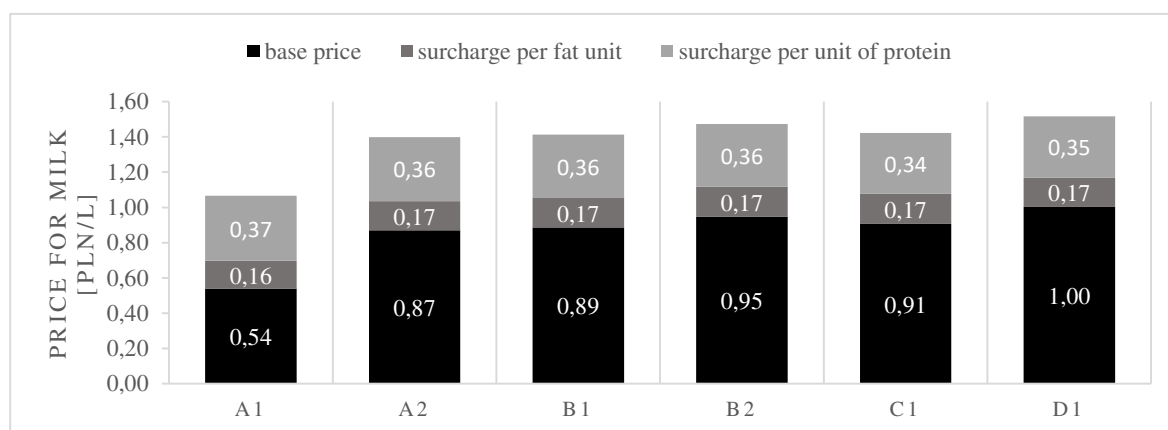


Figure 1. Milk farm gate prices for A1, A2, B1, B2, C1, D1, in 2019.

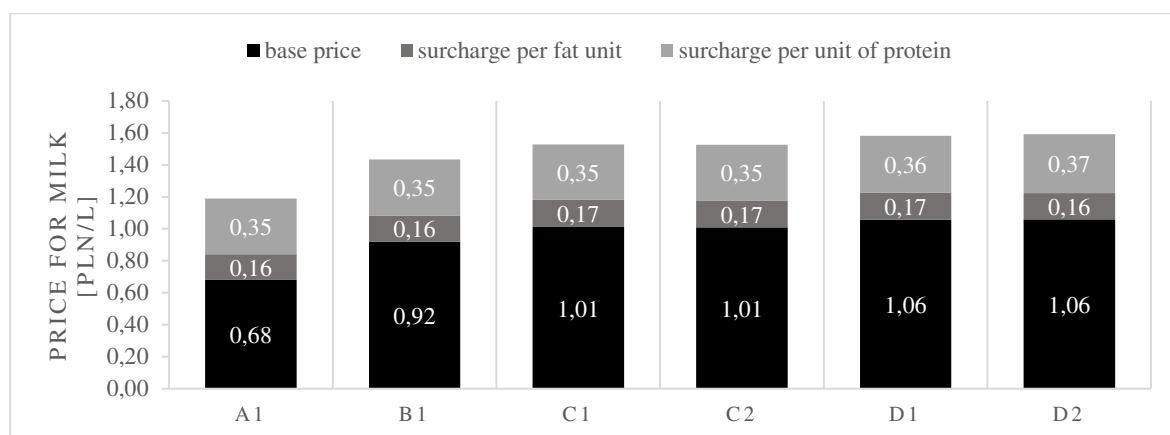


Figure 2. Milk farm gate prices for farms A1, B1, C1, C2, D1, D2, in 2020.

In the case of subsidies for fat content, it was noted that in the industrialized farms of group D, they amounted to more than 153 thousand in both the first and second years of the study, accounting for 12% of the total payment for milk (Figure 3, 4). The largest losses, due to improper microbiological and hygienic quality of milk, were observed in the farms of group A, which sold the most out-of-class milk to the cooperative (SCC > 400 thousand/mL, TBC > 100 thousand/mL). In the first year of the study, milk of improper microbiological and hygienic quality accounted for 92% of the milk sold from farm A1, 16% from farm A2 and 10% from farm C1. This generated serious financial losses, amounting to as much as PLN 10.000 a year for farm A1. On larger farms, problems with maintaining the microbiological and hygienic quality of milk were rare, and did not appear at all on farms with high production levels - both in the first and second research seasons (Figure 1, 3).

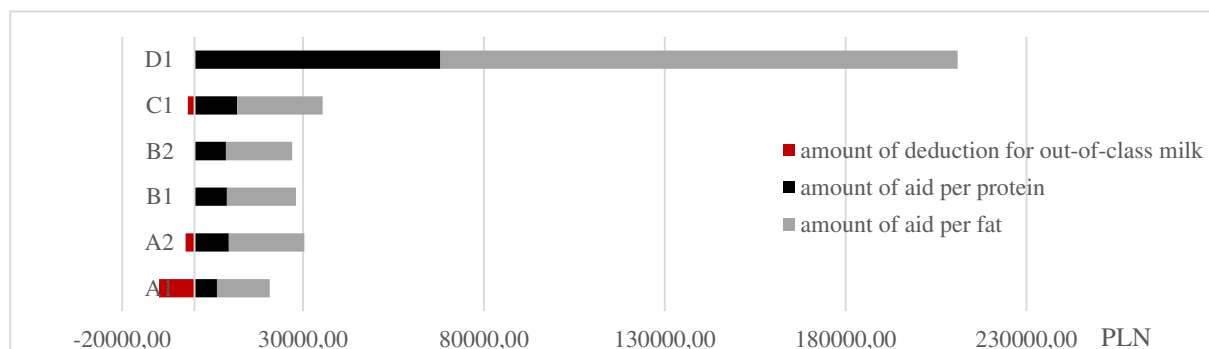


Figure 3. The amount of subsidies and quality deductions included in the price per liter of milk sold in 2019 in experimental farms A1, A2, B1, B2, C1, D1.

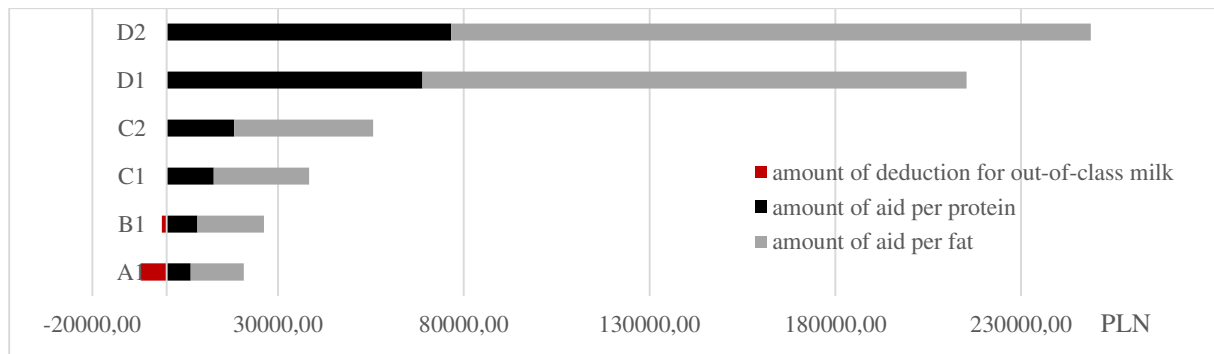


Figure 4. The amount of subsidies and quality deductions included in the price per liter of milk sold in 2020 in experimental farms A1, A2, B1, B2, C1, D1.

In 2023, of the eight experimental farms surveyed, only 3 dairy farms were operating, and their owners declared the presence of a successor. Due to the increase in the price of milk in Poland, published by the Central Statistical Office, by PLN 1,00/L in 2022 (CSO, 2022), the owners of the farms received a higher payment (the highest in farm B1 - Figure 5).

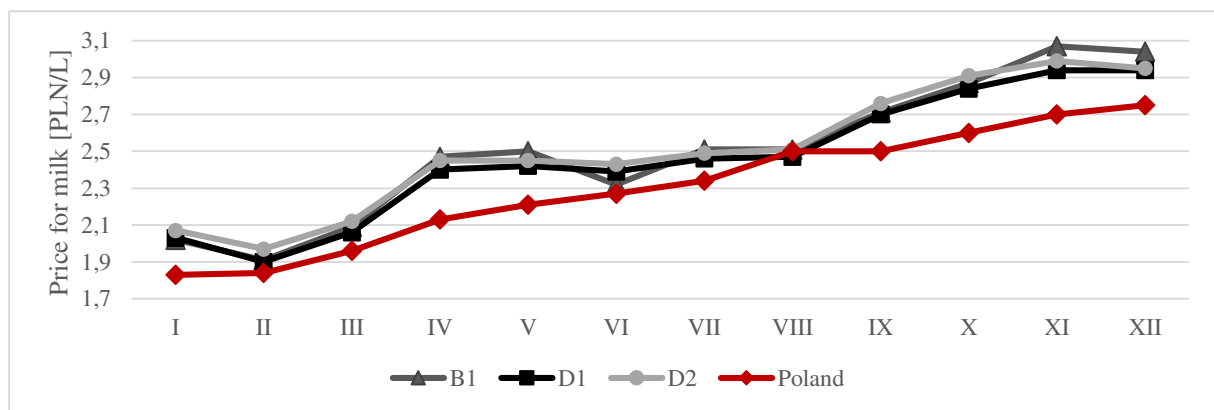


Figure 5. Variability of milk prices in selected experimental farms B1, D1, D2 in 2022 in comparison with prices quoted in Poland by the Central Statistical Office for the given period.

In 2023, difficult economic conditions caused five of the eight experimental farms to cease operation by April 2023. The price of milk fell sharply during this period, amounting to PLN 2,45/L in January, PLN 2,27/L in February and PLN 2,22/L in March (GUS, 2023). In addition, the dairy cooperative to which suppliers gave their milk made changes to the charging rules in 2022. There were modifications to the terms and conditions of milk sales that affected suppliers. Among other things, this was related to changes in surcharges for milk fat units. Starting in 2022, deductions were possible from the base fat content. Subsidies for the volume of milk sold were withdrawn, and deductions for small deliveries were introduced. The sale of 150.000 liters of milk per month entailed a reduction in the price per liter of milk by PLN 0,02/L. Milk of abnormal microbiological and physicochemical quality also lost its price value.

In the current difficult economic situation, it is crucial for dairy farmers to maintain high raw milk quality parameters and maximize the milk yield of their animals, which can help offset the negative financial impact associated with the drastic drop in milk prices in 2023 and the

deterioration of purchasing conditions in the cooperative. Propescu and Angel (2019) suggest that breeders should strive to improve milk quality, as this affects the price of milk. This can be achieved through the use of breeding programs, maintaining a short calving interval for animals, and proper management of reproduction and mating. The authors also recommend producing high-quality feed and a balanced diet to increase the milk yield of cows and obtain milk with high fat and protein content. It is also important to take care of the health of dairy cattle through proper milking hygiene, ensuring animal welfare, regular and rigorous control of the incidence of *mastitis* in the herd, and keeping the level of somatic cells count (SCC) and total bacteria count in milk (TBC) below the maximum thresholds set by law.

According to Propescu and Angel (2019), managing a dairy cattle farm requires certain skills of the owner, such as managerial ability, knowledge and practical experience in the technologies used, such as cultivation, breeding, reproduction, feeding, reproduction and milk yield of animals. The owner of the farm should also take into account financial aspects, such as gross income, production costs and the level of profit earned, when making decisions about the operation of the farm.

According to GUS data (2023) on farm prosperity in the second half of 2022, individual farm owners reported that the material situation had deteriorated for 43% of the farms surveyed. The main factors limiting the development of farms according to the owners were too high production costs (26,5%) and too low selling prices (18,1%). Other limiting factors were indicated by 37,8% of the surveyed farms, of which unfavorable weather conditions were mentioned most often (GUS, 2023). Popescu and Angel (2019) indicate that there are also external factors that affect the price of milk. These include the geographic area where the farm is located, due to specific climatic and soil conditions.

4. Support aimed at owners of dairy farms

For smaller dairy farmers, the European Union has proposed a systemic solution under the Common Agricultural Policy for 2023-2027, called area-based ecoschemes (RMRiRW, 2023). Ecoschemes are paid agrotechnical practices that adapt to national conditions and needs, and their effectiveness is evaluated by the European Commission in terms of achieving environmental and climate goals. Paid agrotechnical practices include the protection of soil, water, climate, animal welfare and biodiversity resources in agricultural production. There are 5 surface ecoschemes and 1 animal welfare ecoscheme. The conditions for sustainable agriculture are aimed at small farms, and farmers can receive subsidies of up to 4.000 PLN per hectare of farmland by meeting the program's objectives (RMRiRW, 2023). This can help improve the economic situation of participating farms.

Another existing financial support program is the subsidy for organic farming, which takes into account the area of farmland and the premium for sustainable crop-animal production. This program covers both the period of conversion of farms from conventional to organic systems and the period after conversion. According to the Ministry of Agriculture and Rural Development (MRiRW) (2023), payments per hectare of farmland are on average 35% higher compared to the rates in effect in 2021, and up to 85% higher compared to the rates in 2015. Organic payments in 2023 and proposed subsidy rates depend on crop group and conversion/post-conversion period (MRiRW, 2023).

Dairy cooperatives have the opportunity to regulate milk quality parameters through additional payments. The dairy cooperative's price list can include subsidies for the use of certified non-GMO feed, premiums for selling milk that meets kosher requirements, premiums for signing a supplier contract with the cooperative, and subsidies for the use of dairy performance monitoring in the herd. In some countries, dairy producers receive additional compensation for milk from pasture-grazed cows, such as in the Netherlands (Elgersma, 2012). In Brazil, subsidies paid by dairy cooperatives for low SCC) and TBC content have contributed to significant improvements in raw milk quality (Botaro et al., 2013). In Austria, price subsidies operate for both organic milk production and hay milk. In 2018 in Austria, the price of conventional milk was €36,84 per 100 kg, hay milk €43,7/100 kg, organic milk €50,5/100 kg, and organic hay milk €55.3 per 100 kg (Zooassets, 2023). In Germany, there is a surcharge for “pasture milk” (labeled with the EPRO PASTURELAND certificate). Pasture milk can be sold year-round under the EPRO PASTURELAND certification, even if cows are on pasture for at least 6 hours a day for 120 days a year (Breeding and Raising Cattle, 2023).

Studies by Rembeza and Seremak-Bulge (2010) and Szajner (2017) indicate that providing up-to-date information on milk procurement prices to dairy farm owners and dairy cooperatives makes it possible to forecast and monitor milk prices. The work of Śmigielska (2023) describes a model for predicting milk procurement prices, which is based on an analysis of price quotations for basic dairy products. The study showed that the price of raw milk depends on the prices of skimmed milk, butter and Edam cheese in more than 85% of cases.

5. Conclusions

A price analysis of the payment for milk sold received by the owners of the farms participating in the experiment found that industrialized farms made significantly higher profits from milk production than relic, low-income and traditional farms. Profits on industrialized farms were 11, 9 and 5 times higher than on the other farm types, respectively. The price per liter of milk was highest on industrialized farms due to additional subsidies associated with the high volume of milk sold and the high physicochemical and microbiological quality of raw

milk. High standards of quality and hygiene on dairy farms and high milk yields of dairy cows were key to favorable economic results. On Group A farms, lower profits from milk sales were due to poor hygienic and microbiological quality of milk, which resulted in the deduction of part of the payment, i.e. PLN 0.27/liter of off-grade milk, by the dairy, which meant a loss of 20% of the milk payment.

In general, it should be stated that owners of extensive farms, in order to survive unfavorable economic conditions, should first of all take care to improve the microbiological and hygienic quality of milk. The primary means to achieve this is to improve animal health and milk yield.

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THE VALUE PROPOSITION – THE BASIS OF AN EFFECTIVE BUSINESS MODEL

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Purpose: The purpose of this article is to analyse the impact of value propositions in business models on the development and success of a company. Indicating how important an individual strategy and vision of company development and continuous improvement of competitiveness are in business.

Design/methodology/approach: The analysis is based on a review of literature on the subject as well as data obtained from an interview with the owner of the largest alpaca farm in Silesia.

Findings: In the discussed cases of various business models, it was observed that a well-chosen value proposition contributes to the success of the company. It is therefore advisable to create a value proposition at the very beginning and build the business model around it.

Originality/value: The article examines a successful company in terms of its operation and development. This example can serve as inspiration for other entrepreneurs. The article is addressed to all entrepreneurs who want to develop their business models based on creating innovative customer value. The value of the article lies in presenting an innovative business model that has proven effective, as evidenced by the continuous expansion of the business and the creation of new customer value propositions.

Keywords: value proposition, modern enterprise, business models.

Category of the paper: Case study, Research paper.

Introduction

In an era of high market competition, it is important for companies to continuously analyse their business models and create new, innovative business models (Anderson et al., 1999; Kardas, 2016; Moreno-Monsalve et al., 2023). To improve or create a good and, above all, effective business model, a company must rely on specific knowledge and skills. A key aspect is understanding and analysing the specifics of the industry in which the business operates. A well-designed business model leads to achieving and maintaining a competitive advantage (Leipziger et al., 2024; Ranta et al., 2020). Recent years, marked by the pandemic and the outbreak of war in Ukraine, have caused disruptions in supply chains and forced new forms of

customer contact and sales opportunities. These situations highlight the importance of continuously analysing and creating new value propositions tailored to customer needs in a changing environment (Zahoor et al., 2022). The aim of the article is to analyze the impact of value propositions in business models on the development and success of the company. To indicate how important an individual strategy and vision of the company's development and constant increase in its competitiveness are in business. A research hypothesis was put forward: Developing a business model based on creating innovative value for the customer affects the development and success of the company. The analysis was based on literature studies on the discussed topic and on the basis of data obtained during an interview with the owner of the largest Alpacarnia in Silesia. This described example can be an inspiration for other entrepreneurs. The article is addressed to all entrepreneurs who want to develop their business models based on creating innovative value for the customer. The topic and purpose of the work are still current and important because in a competitive market entrepreneurs must constantly develop their offers, expand and modify the range of services and products, implement new solutions in line with the needs of recipients. To run your own company and build its image, it is necessary to individually and continuously interpret the results of the company's operations and, based on them, create value for the customer. The value of the article is to present a developed innovative business model that has proven itself, as evidenced by the continuous expansion of the business, the creation of new value propositions for the customer. Indication of how important an in-depth analysis of the operations of a specific company and an individual approach to a given case are for creating value for the customer.

Literature review

The term "customer value proposition" appears in many definitions of business models, as it is a crucial element that influences the success of a business (Table 1).

Table 1.

Definitions of the concept of a business model with the inclusion of the term "value proposition"

Definition of a business model	Source
A business model is the essence of managing transactions in a way that creates value by taking advantage of business opportunities	Amit, Zott, 2010, p. 217.
A business model describes how resources are combined and transformed to generate value for stakeholders and how the enterprise will be rewarded by stakeholders in exchange for the value provided	Margretta, 2002, p. 87.
A business model is the logic of creating and delivering value to customers	Teece, 2010, p. 173.
A business model is a company's value proposition for specific customer groups and a company architecture, indicating the generation of beneficial and sustainable revenue streams	Osterwalder, Pigneur, 2012, p. 2.
A business model indicates how a company identifies and creates value for customers and captures some of that value in the form of revenue	Casadesus-Masanell, Ricart, 2010, p. 196.

Source: own study based on Amit, Zott, 2010; Margretta, 2002; Teece, 2010; Osterwalder, Pigneur, 2012; Casadesus-Masanell, Ricart, 2010.

The definitions of business models provided by various authors suggest that a business model is a detailed description of how a company is supposed to operate (Table 1). A business model determines the operation of a given company (Shamsuzzoha et al., 2023). Among the fundamental elements of a business model is the identification of the customer and their needs. The value proposition defines the reasons why customers should choose a particular offer. A successful company is one that has found a way to create a strong value proposition for the customer, meaning a way to support the customer in accomplishing a specific job (Cosenz, Bivona, 2021). Here, the term "job" refers to an important problem that requires solving in a given situation (Miller et al., 2021). Understanding the essence of this job, all its aspects, including the process of its execution, is a prerequisite for designing a compelling offer for the customer. The value proposition should be clear and understandable to customers, attractive, as well as distinctive and credible. Creating a value proposition is not easy—it requires intuition, managerial talent, the application of innovative methods such as in business model creation, and above all, effort and hard work (Kumar, 2012; Codini et al., 2023). Empathy is also necessary, as it helps to recognise the true, often unspoken, problems of our customers. This is why creating an effective value proposition is so crucial for the success of a company (Day, 2020). However, it is important to remember that a value proposition is never created just once. Every value proposition requires regular "auditing" and possible adjustments. The value proposition should be updated when customer needs change, new market data emerges, or product modifications are introduced. The analysis of creating value for the customer and its implementation is a current and important topic. Many authors analyze this area, including Ballantyne et al., 2011; Berman, 2012; Carvalho, Jonker, 2015; Bernes et al., 2017; Bailetti et al., 2020; He, Ortiz, 2021). However, when analyzing the literature, there is a lack of current publications in the field of Techniques and methods of creating value propositions and the analysis of good examples of created value propositions in companies from various industries. This publication fills the research gap by indicating good examples of creating value propositions.

Creating a customer value proposition

The term "value proposition" first appeared in 1988 in a research article by McKinsey & Co., where it was defined as "a clear, simple statement of the benefits, both tangible and intangible, that the company will provide, along with the approximate price it will charge each customer segment for those benefits" (Lanning et al., 1988). When analysing and describing a value proposition, attention should be paid to elements such as novelty, efficiency, customisation, design, brand/status, price, cost reduction, risk reduction,

availability, convenience/usability (Term: Propozycja wartości, <https://elearning.przemyslprzyszlosci.gov.pl/slownik-pojec/propozycja-wartosci/>).

Different types of value propositions can be analysed and created in terms of the values they represent:

- Functional value – "for the eye".
- Financial value – "for the wallet".
- Social value – experienced through the acceptance of others.
- Psychological value – expressed through emotions and feelings.
- Civic value – benefiting society as a whole.

In particular, in today's highly competitive business environment, the value proposition plays a crucial role for entrepreneurs, as it describes the benefits that customers can derive from their products or services (Brzóska, 2009).

Creating a value proposition is not a simple task and requires the analysis of multiple aspects, such as identifying the benefits offered by the product, explaining why these benefits are valuable, identifying the main problem the customer faces, linking the value to this problem, and positioning the company as the preferred value provider (Holbrook, 1999).

A well-constructed value proposition should answer the customer's question: "Why should I buy the product or use the service from Company X rather than from the competition?"

Although a value proposition should help distinguish the company from the rest of the industry, it is important to remember that it is not a slogan or a company mission statement.

Presenting a value proposition that is easy to convey and recognisable is a critical element today. Every day, we are "bombarded" with a vast amount of information and have access to numerous sources, while competition in the market is rapidly increasing. It is worth emphasising that successful companies define their value proposition before entering the market and plan their activities based on it (Payne, 2017).

There are fundamental elements that create a strong value proposition:

- customer pain points: Addressing customer problems allows the company to demonstrate empathy and understanding of their needs,
- benefits: The advantages show what customers can gain from the offered product or service,
- competition: Standing out from rivals helps emphasize what makes the company unique (Osterwalder et al., 2015). Numerous benefits of creating a value proposition are highlighted by both entrepreneurs and authors of various publications, including:
 - differentiation from the competition,
 - improved quality,
 - increased market share,
 - enhanced operational efficiency.

An effective value proposition is one that resonates with the target audience, clearly communicates the distinct benefits of the product or service, addresses the specific needs, preferences, and pain points of customers, and differentiates the company from its competitors (Anderson et al., 2006).

The first step in developing a business model should be to define the target group and analyse the value that we want to deliver to this group. The Business Model Canvas is well-suited for a holistic view of the business model—presenting all key aspects of the business on a single sheet of paper. A very useful tool for a detailed analysis of customer needs and creating a value proposition is the Value Proposition Canvas (VPC). The Value Proposition Canvas can be used when there is a need to refine an existing product or service offer, or when a new offer is being developed from scratch.

The Value Proposition Canvas consists of two elements (Fig. 1):

- Customer Profile, which focuses on understanding customers' needs, jobs, and problems, helping companies identify what is most important to them.
- Value Map, which shows how the company's product or service addresses these needs, jobs, and problems, presenting the benefits that the company offers.

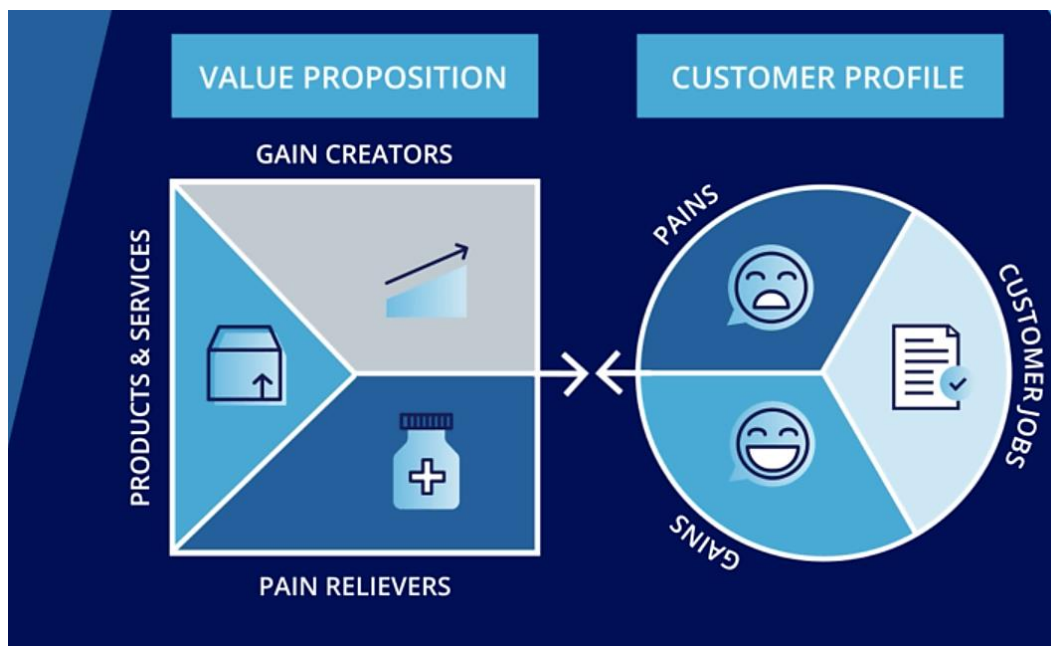


Figure 1. Diagram of the Value Proposition Canvas (VPC) creation process.

Source: (Osterwalder et al., 2014).

The individual elements of the Value Proposition Canvas (VPC) include:

- Pains: Elements that stress the customer on a daily basis, causing worries and anxiety.
- Gains: The next step is to identify the positives related to these jobs. Gains can include any type of positive emotions, social benefits, satisfaction, savings, and profit increase.
- Jobs to be done: Focus on the problem area that is being addressed. This can include goals (that the customer wants to achieve) or needs (that emerge).

- Pain relievers: Creating value for the customer involves either relieving their pain or enhancing the gains they receive.
- Gain creators: Analyse the gains that the proposed solution offers. Consider how the proposed solution will generate positive emotions, social benefits, time savings, and increased revenue/profit for the customer. Finally, try to select the most important gains.
- Products and services: These are the elements that will help the customer with their daily jobs.

A well-crafted and appropriate value proposition can significantly impact the success of an organisation by attracting and retaining customers, increasing conversions, and fostering brand loyalty (Gajda, 2014).

Using the Business Model Canvas template, one can easily and transparently create a business model, centred around the most important element—the value proposition. However, it is crucial to emphasise that every created value proposition requires regular "auditing". External factors that can change customer needs include:

- Economic situation in a given country.
- Public and political sentiments.
- Internal and external conflicts.
- Legislation.
- Fashion trends.
- Availability of key resources.
- Threats.
- Disasters.

Any of these factors can cause the proposed value proposition to lose its relevance. Therefore, when creating a value proposition, it is essential to consider the overall framework within which the business operates (Kowalkowski et al., 2012).

Research methodology

As part of the hypothesis put forward, examples of value propositions in companies were analyzed and an interview was conducted with the owner of one of the companies near Częstochowa.

When starting a business, many companies analyse their customers' needs to create value propositions that are as well-suited as possible to their target group. More organisations are becoming aware of the role of creating business models, and thus the importance of developing a value proposition (Liu, Yu, 2021). A value proposition is meant to convince stakeholders, investors, or customers that a company, its products, or services are innovative, customer-

centric, etc. (Belitski, Mariani, 2023). A well-constructed value proposition also helps a company stand out from the competition, highlighting the brand's unique value and specific benefits, which helps establish it in consumers' minds (Saarijärvi et al., 2013). However, in a dynamically changing business environment, it is crucial to regularly analyse and refine the value proposition to keep it relevant and meet evolving customer needs (Value proposition: jak stworzyć skuteczną propozycję wartości? <https://conversion.pl/blog/value-proposition-propozycja-wartosci/>).

Creating a resonating value proposition is an art, but many companies have shown it is possible (Table 2).

Table 2.
Examples of value propositions from various companies

Company	Value proposition
Uber	Uber leverages technology to connect passengers with drivers. Its value proposition is: convenience, affordability, and reliability offered to its customers.
Amazon	Amazon offers a diverse selection of products available in fast-track mode. It also enhances customer service through various additional conveniences, such as one-click delivery, gift wrapping, time-saving features (saving selected items or creating "wishlists"), and an enticing loyalty program (Amazon Prime).
Etsy	Etsy allows customers to purchase handmade products. One of the main criticisms of the e-commerce market is that the products sold there are mass-produced and lack the individual character typical of handmade items. By creating a marketplace that connects buyers with artisans, Etsy provides a neat solution to this problem.
Nike	Nike offers value through three benefits: exclusive access, free shipping, and birthday rewards. It also offers its customers the opportunity to become Nike members, reflecting the company's passion for promoting inclusivity.
CCC	The CCC brand, known domestically and internationally for its wide range of footwear, accessories, and bags, combines affordability with quality and modernity. This approach, where affordability plays a key role, aligns with the brand's mission and values, proving that "Price Works Wonders" (Polish: Cena Czyny Cuda) can be a driving force for innovation, growth, and consumer loyalty.
Neflix	Netflix's value proposition is primarily personalised streaming content, a user-friendly interface, a wide selection of on-demand content, tailored recommendations, and seamless viewing on various devices.
KFC	KFC's value proposition is: "Delivering the best-tasting fried chicken to customers using a secret recipe".
Google	Google's core value lies in its ability to quickly deliver comprehensive and relevant search results to all users. Google's commitment to providing accurate and up-to-date information has cemented its position as the leading search engine worldwide.
Apple	Apple creates a unique value proposition by focusing on innovative design, user experience, and seamless integration of products and services. The company has become a leader in the technology industry, consistently introducing innovative products and services that emphasise ease of use, excellent customer service, and cross-device integration. Apple's dedication to innovation and exceptional user experience has earned the brand a loyal customer base and a reputation for excellence.
Airbnb	Airbnb bases its value proposition on offering customers a range of travel-related experiences. It no longer only offers room rentals but also guided tours, live concerts, and even cooking workshops.

Source: own compilation based on "Formułowanie propozycji wartości produktu. Porady i przykłady" (English: Formulating the product value proposition. Tips and examples), <https://www.linkedin.com/pulse/formu%C5%82owanie-propozycji-warto%C5%9Bci-produktu-porady-i-%C5%82ukasz-lipi%C5%84ski/>

In the examples provided, it is evident that weaving a narrative into the value proposition helps establish an emotional connection with the audience. It is also noteworthy that in some cases simplicity wins. The message is straightforward, focused on the benefits for customers. It is worth noting that the presented value propositions are clear and concise, making them easy to remember. The propositions presented indicate logical arguments, which in turn influence the imagination of customers.

To deepen the understanding of the role of value propositions in the business models of successful companies, a direct interview was conducted with Mr Piotr Majcherczyk, the owner of an alpaca farm Alpakarnia Poczesna. The interview took place in May 2024, and several open-ended questions were asked, allowing the owner to freely explain various issues related to creating a business model, and especially the creation of a value proposition. In Poczesna, near Częstochowa, on an area of nearly 5 hectares, lies the largest alpaca farm in Silesia and one of the largest in Poland.

As the owner recalls, he has always been fascinated by exotic animals, observing their lives and habits. He bred them, observed their lives and habits. At a certain point, he decided that these animals should be admired not only by him, his family, and his circle of friends, but especially by children. This idea was brought to life in 2018. His passion and hobby transformed into a well-prospering, innovative business, although, as he emphasises, at the beginning, he did not expect such a large investment and such rapid business growth. It is worth noting that the entire business model was initially developed by the owner himself. By analysing the operations of other similar ventures, he attempted to create his own innovative model. As Mr Piotr emphasises, thanks to this approach, he "does not feel the pressure of competition". The owner intuitively applied the "Blue Ocean Strategy," where companies create untapped and uncontested market spaces, rendering competition irrelevant, while fully leveraging innovation to shape their position. The essence of this strategy lies in value innovation, which focuses on creating new values for both customers and the company itself.

A value proposition is a crucial element of any business model. It forms the foundation of the entire model, which is why the owner of the alpaca farm was asked *how this value proposition was developed and whether he used the services of external companies that help create business models, including value propositions*. The owner emphasised that he created the value proposition within the business model himself, based primarily on:

- observation and analysis of the needs of customers in the local area,
- analysis and evaluation of the operations of similar businesses in the country and abroad,
- review of literature reports concerning the functioning of the proposed services.

The owner of Alpakarnia emphasises that the success of his business and the creation of a solid value proposition began with an in-depth analysis of the market and the societal needs for the services offered. He analysed how his investment and proposed services could meet the specific needs and expectations of local customers. He also had to thoroughly research what the competition was offering in the planned business area, identify gaps, and propose something

unique that would distinguish his venture from competitors. Another crucial step was understanding and analysing the fundamental legal regulations governing the operation of small zoos. The operation of zoological gardens is regulated by numerous legal provisions. The owner highlights that important and significant are the zoological restrictions and compliance with regulations related to the breeding of animal species, ecological education, animal protection, and recreation. Other issues, such as running a catering outlet or adhering to health and safety regulations, are also regulated by law. To create a business model and formulate an effective value proposition, the owner had to consider all these factors and conditions. A poorly crafted value proposition, and consequently a lack of customers, ultimately leads to the failure of a business.

After launching the alpaca farm, the owner had to focus on creating new values for customers and growing the business. To do this, he closely observed the first customers and analysed what they expected, what made them happy, interested them, what they feared, and what problems they encountered. Additionally, he engaged in conversations with them and his employees. The owner recalls that he had to verify and adjust some ideas, derived from observations and conversations, to match the capabilities of the facility and legal regulations in order to find the "golden mean", which was not easy. As the owner emphasises, having a good business idea is not everything—advertising is also crucial to verify ideas against customer reactions and observations. The owner invested in both online advertising (Facebook) and traditional media like radio, billboards, and newspaper ads, which enabled quick promotion of the business. In the owner's view, the value proposition for the customer should be one of the first messages encountered at all brand touchpoints. Initially, the value proposition was not as extensive and was primarily aimed at families with children. However, as the alpaca farm grew, the customer segments expanded significantly, including adults, seniors, and people with disabilities.

Customers are delighted that they can interact so closely with animals (alpacas, goats, camels, donkeys, etc.), petting and feeding them, learning empathy, gentleness, and care.

In our alpaca farm, we have two of the most popular alpaca breeds: Huacaya and Suri. Alpacas are generally very gentle, have wool without lanolin, so they are not allergenic, and anyone can touch them and be around them. Our main attraction is direct contact with alpacas because not every species of animal is suitable for direct contact with humans, says Piotr Majcherczyk, owner of Alpakarnia in Poczesna. Contact with alpacas, as numerous studies highlight, positively influences the development of children's motor, cognitive, emotional, and social skills.

During his observations, the owner noticed that customers wanted to stay longer in the place, so to make their stay more enjoyable, he began bringing in new animals such as goats, sheep, kangaroos, Poitou donkeys, camels, exotic birds, capybaras, lemurs, flamingos, meerkats, zebras, monkeys, parrots, and many others. Additionally, customers can enjoy several hectares of open space, and when it rains, they can visit the alpacas in a covered hall.

Another value proposition is the café offering delicious ice cream and pastries from the Consonni brand. The place is unique, combining the taste and aroma of the best coffee with the company of beautiful live plush toys. Such a combination—the largest alpaca farm in Poland, plus a mini zoo, café, playground, and additional offers like organising birthday parties or educational activities—is undoubtedly an innovative business model. Another question posed to the owner was: *How often do you think the value propositions should be re-evaluated and improved?*

According to the owner, in the rapidly changing business world, it is very important to regularly check the company's activities and continuously improve the value proposition. To attract customers, one must meet their changing needs. A saturated market and growing competition do not permit stagnation. Innovations and enhancements to the value proposition are necessary. Therefore, the actions within the established business model are constantly being evaluated. Recently, for example, more seating areas (gazebos, benches, deck chairs) have been added in open spaces to provide visitors with greater comfort during their visits to Alpakarnia. These spaces are also useful for seniors or groups of friends who want to spend pleasant time together over coffee. Observing increased customer traffic led to the opening of new parking spaces.

Another question was: *Are you planning any significant changes or additions to the value proposition for customers in the near future?*

Customer observation leads me to expand the range of products sold at our alpaca farm. There is a high demand for souvenirs related to visits to the facility, such as plush animals, toys, t-shirts with prints, and various alpaca wool products like jumpers and socks. I also plan certain changes related to animal breeding, such as new enclosures, cages, and renovations or modifications of the animal hall.

As part of the interview, the owner was also asked about the pandemic period. The question was: *How did the company cope during the pandemic?*

As the owner points out, it was a challenging period, beginning with a complete closure. Later, as restrictions eased, visitors were gradually allowed access to the open areas of the facility, but purchases of coffee and pastry were only possible through a specially adapted takeaway window. Analysing the situation during the pandemic also led the owner to quickly modify ongoing actions.

In 2023, the owner of the alpaca farm was recognised and awarded the SYDERYT (the originator of the "SYDERYT" awards is the Head of the Poczesna Commune, Krzysztof Ujma, who annually honours individuals particularly distinguished in the development and promotion of the Poczesna Commune).

Of course, the owner also mentioned the challenges of running such a business. The daily care of the animals, the costs associated with veterinary care—these are also integral parts of the business operations.

Discussion

The analysis was based on literature studies on the discussed topic and on the data obtained during an interview with the owner of the largest Alpacarnia in Silesia. After analyzing selected examples of companies and analyzing the company (Alpakarnia), the research hypothesis is confirmed. A well-chosen value proposition contributes to the success of the company. Therefore, from the very beginning, it is worth analyzing and creating value propositions based on it. It is also worth emphasizing that the owner's involvement is essential for creating and evaluating value propositions for customers. Continuous expansion of knowledge of company managers about their business and customer needs is the key to planning an effective strategy and competitiveness. The analysis of the presented example of Alpacarnia draws attention to one important aspect in particular, which is the involvement of the company owner in the area in which they develop their business model. After the interview, it can be stated that the basis of a well-developing innovative business, creating an interesting value proposition is the owner's hobby, passion. It should be emphasized that as the business is run, changes and modifications occur in the initially developed plan. A very important aspect in creating an interesting, innovative value proposition is the use of the customer observation method. The owner of Alpakarnia emphasized that in times of great competition, the most important thing is for the customer to feel that they are important to us and that we respond to their needs. The customer is the most important advertisement for our company because they issue opinions about our activities and can recommend or advise against our services. Therefore, it is very important to listen carefully and appreciate the advice or comments of customers. In addition to surveys and interviews, the method of observing our customers allows for the creation of a better value proposition tailored to their needs. Based on the observation of the recipient, it can be determined whether the offered proposition meets their expectations. Based on this information, the owner of the discussed company searched for and implemented new areas of activity, undertook various initiatives. It is also important to observe the competition and implement comprehensive, innovative solutions. This is also confirmed by other researchers (Shamsuzzoha et al., 2023; Ranta et al., 2020; Leipziger et al., 2024; Ballantyne et al., 2011; Berman, 2012; Carvalho, Jonker, 2015; Bernes et al., 2017). The unique nature of the facility also results from the fact that in one area you can spend time with interesting animals, have fun on the playground, eat in a café, buy interesting souvenirs or useful products made of alpaca wool, relax in beautiful gazebos or deckchairs. An additional offer is the possibility of organizing educational or rehabilitation classes for children and various celebrations such as birthdays or children's day. The value proposition is one of the most valuable tools in the company's communication area. It enables stakeholders to speak accurately and confidently about the company and ensures that communication materials and marketing campaigns are consistent with each other and with the overall tone of the brand. Therefore, it is worth

extending the research to include, among others, analysis of new methods and techniques that companies use to create their innovative value proposition.

Summary

Value proposition and business model template are very useful frameworks for success for any company. They help to see what the company has to offer from a different perspective, allowing it to improve and attract more customers. Not all companies create their value proposition or it is often confused with a mission or slogan. Therefore, it is worth emphasizing that Value proposition focuses on what the company offers to customers, while mission is more about describing the purpose of the company. Secondly, value proposition is more focused on products and/or services, while mission is about the goals set for itself. It is also necessary to distinguish between slogan and value proposition. A slogan is a short statement that embodies a certain aspect of the company, a value proposition is more specific. Therefore, it is worth considering how to create and what features a good value proposition should have: first of all, it should fit the selected business model, solve various needs of our customers, including emotional and social ones, and stand out from the competition in at least one aspect. The results of the interview with the owner of the well-developing company described in the publication indicate that a properly defined value proposition is the key to success in the changing world of business. The owner of the company emphasized that competition in the service industry forces careful observation and analysis of customer needs and offering increasingly better customer service. The success of the analyzed company was possible thanks to the owner's deep knowledge of the business, commitment and reliable analysis of customer needs as well as observation and assessment of the competition. Openness to innovation, flexibility and the ability to adapt to market changes are also very important.

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ASSESSING THE QUALITY OF AI-GENERATED CONTENT IN TOURISM - A SIGNALLING THEORY APPROACH

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Purpose: The study highlights gaps in AI research from the perspective of non-business users. The main aim of this article is to identify quality dimensions and signals used to evaluate the results generated by GenAI in tourism planning.

Design/methodology/approach: The study employed a qualitative research methodology, specifically an exploratory focus group. Conducted in Poland in 2024, the study assessed how Generation Z representatives search for quality signals in artificial intelligence-generated content (AIGC).

Findings: Using signalling theory, the signals considered in the evaluation process were identified and categorized. The study sheds light on the impact of visible signals such as links, images, and AI brands on AIGC satisfaction and how these signals relate to content quality dimensions. The findings indicate that relevant and accurate links are crucial as they help verify the information's authenticity, while irrelevant or incorrect links erode trust. Photographs enhance the plausibility of the answers and aid in visualizing attractions, though consistency and truthfulness remain vital to the quality of the response. The AI's brand, however, is deemed unimportant.

Originality/value: This paper adds to the developing field of tourism planning by focusing on the use of AIGC. Moreover, it contributes to the field of human-AI interactions, and human-centred AI, by investigating how users evaluate the quality of AIGC. The framework employs a unique approach by combining signalling and screening theory to analyze AIGC and elucidate the relationship between signals and perceived quality.

Keywords: artificial intelligence; signalling theory; AIGC; tourism; human-AI interactions.

Category of the paper: Research paper.

1. Introduction

As generative artificial intelligence (GenAI) is a recent technological development, there is a limited amount of research available on how customers respond to it. The focus of AI research remains on technological advancement, with the efficiency of these systems primarily evaluated through system performance metrics rather than the quality of their human interaction

capabilities (Jin, Zhang, 2023; Raees et al., 2024). The importance for the tourism industry of understanding customer responses to GenAI has been highlighted by Kim et al. (2023). They have also identified research gaps, including the absence of studies on customers' reactions to AI-generated content (AIGC).

Implementing AI in the travel planning and organization process has been found to have several benefits, including the objectivity of the results (Christensen et al. 2024), reduction of online information overload, and enhanced personalization (Kim et al., 2023). However, it is important to acknowledge that AI results may be subject to bias. The issue of AI hallucinations, i.e. making up results, is a concern that needs to be addressed to maintain trust in AI work. According to Wei et al. (2022), the reliability (truthfulness) of responses is the main factor determining their quality. Additionally, when planning and organizing holidays with AI, factors such as completeness, timeliness, and usefulness of the answer may also be considered (Kim et al., 2023). It is worth noting that the criteria used to evaluate performance may not always be clear, especially for younger individuals. According to Christensen et al. (2024), a significant number of Gen Z and Millennial consumers have shown a preference for the ChatGPT travel itinerary, even though it may contain inaccurate or fabricated information. This is due to their perception of ChatGPT as a more reliable content source than conventional and popular sources used for travel and tourism decision-making. In line with signalling theory, the paper assumes that, in the presence of information asymmetry, AIGC recipients search for observable cues indicating high or low quality content. Thus, it is important to identify not only the dimensions of AIGC quality, but also the signals that are perceived as proxies for these dimensions.

Taking this into consideration, the main aim of this article is to identify quality dimensions and signals used to evaluate the results generated by GenAI in tourism planning. This paper draws on two distinct bodies of literature. Firstly, it contributes to the emerging field of tourism planning, with a particular focus on the use of AI-generated content (Chen et al., 2023). Secondly, this study makes a contribution to the field of human-AI literature more broadly, and to the specific area of human-centred AI (Raees et al., 2024), by examining how users assess the quality of AI-generated content.

The potential for improving the quality of AI outputs has significant implications for AI content creators. Furthermore, the study provides valuable insights into consumer reactions and behaviours associated with AI interactions. The framework's unique approach combines signalling and screening theory to understand AI-generated content and clarify the relationship between signals and perceived quality.

2. Quality of AI-generated content

The investigation of content quality and its influence on consumer decision-making in the context of tourism has been a long-standing area of research (Z. Zhang et al., 2016). The focus of research has been on both marketer-generated information and consumer-generated information (Bickart, Schindler, 2001; Chua, Banerjee, 2016).

Artificial intelligence-generated content (AIGC) results from the process of creating digital content, including images, music, and natural language, through the use of AI models (Wang et al., 2023). The quality of AI-generated content (AIGC) and the consumer experience with AI are new areas of research that are becoming increasingly popular in service research (Chen et al., 2023; Khan, Mishra, 2023). Recent studies suggest that AI-generated content shares many attributes with content created by humans, but it tends to be more detailed, accurate, and effective (Zhang et al., 2024). The impact of consumers' interactions with AI tools can be either positive or negative. On the one hand, the advantages of use, such as convenience, speed of operation, and so forth, can lead to a positive experience. Conversely, negative experiences may result from factors such as hallucinations, vague data, and data security concerns.

The concept of content quality is related to the general idea of the quality of services understood as the ability to meet or exceed customer expectations (Parasuraman et al., 1986). Definitions of AIGC quality, therefore, focus on meeting the AI users' needs and requirements. AIGC typically comprises two phases: the first is the extraction and understanding of user intent information, while the second is the production of desired content based on the extracted intentions (Wang et al., 2023). The quality of the outcome is contingent upon the extent to which the generated results align with the user requirements initially specified in the prompt.

3. Dimensions of AIGC quality

Various researchers have studied the factors that influence users' intentions to use AI-based technology in tourism. According to Pillai and Sivathanu (2020), perceived ease of use, usefulness, and trustworthiness are among the significant factors. Melián-González et al. (2019) also found that expected performance is crucial. Loureiro et al. (2021) discovered that a tourist's perceived value impacts the quality of the relationship between tourists and intelligent voice assistants. Pham et al. (2024) conducted a study using three human-like cues - perceived warmth, speed of communication, and perceived competence. These cues stimulated cognitive responses, such as trust in ChatGPT and attitudes towards ChatGPT, resulting in increased satisfaction and intention to continue using ChatGPT for travel services.

The research on content quality indicates various ways of defining the dimensions of quality. In one of the pioneering studies on service quality, Grönroos (1984) formulated an early multi-dimensional framework for assessing service quality, identifying two main dimensions: technical quality and functional quality. The technical quality of AI-generated content is contingent upon the substance of the response, which can be described by the relevance of the response, detail, veracity, and other content-related dimensions. In contrast, the functional quality of AI-generated content is concerned with the form and delivery of the response. With regard to the functional quality of AI-generated content, the aesthetic presentation, graphical form, and speed of generation of results are of particular importance.

On the other hand, the quality of information can be understood through three dimensions: comprehensibility, specificity, and reliability (Chua, Banerjee, 2016; Kim, Lei, 2024). The comprehensibility of AI-generated content can be measured by determining how easily it can be understood (Fang et al., 2016). The specificity of text created by AI can be assessed by evaluating the amount of relevant information it provides to assist with decision-making. The reliability of information can be gauged by determining the extent to which consumers trust it (Table 1).

Table 1.
AIGC quality dimensions

Quality dimension	Description	Source
Reliability	Absence of false information	Chua, Banerjee (2016); Kim, Lei (2024)
Comprehensiveness	Specificity and information depth, relevance to the purpose	Chua, Banerjee (2016); Kim, Lei (2024)
Readability	Ease of understanding, simplicity of language	Chua, Banerjee (2016); Fang et al., (2016)

Source: Authors own work.

The question of what users perceive as quality, regardless of how it is defined, is an important one. This study employs signalling and screening theory (Spence, 2002) to address the issue of proxies of the quality of AI-generated content in tourism planning. Signaling theory, as introduced by Michael Spence, originally emerged in the context of labor markets to explain how individuals convey their abilities or qualifications to potential employers. In this framework, "signals" are observable attributes or actions that convey information about some unobservable quality.

The signalling theory suggests that in the presence of an information imbalance, the party with less information will seek to employ different information signals or indicators to bridge the gap and enhance their decision-making process (Connelly et al., 2010). According to Perner and Skjølvsvik (2019), this theory explores the process by which receivers interpret and evaluate signals from signalers to gain insight into their quality.

It is presumed that the quality of AI-generated content is unknown to the users. It is only when users assess the output generated by the AI that they can conclude the quality of the result. The act of seeking out quality information can be considered a form of screening.

Similarly, the sending of information (or cues) that suggest high quality can be considered a form of signalling. In light of the above, the article seeks to address the following questions: what signals do GenAI users use to identify and differentiate between high and low quality content in the tourism planning process?

4. Method

In 2024, a study was conducted in Poland to examine the process of searching for quality signals in response, based on the views of representatives from Generation Z.

The study employed a qualitative research method, specifically an exploratory focus group. In this study focus group was „a carefully planned discussion designed to obtain perceptions on a defined environment" (Kreuger, 1998 p. 88 in Smithson, 2000).

This approach is conducive to the generation of novel ideas that emerge within a social context. One of the key benefits of this methodology is that it allows research participants to collaborate and develop ideas collectively, ensuring that their priorities and perspectives are taken into account (Smithson, 2000). This approach helps to create a theory firmly rooted in the actual experiences and language of the participants. The use of focus groups is not without limitations. One such limitation is the tendency for socially acceptable opinions to emerge, as well as the tendency for certain types of participants to dominate the research process (Smithson, 2000).

Individuals meeting the following inclusion criteria were invited to participate in the study: representatives of Generation Z who use generative artificial intelligence and are willing to participate. According to Breen, (2006), theoretical saturation in focus-group research is normally reached after 10–12 interviews. In this study, the group included 18 individuals. The subjects involved were between 20 and 22 years of age and were mostly male ($n = 10$).

The research procedure was based on Smithson's (2000) and Breen, (2006) recommendations and involved three stages:

- In the first stage, participants were requested to search for content using leading GenAIs such as ChatGPT by OpenAI, Gemini by Google, and Copilot by Microsoft for trip inspiration, destination information, and details on dates, prices, and service providers.
- In the second stage, participants were requested to provide an evaluation of the results they obtained. They were asked to indicate whether they were satisfied or dissatisfied with the results and to explain the reasons behind their choice. Additionally, respondents were asked to specify the criteria by which they evaluated the quality of an answer as either positive or negative.

- Length and Depth of Response.
- Use of Links.
- Use of Photos.
- Brand of the GenAI.

In the next step, signals were linked to quality attributes (Chua, Banerjee, 2016; Kim, Lei, 2024). The results are presented in Figure 2.

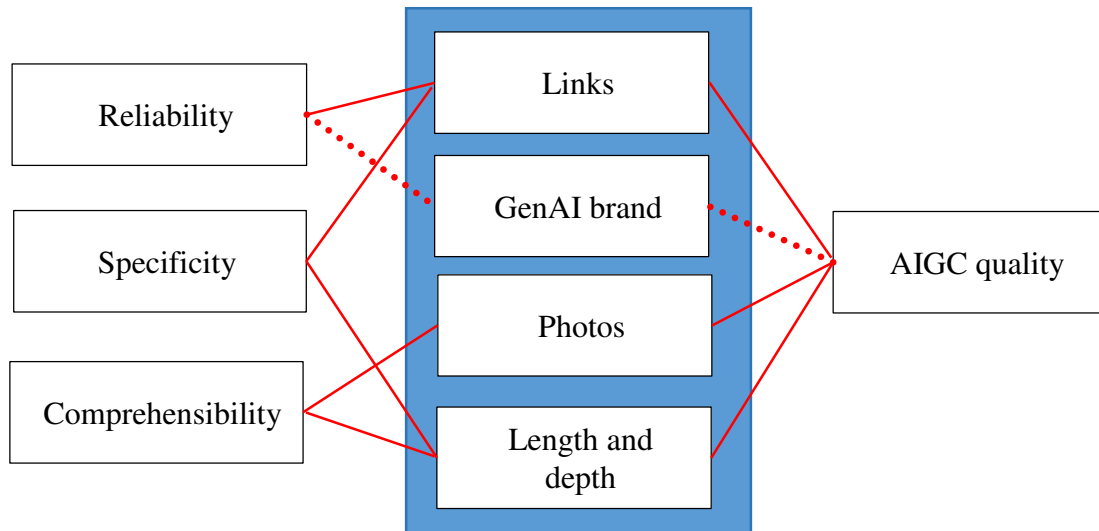


Figure 2. Word cloud based on user responses.

Source: Authors own work.

The length and depth of the results are considered proxies for the quality of the results. On the one hand, longer and more detailed answers allow for more knowledge and correspond better to the need to know a place. On the other hand, shorter answers are easier to read and absorb.

As the participants in the interviews indicated:

- „The length and depth of the answer can indicate quality”.
- „The clearest, simplest answer that looks credible”.
- „A good response avoids long, convoluted sentences and accumulates information effectively”.

Another signal that users employ to infer quality is the presence of images that complement the text of the responses. As indicated by the participants:

- „Photos can influence interest in a place by showing that it exists and making the information more engaging”.
- „Photographs made the answer seem credible, they can influence interest in a particular object/place”.
- „However, photos are not always necessary, and their importance can vary”.

Additionally, relevant proxies of AIGC include links to external websites embedded within the text of the answer. The inclusion of such links, provided they are genuine and direct to actual external pages, serves to enhance both the credibility of the answers and their depth. As stated by the individuals who participated in the interviews:

- „The links were meaningful. They allowed me to verify whether AI's answers made any sense”.
- „Links make a difference to the speed of verifying the information provided, they certainly make this easier, but if the app provides random links then it becomes immediately unreliable”.
- „Links are helpful but not essential, and their presence can make it easier to check the provided information”.

GenAI's branding may indicate a higher reliability of the responses. The majority of respondents indicated that the responses generated by ChatGPT, a tool developed by OpenAI, were of a notably high quality. OpenAI is a well-known and highly regarded brand in artificial intelligence. At the same time, participants emphasised that the content itself was more important than the GenAI brand.

As indicated by the participants:

- „In my opinion, the content is more important than the name”.
- „The name does not matter more than the content”.
- „The content of the answer is very important, but the brand can also indicate the sophistication of the artificial intelligence”.

According to the survey, the role of generative AI is not only to provide content based on the user's query but also to ensure that it is presented in a way that gives the impression of high-quality content. In other words, it should appear reliable, readable and complete. To effectively evaluate content quality, it is important to consider multiple signals in conjunction. Relying on a single signal, such as the presence of links, can lead to biased or incomplete assessments.

6. Discussion

Fluctuations in AIGC quality present a significant challenge to the widespread application of AI in tourism activity planning. It is therefore essential to understand the performance evaluation process from the perspective of those using it and to develop mechanisms to identify low-quality content.

Signalling theory provides a valuable framework for understanding how content quality is perceived and evaluated. By examining the signals emitted by an AI platform - whether through links, images, content length and depth, or the AI brand - consumers can make more informed decisions about content quality. The challenge, however, is to distinguish authentic signals from

those that are manipulated or misleading, and to ensure that the mechanisms in place (both human and algorithmic) are sophisticated enough to adapt to the evolving nature of these signals.

The study presents findings on the factors that influence the use of AI in travel planning. It acknowledges research gaps in the area of AI research from a non-business user perspective. The signals considered in the evaluation process were identified and classified using signalling theory. This study provides insights into the impact of visible cues such as links, images and brand AI on AIGC satisfaction and how these signals relate to the dimensions of content quality. First, it was found that the inclusion of links is important as they help to verify the veracity of information. Links should be relevant and accurate; random or incorrect links undermine trust. Photographs are also helpful as they make the answer more plausible and help to visualise the attractions. However, consistency and truthfulness are critical to the quality of the answer. The name of the AI is not considered important.

The study offers practical recommendations for the development of GenAI tools dedicated to tourism planning. To create quality content, it must first meet three criteria: reliability, specificity and comprehensibility. However, this is not the full picture. In addition, it is necessary to understand how to communicate these qualities by using signals and cues from which users will infer quality. Content should be free of hoaxes, of an appropriate length, supplemented with links and good-quality images. Furthermore, it should be free of errors and misleading information, and it should be presented in a clear and concise manner.

Further research is required to identify additional methods for assessing the quality of AIGC results. Moreover, it is recommended that research be conducted using quantitative response analysis methods, such as the Gunning-Fog Index, the Coleman-Liau Index, and the Automated Readability Index, among others (Chua, Banerjee, 2016). This will enable the objective assessment of AIGC quality attributes. Furthermore, research involving large samples of respondents is essential. The advancement of GenAI technology must be accompanied by the further development of research dedicated to the interactions between AI and humans, with a particular focus on human-centric research.

In light of the considerable capabilities of GenAI in the creation of content, it is imperative that humans engage in a process of critical examination and review of the results produced by this technology. It is thus vital to maintain a continuous examination of the process of evaluating and appraising AI-generated content. Future applications of signalling theory to the evaluation of AI-generated content in tourism could include the analysis of how well the content signals its quality and reliability to potential tourists. This could help to develop better AI systems for content generation and more effective ways for users to assess the trustworthiness of AI-generated travel information.

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ONLINE, OFFLINE OR NOT AT ALL? CONSUMER CHOICE OF PURCHASE CHANNEL AND DELIVERY SCHEME, GIVEN PRICE DISCRIMINATION ACROSS CHANNELS

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Purpose: The purpose of this research was to understand how multi-channel pricing strategies influence consumer purchasing behavior, namely, their purchase intention, choice of channel, and delivery scheme, in face of today's fast changing consumer online vs. offline shopping habits, and retail transformation toward using many channels.

Design/Methodology/Approach: An experimental method was employed, using the between-subjects research design, where discount, price, and purchase urgency were manipulated across 10 scenarios. Purchase decision included purchase offline, online with different delivery schemes, or no purchase option. To accomplish the research objective, 553 respondents sourced from online panel were interviewed using CAWI, after which, regression and moderation analysis was performed.

Findings: This research asserts that the levels of discount and price are significant determinants of consumer purchase scheme choice. Additionally, the price level appears to be a moderating factor for the discount → purchase scheme relationship, while purchase urgency does not. Further, urban inhabitancy appears to have significant impact on purchase scheme choice, while gender, age, and Internet usage do not.

Research Limitations/implications: In future studies, more focus on frequent purchase product categories, such as foods or cosmetics, should be undertaken, along with lower price levels. Alternative purchase paths should also be taken into consideration, to examine the impact of the lower transparency of cross-channel price discrimination at the precise moment of purchase.

Practical Implications: As much as the high discount online vs. offline massively redirects consumer purchase decisions to online, even for urgent purchases, that high discount generally does not discourage customers from closing the deal, except for large city inhabitants, who have declared a relatively higher intention to abandon the transaction when faced with the price discrimination.

Originality/Value: This paper extends multichannel customer management theory, specifically in the area of discriminatory pricing. It also delves into the consumer purchase decision, introducing online purchase delivery time and costs, as well as the purchase urgency angle and its impact. It should help multi-channel retailers better formulate their cross-channel pricing strategies.

Keywords: Purchase decision, delivery scheme, multi-channel retail, price discrimination.

Category of the paper: Research paper.

1. Introduction

The percentage of consumers who purchase online increased considerably between 2018 and 2022, from 56% to 77% of Internet users in Poland (Gemius Polska, 2018, 2022). This phenomenon could possibly be explained by the COVID-19 pandemic and its related restrictions, which had an overwhelming impact on purchase behaviors (Gemius Polska, 2022). According to Strategy&-PwC (2022), the value of the e-commerce market in Poland grew between 2018 and 2021 from 48bn PLN to 92bn PLN, and is estimated to get to 187bn PLN by 2027 (Strategy&-PwC, 2022). Additionally, e-commerce grew its share in the retail market from 8% in 2018 to 12.9% in 2021, and is now estimated to account for 17% by 2027.

Price remains the most important factor when shopping online and more important than when shopping offline. Depending on product category, 56% to 63% of the respondents treated price as the most critical factor when shopping online, while 43% to 55% of respondents mentioned price as the most important factor when shopping offline (YourCX, 2021).

Over time, offline retailers, when faced with the competition from online retailers realized that to respond to this threat, they should add their own online channels, and exploit the potential synergies between the two types of channels. This ongoing transformation of retailers from pure-play (i.e., offline-, or online-only) to selling multi-channel, produced many strategic questions (Ratchford et al., 2022).

An important advantage of the online over the offline channel is lower distribution costs. This advantage stems from the possibility to store products available online in just a few remote warehouses vs. the necessity to store products in multiple physical stores. Physical stores are limited in terms of shelf and storage space, and they must be situated in places in reasonable proximity to their customers, so that choice is associated with higher real estate costs vs. the remote warehouses of online retailers (Ratchford et al., 2022). On the other hand, offline stores have an advantage in being able to offer additional services, store personnel attention, and immediate product availability, while online channels limit the travel time, and are usually able to offer considerably broader assortments at a lower cost to the retailer (Betancourt et al., 2016).

Taking into consideration the fast changes occurring in online vs. offline consumer shopping habits, the fact that price remains the most crucial criterion when shopping online, and the channels' value vs. cost characteristics, the applicability of price discrimination has become one of the priorities for retailers and for researchers (Kannan, Li, 2017). Despite the fact that the price discrimination strategy might seem tempting, doubts have been expressed

about whether retailers can “actually charge different prices for the same item in different channels” (Neslin, Shankar, 2009, p. 79) because “consumers may perceive inconsistent prices offline and online (...) [as] unfair” (Li et al., 2018, p. 828). The issue of consumers’ perception of multichannel pricing strategies still remains open.

In view of the latest changes in consumer shopping patterns and the growing market share of online shopping, there is a growing need to understand consumer attitudes toward multi-channel pricing strategies, and how they affect consumer behavior. Thus, the main objective of this study is to understand how multi-channel pricing strategies influence consumer purchasing behavior, namely, their purchase intention, choice of the channel and the delivery scheme.

As such, the research questions for this study were set as follows:

RQ1: In a situation of price discrimination between online and offline channels, is the consumer choice of purchase channel and delivery scheme related to the depth of between-channel price discount? If so, a second research questions is:

RQ2: Is this relationship moderated by the absolute price level and the urgency of making the purchase?

Our study makes a number of contributions to the literature on discriminatory pricing. First, following the framework for multichannel customer management (Neslin et al., 2006), we aim to enhance the research in the field of coordinating channel strategies, specifically on the issue of coordinating prices between the channels. The latest seminal work from Neslin (2022) published in *Journal of Retailing*, extends this framework into the omnichannel, and recommends a set of future research priorities. Our research project addresses at least two of these research directions: Harmonizing Prices (more research on price sensitivity needed, the role of shipping costs); and Task Sharing (the role of the buy-online-pick-up-in-store scheme).

Second, the importance of this research project is emphasized by the fact that it refers to one of the research priorities formulated by the Marketing Science Institute (MSI, 2022) for years 2022-2024 (released Oct, 2022). MSI is a platform used for generating and disseminating research that drives best practices in marketing with a mission of benefiting both business and society. Our project refers to the third priority set by MSI, i.e., 3. Long-term changes in how customers and firms interact, specifically, 3.1. Effects of changing patterns of living and working on customer demand. The effort seeks to answer the key question: How will remote work and technology-mediated consumption affect optimal channel structures? Based on that focus, this research project complies with the current trends of theoretical studies in marketing.

Third, as far as social impact of this project is concerned, price differentiation strategies are regarded as vehicles that will increase overall consumer welfare (Fassnacht, Unterhuber, 2016), as they allow for lower online prices, thereby extending product availability to a broader spectrum of consumers. Further, finding solutions to some of the problems involved when implementing discriminatory pricing across a wider range of categories may be welfare-

improving for the retail economy as a whole (Richards et al., 2016). As such, our project will contribute to improving the welfare of consumer, as well as the total retail economy.

2. Literature Review

The literature available on online and offline channels interactions at multichannel retailers have mainly focused on the effects of adding a new channel to an already existing other channel. The important conclusion to come from this research stream is that the new channel is not necessarily significantly cannibalizing or threatening the existing channel (Ratchford et al., 2022). According to Fassnacht and Unterhuber (2015), cross-channel price discrimination has been researched from three perspectives: (a) theoretical research asserting optimal retailer behavior, (b) observational research illustrating current retailers' practices, and (c) empirical research exploring consumer attitudes toward price discrimination practices, and their behaviors when faced with such practices.

The latest research on multichannel pricing strategies addresses the cross-channel effects of price promotions on purchase decisions for multi-channel grocery retailers (Breugelmans, Campo, 2016); the role of competition in geographic price discrimination (Li et al., 2018); price differentiation in relation to shipping options online (delivery from stock vs. drop-shipping) (Hammami, et al., 2022); or retailers' adoption of a self-matching strategy across a range of competitive scenarios (Kireyev et al., 2017).

Customers' perception of fairness in channel-based price differentiation still remains an important research topic. Bondos (2016) analyzed image consequences that might lead to unfavorable consumer purchasing behavior changes. The research concentrated on purchase intentions in personalized pricing (Hufnagel et al., 2022; Richards et al., 2016); or examined pay-what-you-want (PWYW) induced price discrimination between channels (Narwal, Nayak, 2020). Research has shown that consumers respond to a pricing practice that is perceived to be unfair with negative behavioral reactions (Haws, Bearden, 2006; Huang et al., 2005; Maxwell, Garbarino, 2010). Perceived unfairness diminishes purchase intentions, both offline and online (Campbell, 1999; Huang et al., 2005; Kahneman et al., 1986; Lii, Sy, 2009).

Surprisingly, part of the research also shows that in certain circumstances, the price discrimination might not necessarily evoke negative consumer perceptions, and that explaining the rationale for online vs. offline price difference (information on the costs difference between these channels), could have a positive impact on the perception of price fairness (Fassnacht, Unterhuber, 2016; Homburg et al., 2019). Indeed, consumers are more willing to purchase if the perceived inequity in pricing is in their favor, and less likely to purchase if it is not (Richards et al., 2016).

On the other hand, historically the research shows that the majority of retailers were setting their prices at parity between the channels, and if a price difference occurred, it was discounted online with diverse magnitude (Wolk, Ebling, 2010; Cavallo, 2017; Ancarani et al., 2009; Reinartz et al., 2017; Kannan, Li, 2017; Hitsch et al., 2021). The latest review of current retailers' practices in Poland (Kiczmachowska et al., 2023) confirmed these findings, however, for the retailers that were involved in price discrimination practices, the depth of discount appeared to be significantly higher than previously reported. Therefore, the need to understand consumers' reactions to deeper online discounts (up to 40%) appears to be clearly advisable.

In summary, the issue of whether to apply a price differentiation strategy or not remains unresolved for retailers who are offering multichannel experience (e.g. Kannan, Li, 2017), and requires further research to investigate the consumer perceptions in different consumer clusters and for different product groups.

In online purchase, the delivery scheme appears as the price building factor. Online order delivery is usually delayed (2-5 working days), and multi-channel retailers usually offer two delivery schemes, namely, additionally paid delivery by courier/ to a pick-up point or free delivery to one of the retailer's stores. The multi-channel pricing strategy may influence consumer purchase decision-making, leading to switching between the channels and the delivery options. Delivery scheme has been usually omitted in the research done so far. Namely, in the case of online shopping, the next day delivery at zero costs was claimed, the research scenarios assumed no additional charges, such as shipping or handling (Fassnacht, Unterhuber, 2016; Narwal, Nayak, 2020), or just the purchase intention offline was measured (Homburg et al., 2019). In our research, we made the scenarios as realistic as possible, including the delay in product delivery when purchased online, and options offered for the delivery scheme, i.e., by courier/delivery point with an additional fee, or pick-up at the retailer's store free of charge. As a result, the following hypothesis was proposed:

H1: In a situation of price discrimination between online and offline channels, the depth of the between-channel price discount impacts the consumer choice of purchase channel and the delivery scheme.

The circumstances in which consumers do their purchases might play an important role in their purchase decisions as well (Homburg et al., 2019). While some purchase conditions were tested, such as impulse vs. planned purchase (Homburg et al., 2019), the issue of purchase urgency has not been researched, yet. On the contrary, the researches usually assumed product need and online delivery for the next day (Fassnacht, Unterhuber, 2016; Narwal, Nayak, 2020). Combining this focus with the absolute price level of the product to be purchased, and the delivery scheme playing a price-building role in the transaction, the following hypotheses were set:

H2a: In a situation of price discrimination between online and offline channels, the relation between the between-channel depth of discount and the consumer channel and delivery scheme choice is moderated by the absolute price level.

H2b: In a situation of price discrimination between online and offline channels, the relation between the between-channel depth of discount and the consumer channel and delivery scheme choice is moderated by the urgency of purchase.

The research model is depicted in Figure 1.

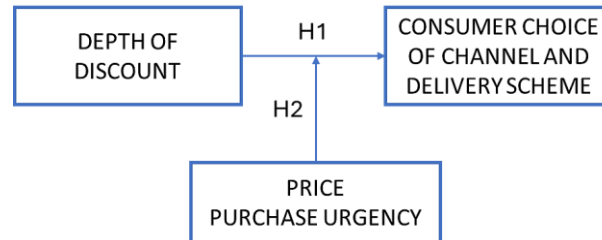


Figure 1. Research model.

Source: Authors' elaboration.

Of the product categories researched so far, we could find touch-and-feel items (apparel) (Malc et al., 2016; Fassnacht, Unterhuber, 2016; Richards et al., 2016; Narwal, Nayak, 2020), electronics (Homburg et al., 2019; Hufnagel et al., 2022), or furniture (Fassnacht, Unterhuber, 2016), where the purchase intention was 'for myself', or not specified. With the objective of expanding the product base researched in the context of cross-channel price discrimination (Neslin, 2022), we tested a product meant 'for others', and that has not been researched so far. The toys category was our choice, as this product category is almost exclusively purchased for kids or teenagers, so testing the adults would serve the purpose of purchasing 'for others'. Additionally, to increase the respondents' engagement in the purchase, it was described as a birthday gift for a close person. The toys category was also an easy category to manipulate the prices, so it was possible to test the different price levels for the same product category. Finally, this product category also overcame the gender, age, or urban inhabitancy barriers, since people of all characteristics, do make purchase decisions in the toy category.

Our study makes several contributions to the multi-channel retail management literature stream. First, it delves into the purchase intention area by not only answering the question of completing or resigning from the purchase, but also getting information on the intention to purchase online vs. offline and also the intention to use different online purchase delivery options. It assumes additional conditions of the online purchase, such as delivery waiting time, and additional delivery fees, issues that have not been researched thus far. Secondly, our study extends the scope of the currently available research into a product category that is infrequent, hedonic, and purchased 'for others'. Third, it makes an attempt to research other purchase conditions, thereby extending the online vs. offline price discount depth, and comparing different absolute price levels. Fourth, it employs purchase urgency as a possible moderating factor of price difference → purchase scheme choice relationship.

Our study offers significant practical contributions, such as outlining consumer purchase behaviors in a situation of cross-channel price discrimination. For retailers, it is important what portion of customers choose to drop the purchase because of price discrimination practices,

as this would result in losing the turnover. Equally, the choice of online vs. offline purchase has its revenue effects: purchase offline delivers the highest revenue (provided there is a price discount online). Consumer behavior modelling would also allow retailers to effectively manage their customers' flows, redirect them between the channels, and avoid transaction loss.

3. Methodology

3.1. Research method

To deliver research objectives, an experimental method was employed, using scenario approach. Experimental studies became the predominant form of data collection in management research (Czakon, 2016), as they are suitable for researching relations between pre-defined factors and they allow controlling for interferences. The between-subjects research design covered eight cells, with discount, price and purchase urgency being manipulated across the scenarios: 2 online vs. offline discount levels (-10%; -40%) x 2 price levels (70PLN; 300PLN) x 2 purchase urgency level (for tonight; in 2 weeks). Additionally, two reference cells were carried out (online vs. offline parity; 2 price levels; non urgent), getting to final number of ten cells. After being exposed to a given scenario, the respondents were to take the decision on their most probable purchase scheme choice (only one), provided they found themselves in such a situation. The available purchase schemes were as follows: [1] purchase offline; [2] purchase online delivered by courier / to a pick-up point (additional charge of 10.99PLN); [3] purchase online delivered to retailer's store of consumer choice (free of charge); [4] not purchase at all.

The data were analyzed using descriptive statistics, independent group comparisons (Kruskal-Wallis Test and Mann-Whitney U Test), correlation analysis, and finally, regression analysis, where moderating roles of price and purchase urgency were tested employing Hayes SPSS PROCESS macro (Hayes, 2012).

3.2. Sample

Online Panels have recently gained popularity in management research, and their use in experimental studies is prevalent (Porter, 2019). Our research employed Ariadna Panel, which allows to reflect a real social structure in terms of gender, age, and urban inhabitancy in Poland (Ariadna, 2024). The Panel consists of 300,000 respondents that are constantly verified, and full anonymity is guaranteed.

A total sample of 642 respondents were interviewed, who bought a product category at least once in the last 12 months. 557 respondents declared correctly the price difference (or parity), of which 4 turned out to be non-binary and, assessed as too small group for analysis, were deducted from the sample, leaving us with 553 valid responses. The groups did not

perform significant differences in terms of gender, age and urban inhabitancy, as well as Internet usage intensity (Table 1).

Table 1.
Demographics and Internet usage across scenarios

Kruskal-Wallis Test Summary	Gender	Age	Urban	Internet
Total N	553	553	553	553
Test Statistic	8.644 ^a	2.538 ^a	1.812 ^a	9.684 ^a
Degree Of Freedom	9	9	9	9
Asymptotic Sig.(2-sided test)	0.471	0.980	0.994	0.377
Decision on the null hypothesis ^b	Retain	Retain	Retain	Retain
a. The test statistic is adjusted for ties.				
b. The significance level is .050.				

Source: Authors' elaboration.

3.3. Research scenarios

The research employed scenario approach, where respondents were asked to imagine they intended to purchase a toy as a birthday gift for a close person. They were also asked to imagine they started with browsing the Internet for the best offer, found one at the retailer that also run offline stores, and then they went to the offline store to find out that the price offline was higher (or at parity) vs. online. Online purchase was available with 48-hours delivery scheme, with 2 options: [1] by courier or to the pick up point with 10.99 PLN fee, and [2] free of charge to the retailer's store. The discount online vs. offline, the absolute price level and purchase urgency were manipulated in line with Table 2.

Table 2.
Research scenarios: variables manipulation

#	Scenario	N	Discount online vs. offline	Absolute price (PLN)	Purchase urgency
1	LD-LP-U	58	10%	69.99	tonight
2	LD-LP-NU	50	10%	69.99	2 weeks
3	LD-HP-U	54	10%	299.99	tonight
4	LD-HP-NU	60	10%	299.99	2 weeks
5	HD-LP-U	50	40%	69.99	tonight
6	HD-LP-NU	59	40%	69.99	2 weeks
7	HD-HP-U	61	40%	299.99	tonight
8	HD-HP-NU	61	40%	299.99	2 weeks
9	PAR-LP-NU	47	0%	69.99	2 weeks
10	PAR-HP-NU	53	0%	299.99	2 weeks

L = low; H = high; D = discount; P = price; U = urgent; NU = non-urgent; PAR = parity.

Source: Authors' elaboration.

3.4. Variables

Nine variables (Table 3) were used to analyze the purchase scheme choice of customers in a situation of price differentiation between online and offline channels at the same retailer. Gender variable was operationalized as dichotomic variable taking values of 1 for female and 2 for male (non-binary respondents, as too small group, were removed from the analysis). Age variable was operationalized as age ranges from 18-24 years (coded 2), 25-34 years (coded 3), 35-44 years (coded 4), 45-54 (coded 5), and 55 or more (coded 6). Urban inhabitancy was operationalized as rural (coded 1), urban up to 20K inhabitants (coded 2), urban between 20K and 99K inhabitants (coded 3), urban between 100K and 500K inhabitants (coded 4), and urban above 500K inhabitants (coded 5). Internet usage was operationalized as daily usage of the Internet, declared by respondents by number of hours: 1h or less (coded 1), more than 1h up to 2h (coded 2), more than 2h up to 3h (coded 3), more than 3h up to 4h (coded 4), more than 4h up to 6h (coded 5), and more than 6h daily (coded 6). Three discount levels were tested, parity (coded 0), 10% discount online vs. offline (coded 1) and 40% discount (coded 2). Two price levels (70PLN and 300PLN) were coded 1 and 2 respectively, while purchase urgency was coded 0 as non-urgent (in 2 weeks), and 1 as urgent (for tonight). In terms of purchase scheme, 2 variables were introduced: purchase scheme and purchase yes/no. Purchase scheme was coded according to the retailer revenue, from the highest to the lowest: (1) offline (OFF), (2) online delivered by courier (ON-C), (3) online delivered to the store (ON-S), and (4) no purchase (NO). The purchase yes/no variable was created from the previous variable as a binary variable, where all three options of purchase (OFF, ON-C, ON-S) were grouped together to form purchase-yes (coded 1), while no purchase option was coded 0.

Table 3.
Variables

#	Variable	Coding
1	Gender	Female = 1; Male = 2
2	Age	18-24 = 2; 25-34 = 3; 35-44 = 4; 45-54 = 5; 55 or more = 6
3	Urban inhabitancy	rural = 1; city up to 20K = 2; 20K-99K = 3; 100K-500K = 4; more than 500K = 5
4	Internet Usage [IU]	IU ≤ 1h = 1; 1h < IU ≤ 2h = 2; 2h < IU ≤ 3h = 3; 3h < IU ≤ 4h = 4; 4h < IU ≤ 6h = 5; IU > 6h = 6
5	Discount online vs. offline	parity = 0; -10% = 1; -40% = 2
6	Price	70PLN = 1; 300PLN = 2
7	Purchase Urgency	non-urgent = 0; urgent = 1
8	Purchase scheme	purchase offline = 1; purchase online delivered by courier or to pickup point (additional charge) = 2; purchase online delivered to the store = 3; no purchase = 4
9	Purchase Yes/No	no purchase = 0; purchase (any scheme) = 1

Source: Authors' elaboration.

4. Results

4.1. Scenarios

The scenarios were assessed as being easy to understand ($M = 6.44$; $SD = 1.094$) and realistic ($M = 6.10$; $SD = 1.219$) (Table 4). Further, Kruskal-Wallis Test confirmed that there were no significant differences in distribution across the scenarios (easy to understand: $p = .429$; realistic: $p = .327$) (see Table 5).

Table 4.

Scenarios' assessment of being easy to understand and realistic

	N	Min	Max	Mean	Std. Dev.
Easy to understand	553	1	7	6.44	1.094
Realistic	553	1	7	6.10	1.219

Source: Authors' elaboration.

Table 5.

Easy to understand and realistic scenario assessment across the scenarios

Independent-Samples Kruskal-Wallis Test Summary		
Total N	553	553
Test Statistic	8.050 ^a	9.537 ^a
Degree Of Freedom	9	9
Asymptotic Sig.(2-sided test)	0.529	0.389
Decision on the Null hypothesis ^b	Retain	Retain
a. The test statistic is adjusted for ties.		
b. The significance level is .050.		

Source: Authors' elaboration.

4.2. Purchase decisions across the scenarios

The purchase decisions differed across the scenarios (Table 6). The highest intention to buy offline was expressed when the prices were equal across the channels (66% and 60,4%), second highest was the LP-LD-U scenario (50%), followed by LP-LD-NU scenario (34%) and LP-HD_U scenario (27,8%).

Table 6.

Purchase intention and delivery scheme choice across scenarios

Group/ Purchase	LD- LP-U	LD- LP-NU	LD- HP-U	LD-HP- NU	HD- LP-U	HD- LP-NU	HD- HP-U	HD-HP- NU	PAR- LP-NU	PAR- HP-NU	Total	
OFF	#	29	17	15	1	6	4	3	2	31	32	140
	%	50.0%	34.0%	27.8%	1.7%	12.0%	6.8%	4.9%	3.3%	66.0%	60.4%	25.3%
ON- C	#	15	14	19	26	23	25	39	34	10	10	215
	%	25.9%	28.0%	35.2%	43.3%	46.0%	42.4%	63.9%	55.7%	21.3%	18.9%	38.9%
ON- S	#	11	17	15	27	15	26	12	19	6	7	155
	%	19.0%	34.0%	27.8%	45.0%	30.0%	44.1%	19.7%	31.1%	12.8%	13.2%	28.0%
NO	#	3	2	5	6	6	4	7	6	0	4	43
	%	5.2%	4.0	9.30%	10.0%	12.0%	6.8%	11.5%	9.8%	0.0%	7.5%	7.8%
Total	#	58	50	54	60	50	59	61	61	47	53	553
	%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Authors' elaboration.

The remaining scenarios favored online purchases, either with or without additional delivery costs. The interesting point was that for urgent purchases, the percentage of online purchases (delivered after 48 hours) remained considerable, from 44,8% for LD-LP-U scenario, to 83,6% for HD-HP-U scenario! It means that if the price bargain was high enough, the consumers allowed delays in handing the birthday gifts to the close persons. It is a very valuable finding, as it implies that if the saving for the consumer was considered by him/her high, the price differentiation strategy led to redirecting the purchases from offline to online, even for the urgent purchases.

For the retailer, the most important factor would be to prevent from abandoning the transaction, namely to set the prices in a way that would not discourage the customers from actual purchase (either online or offline). To verify this, a dichotomic dummy variable was created, coded 0 = no purchase, and 1 = purchase, regardless the channel. The Kruskal-Wallis test performed for this variable across the scenarios revealed that none of the scenarios was significantly different (see Table 7), even pairwise comparisons did not show any significant differences. It means that regardless of the discount, price or purchase urgency, the consumers do not declare different purchase behavior as far as 'I will not purchase at all' behavior is concerned. It is a positive news for the retailers, as it induces that for this product category (hedonic/infrequent/for others), the threat to lose a transaction is quite low, even for HD-HP transactions.

Table 7.

Purchase schemes intention across the scenarios

Independent-Samples Kruskal-Wallis Test Summary	
Total N	553
Test Statistic	8.923 ^a
Degree Of Freedom	9
Asymptotic Sig.(2-sided test)	0.444
Decision on the Null hypothesis ^b	Retain
a. The test statistic is adjusted for ties.	
b. The significance level is .050.	

Source: Authors' elaboration.

4.3. Demographics

Analysis for demographic characteristics (gender, age, and urban inhabitancy) revealed significant, but not particularly strong relation of purchase behaviors to urban inhabitancy (.101; $p = .017$), but did not show any relations to either gender (.001; $p = .974$), or age (.006; $p = .893$). Also, it did not reveal any relation to the Internet usage (.009; $p = .829$) (Table 8).

Table 8.*Correlation analysis of purchase schemes and gender, age, urban inhabitancy, Internet usage*

Correlations		Gender	Age	Urban	Internet	
Spearman's rho	purchase	Correlation Coefficient	.001	.006	.101*	.009
		Sig. (2-tailed)	.974	.893	.017	.829
		N	553	553	553	553

Source: Authors' elaboration.

Significant differences in purchase behavior across urban inhabitancy were confirmed by Kruskal-Wallis Test (12.303; $p = .015$) (Table 9). Looking at Figure 2, it seems that respondents in each segment had their preferred purchase/delivery scheme. For rural and small city inhabitants this would be online order delivered by courier (46.1% and 44.4% respectively), who most probably want to use every opportunity to buy at the discount, but because of the distant location, the courier delivery seems to be the most convenient option. For medium and big city inhabitants, the structure of declared behaviors was pretty similar for both groups, with dominant online purchase (combined results for courier and store delivery were 67.6% and 69.1% respectively), but the highest share of online order picked up at the store (33.3% and 37.2% respectively). Online order picked up at the store is the cheapest option (online discount and no delivery charges incurred), and medium and big city inhabitants might assume it would be relatively easy for them to visit the store again, as the store would be most probably located in their city. On the contrary to other groups, the large city inhabitants declared the highest portion of 'no purchase' behavior (21.7% vs. 4.2%-7.4% results for other groups). This is a very interesting finding, as these customers, being the most affluent and having the broadest range of alternatives at hand, seem to be also the most moody and reactive when faced with inequality transaction.

Table 9.*Purchase schemes across urban inhabitancy*

Independent-Samples Kruskal-Wallis Test Summary	
Total N	553
Test Statistic	12.303 ^a
Degree Of Freedom	4
Asymptotic Sig.(2-sided test)	0.015
Decision on the Null hypothesis ^b	Reject
a. The test statistic is adjusted for ties.	
b. The significance level is .050.	

Source: Authors' elaboration.

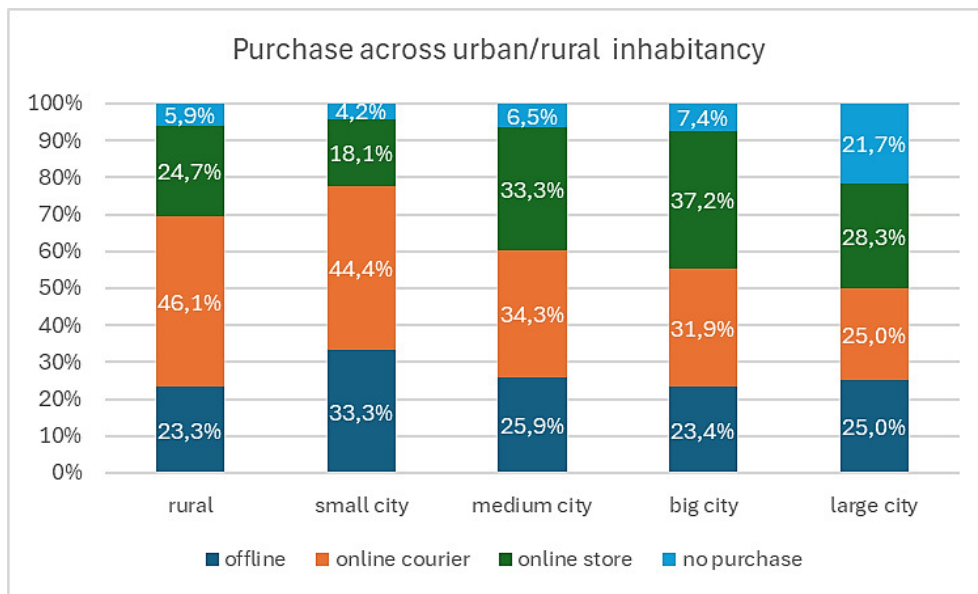


Figure 2. Purchase decisions across urban inhabitancy.

Source: Authors' elaboration.

4.4. Discount, price, and purchase urgency

Further, we looked at the variables of discount, price and purchase urgency. As visible in Table 10, both discount and price displayed positive and significant relations to purchase and delivery scheme choice: discount (.329; $p < .001$); price (.118; $p = .005$). In this context it means that the higher the discount and price, the more savvy or 'blow the transaction' behaviors were declared by the respondents. At the same time, the purchase urgency did not display any relation to purchase scheme choice (-.003; $p = .952$), showing that even for urgent purchases consumers do not feel obliged to do 'here and now' purchases, if they feel the price bargain would be enough to justify that.

Table 10.

Correlation between purchase schemes and discount, price, and purchase urgency

Spearman's rho		Purchase	Discount	Price	Urgency
purchase	Correlation Coefficient	1.000	.329**	.118**	-.003
	Sig. (2-tailed)	--	<.001	.005	.952
	N	553	553	553	553

** . Correlation is significant at the 0.01 level (2-tailed).

Source: Authors' elaboration.

Independent samples tests (Table 11) confirmed the correlation findings, revealing that the distribution of purchase scheme choice differed across discount (68.904; $p < .001$) and price (43111.5; $p = .005$), but did not significantly differ across purchase urgency (36689.5; $p = .952$).

Table 11.*Independent samples tests for discount, price and purchase urgency across purchase schemes*

Test Summary	K-W Test ^c	M-W U Test ^b	M-W U Test ^b
	discount	price	urgency
Total N	553	553	553
Test Statistic	68.904 ^a	43111.5	36689.5
Standard Error	--	1782.967	1751.063
Degree Of Freedom	2	--	--
Asymptotic Sig.(2-sided test)	<.001	0.005	0.9520
Decision on the null hypothesis ^d	Reject	Reject	Retain
<i>a. The test statistic is adjusted for ties.</i>			
<i>b. M-W U Test: Mann-Whitney U Test; c. K-W Test: Kruskal-Wallis Test.</i>			
<i>d. The significance level is .050.</i>			

Source: Authors' elaboration.

4.5. Regression analysis: moderating effects

Based on previous findings, different regression models using SPSS's PROCESS macro (Hayes, 2012) were tested, and interpreted (Clement, Bradley-Garcia, 2022; Lorah, 2020).

First, moderating role of price in discount → purchase scheme relation was tested (Table 12). The model turned out to be statistically significant ($p < .001$), with $R\text{-sq} = .1300$, meaning that it explained 13% of purchase scheme variability. The interaction term was statistically significant ($b = -.1972$, $se = .0947$, $p < .05$), indicating that the relationship between discount level and purchase scheme choice was conditional on the level of price. The slopes for discount and price were positive and significant (discount: $b = .4044$; $se = .0476$; $p < .001$; price: $b = .2174$; $se = .0715$, $p < .005$). The $R\text{-sq}$ improvement of price moderating role was calculated at $R\text{-sq chng} = .0065$. This confirmed H1, stating that the depth of between-channel price discount impacts the consumer choice of purchase channel and delivery scheme. Also, it confirmed H2a, stating that the relation between the between-channel depth of discount and the consumer channel and delivery scheme choice is moderated by the absolute price level.

Table 12.*Moderating role of price in the discount → purchase scheme relationship*

Model Summary						
R	R-sq	MSE	F (HC0)	df1	df2	p
.3605	0.1300	0.7108	32.5416	3.00	549.00	0.00
Model						
	coeff	se (HC0)	t	p	LLCI	ULCI
constant	2.1828	0.0357	61.0856	0.0000	2.1126	2.2530
discount	0.4044	0.0476	8.4970	0.0000	0.3109	0.4979
price	0.2174	0.0715	3.0403	0.0025	0.0769	0.3579
Int_1	-0.1972	0.0947	-2.0831	0.0377	-0.3831	-0.0112
Test(s) of highest order unconditional interaction(s):						
	R-sq-chng	F(HC0)	df1	df2	p	
discount*price	0.0065	4.3394	1.0000	549.0000	0.0377	

Source: Authors' elaboration.

Second, the moderating role of purchase urgency in discount \rightarrow purchase scheme choice relation was tested (Table 13). The model turned out to be statistically significant ($p < .001$), with $R\text{-sq} = .1181$, meaning that it explained 11.81% of purchase scheme choice variability. However, the interaction term was not statistically significant ($b = -.0310$, $se = .1297$, $p = .8109$), indicating that the relationship between discount level and purchase scheme choice was not conditional on the level of purchase urgency.

Table 13.

Moderating role of purchase urgency in the discount \rightarrow purchase scheme relation

Model Summary						
R	R-sq	MSE	F (HC0)	df1	df2	p
.3436	0.1181	0.7206	26.4703	3.00	549.00	0.0000
Model						
	coeff	se (HC0)	t	p	LLCI	ULCI
constant	2.1859	0.0392	55.7254	0.0000	2.1089	2.2630
discount	0.4328	0.0575	7.5260	0.0000	0.3198	0.5457
urgency	-0.1770	0.0841	-2.1055	0.0357	-0.3421	-0.0119
Int_1	-0.0310	0.1297	-0.2394	0.8109	-0.2857	0.2237
Test(s) of highest order unconditional interaction(s):						
	R-sq-chng	F(HC0)	df1	df2	p	
discount*urgency	0.0001	0.0573	1.0000	549.0000	0.8109	

Source: Authors' elaboration.

The slopes for discount and purchase urgency were significant, positive for discount ($b = .4328$; $se = .0575$; $p < .001$), and negative for purchase urgency ($b = .1770$; $se = .0841$, $p < .05$). As such, this did not confirm the H2b, stating that the relation between the between-channel depth of discount and the consumer channel and delivery scheme choice was moderated by the urgency of purchase.

Third, moderating roles of price and purchase urgency in discount \rightarrow purchase scheme choice relation were tested (Table 14). The model turned out to be statistically significant ($p < .001$), with $R\text{-sq} = .1385$, meaning that it explained 13.85% of purchase scheme variability. The interaction term for price was statistically significant ($b = -.1903$; $se = .0949$; $p < .05$), indicating that the relationship between discount level and purchase scheme choice was conditional on the level of price. The interaction term for urgency was not statistically significant ($b = -.0459$; $se = .1289$; $p = .7220$), indicating that the relationship between discount level and purchase scheme choice was not conditional on the level of purchase urgency. The slopes for discount, price and purchase urgency were significant, positive for discount and price (discount: $b = .4291$; $se = .0573$; $p < .001$; price: $b = .2165$; $se = .0827$; $p < .005$), and negative for purchase urgency ($b = -.1672$; $se = .0827$; $p < .05$). The R-sq improvement of price moderating role was calculated at $R\text{-sq chng} = .0060$.

Table 14.*Moderating role of price and purchase urgency in discount → purchase scheme relationship*

Model Summary						
R	R-sq	MSE	F (HC0)	df1	df2	p
.3721	0.1385	0.7065	21.1783	5.00	574.00	0.0000
Model						
	coeff	se (HC0)	t	p	LLCI	ULCI
constant	2.1877	0.0386	56.6175	0.0000	2.1118	2.2635
discount	0.4291	0.0573	7.4935	0.0000	0.3166	0.5416
price	0.2165	0.0712	3.0405	0.0025	0.0766	0.3563
Int_1	-0.1903	0.0949	-2.0056	0.0454	-0.3767	-0.0039
urgency	-0.1672	0.0827	-2.0218	0.0437	-0.3296	-0.0048
Int_2	-0.0459	0.1289	-0.3559	0.7220	-0.2990	0.2073
Test(s) of highest order unconditional interaction(s):						
	R-sq-chng	F(HC0)	df1	df2	p	
discount*price	0.0060	4.0224	1.0000	547.0000	0.0454	
discount*urgency	0.0002	0.1267	1.0000	547.0000	0.7220	
BOTH	0.0063	2.1869	2.0000	547.0000	0.1132	

Source: Authors' elaboration.

Finally, the most complex model was calculated, that included discount as focal predict, price and purchase urgency as moderators, and urban inhabitancy as covariate (see Table 15). The model turned out to be statistically significant ($p < .001$), with $R\text{-sq} = .1572$, meaning that it explained nearly 16% of purchase scheme choice variability. The interaction term for price was statistically significant ($b = -.1916$; $se = .0941$; $p < .05$), indicating that the relationship between discount level and purchase scheme choice was conditional on the level of price. The interaction term for urgency was not statistically significant ($b = -.0442$; $se = .1281$; $p = .7304$), indicating that the relationship between discount level and purchase scheme choice was not conditional on the level of purchase urgency. The slopes for discount, price and purchase urgency were significant, positive for discount and price (discount: $b = .4386$; $se = .0568$; $p < .001$; price: $b = .2166$; $se = .0705$; $p < .005$), and negative for purchase urgency ($b = -.1717$; $se = .0819$; $p < .05$). The slope for urban inhabitancy as covariate was positive and significant ($b = .0866$; $se = .0264$; $p = .0011$). The $R\text{-sq}$ improvement of price moderating role was calculated at $R\text{-sq chng} = .0061$. This model turned out to have the highest predictive power in comparison to other models.

Table 15.

Model for discount → purchase scheme relationship, incl. price, purchase urgency, and urban inhabitancy

Model Summary						
R	R-sq	MSE	F (HC0)	df1	df2	p
0.3965	0.1572	0.6924	20.3782	6.00	546.00	0.00
Model						
	coeff	se (HC0)	t	p	LLCI	ULCI
constant	1.9741	0.0704	28.0286	0.0000	1.8357	2.1124
discount	0.4386	0.0568	7.7283	0.0000	0.3271	0.5501
price	0.2166	0.0705	3.0716	0.0022	0.0781	0.3550
Int_1	-0.1916	0.0941	-2.0360	0.0422	-0.3765	-0.0067
urgency	-0.1717	0.0819	-2.0970	0.0365	-0.3325	-0.0109
Int_2	-0.0442	0.1281	-0.3448	0.7304	-0.2958	0.2075
urban	0.0866	0.0264	3.2802	0.0011	0.0347	0.1384
Test(s) of highest order unconditional interaction(s):						
	R-sq-chng	F(HC0)	df1	df2	p	
discount*price	0.0061	4.1454	1.0000	546.0000	0.0422	
discount*urgency	0.0002	0.1189	1.0000	546.0000	0.7304	
BOTH	0.0063	2.2460	2.0000	546.0000	0.1068	

Source: Authors' elaboration.

A summary of the hypotheses verifications is covered in Table 16. Hypothesis H1, stating that the depth of discount impacts consumer choice of purchase channel and delivery scheme, as well as Hypothesis H2a, stating that this relationship is moderated by the absolute price level, were both confirmed. However, Hypothesis H2b, stating that this relationship was moderated by purchase urgency, was not confirmed.

Table 16.

Hypotheses verification summary

Hypothesis	Result	
H1	the depth of between-channel price discount impacts the consumer choice of purchase channel and delivery scheme	confirmed
H2a	the relation between the between-channel depth of discount and the consumer channel and delivery scheme choice is moderated by the absolute price level	confirmed
H2b	the relation between the between-channel depth of discount and the consumer channel and delivery scheme choice is moderated by urgency of purchase	not confirmed

Source: Authors' elaboration.

5. Discussion

Our research carries important implications for theory, as well as for practice. Along with the multichannel management framework (Neslin et al., 2006), we shed light on the consumer purchase scheme choice in the situation of price differentiation between the online and offline channels at the same retailer. First, we addressed the delivery scheme choice, which has been omitted so far (Fassnacht, Unterhuber, 2016; Richards et al., 2016). Second, we used the product category that has not been researched so far (hedonic/infrequent, for others) (Fassnacht,

Unterhuber, 2016; Richards et al., 2016; Narwal, Nayak, 2020). Third, we extended the online vs. offline price discount span, applying a 10% and 40% price difference vs. 2%-3%-5%-10%-15% discounts that have been researched up to this date (Fassnacht, Unterhuber, 2016; Richards et al., 2016; Narwal, Nayak, 2020). Fourth, we employed purchase urgency as a possible moderating factor of the price difference → purchase scheme choice, in contrast to impulse/non-impulse purchase typology that had been tested in the past (Narwal, Nayak, 2020).

Obviously, the highest intention to buy offline was exhibited for price parity scenarios, followed by the low price and low discount scenarios. The more substantial was getting the price bargain, the more online purchases were favored, even for the urgent purchase scenarios (despite the 48-hour delivery scheme, causing late handing of the birthday gift to the close person). This finding implies that high price difference strategy largely redirects purchases from offline to online, even in a situation when the consumer is already present at the store, and a birthday party is carried out on the same day.

The demographic variables of gender and age did not appear to have a statistically significant relationship to purchase scheme choice. On the contrary, urban inhabitancy turned out to be related to purchase scheme choice in such a way that large city inhabitants declared higher intention to abandon the transaction, while rural and small city inhabitants favored online purchases delivered by courier. In terms of behavioral characteristics, Internet usage patterns surprisingly did not appear to have a significant relationship to purchase scheme choice. That means that the high intensity Internet users did not favor online purchases more than did low intensity Internet users, which was our expectation.

The regression modelling with moderating effects turned out to deliver the best predictive power in the configuration where depth of discount impacted purchase scheme choice, along with price level and purchase urgency; however, only price proved to have any significant moderating effect on the main relationship. Additionally, urban inhabitancy tested as a significant covariate to the discount → purchase scheme choice relationship.

As for practical implications, from the perspective of the retailer's revenue, it is important if consumers buy offline (higher price), online (lower price), or don't buy at all (no revenue). In view of the results achieved, it seems that low online price (high discount online vs. offline), apart from increasing retailer's price competitiveness vs. other online retailers, leads to massive purchase redirection from offline to online, even for urgent purchases. Once the price difference online vs. offline exceeds the delivery costs (a net benefit for consumers), then the intention to purchase offline falls dramatically, mostly to low single digit percentages. Therefore, for a multichannel retailer, the implementation of such a strategy would be positive in terms of competitive advantage and gaining customers, but detrimental to the revenue (having a vast majority of the stock sold at the high discount price). On the other hand, this strategy does not seem to be harmful in terms of losing purchases – the 'not purchase at all' option does not appear to be at all related to any of the price – discount – purchase urgency combination. This finding means that, in a situation with information transparency (consumers are aware of

the price difference prior to the purchase), the consumers are rather more willing to utilize the bargain and purchase online, than to blow a deal and abandon the transaction completely.

However, there is one group of customers who are significantly more eager to blow a deal, regardless of the scenario. Large city (>500K inhabitants) customers declared almost a 22% rejection rate in the case of price differentiation compared to the low single digit results for other urban or rural inhabitants. This affluent group of customers seem to be more upset with the price differentiation strategy than other groups are by declaring they would step away from the table when faced with the price difference. The reasons for such behavior might be twofold. One would be that they have considerably more alternatives to follow, compared to those found in smaller cities and rural areas, so they are confident they can just switch to something else easily, just to teach the lesson to the retailer. Another possible explanation would be that they are upset with the retailer wasting their time. In these scenarios, the respondents were supposed to imagine traveling to the offline store and there realizing the price was higher vs. online. In a large city such a trip would be probably more time consuming vs. in smaller cities (but not vs. rural areas), and big city inhabitants are presumed to be more rushed around always and thus more time conscious. Whatever the explanation, the retailers should pay attention to their client base structure, as given the high share of large city urban customers, a high difference price strategy could be more detrimental to the revenue of retailers.

6. Summary

To our knowledge, this research is the first to study the purchase intention in conditions of cross-channel price differentiation that splits the purchase schemes into: [1] offline, [2] online delivered by courier or to pick-up point (with additional fee), [3] online delivered to the retailer's store of consumer choice (free of charge), and [4] refusal to purchase. As such, this research indicates the consequences of cross-channel price differentiation strategy for multichannel retailers that are offering online and offline purchase options and makes an important contribution to the theory of multi-channel retail management and the practice of cross-channel price setting. The findings assert that both discount and price level are significant determinants of purchase scheme choice by consumers. Additionally, price level appears to be a moderating factor for the discount → purchase scheme relationship. Urban inhabitancy also appears to have a significant impact on purchase scheme choice, while gender, age, and Internet usage are not significant determinants of the final purchase scheme choice.

This research does have several limitations. First, it focused on just one product category, namely, infrequent/hedonic/'for others', so more focus on frequent purchase product categories, such as foods or cosmetics, should be recommended for future research. Also, to cover a broader range of product categories, the purchase of 'for myself' products could be an interesting future

research avenue. Second, three levels of discount were involved in this research: parity (0%), low (10%) and high (40%). However, more detailed analysis similar to price elasticity could be recommended for future research. Third, this research assumed that the information about price difference between the channels was available to the consumer before the purchase decision was made. Therefore, alternative purchase paths should be taken into consideration to research lower transparency of cross-channel price discrimination at the moment of purchase. Finally, two price levels were tested (70PLN and 300PLN), so lower price levels comparisons should be recommended for future research, especially important for frequent purchase products.

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SIMULATION MODELING IN THE STUDY OF MANUFACTURING ENTERPRISES' VULNERABILITY TO DISRUPTION

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Purpose: In recent years, manufacturing companies have been confronted with an increased incidence of disruptions affecting production processes. Finding approaches to effectively resist the occurrence of disruptions is crucial for enterprises. The development of Industry 4.0 technology enables the use of innovative tools to prepare for the unpredictable situations and ensure business continuity.

Design/methodology/approach: The aim of the manuscript is to investigate the possibility of using simulation modeling to study the vulnerability of production processes to disruptions. The research was limited to the study of internal disruptions occurring in a manufacturing enterprise. The manufacturing process performed at a mechanical engineering company was studied. A case study was conducted to investigate the process vulnerability to selected internal disruptions identified at the company. The research was performed in Tecnomatix Plant Simulation software. Three simulation experiments were performed for disruptions such as machine failure, decrease in employee efficiency, and delivery delay of materials.

Findings: The conducted research proved that simulation modeling can be applied to assess the vulnerability of the production process to selected disruptions. The benefits of the presented approach were indicated, especially in supporting the decision-making process.

Research limitations/implications: The research was conducted for selected internal disruptions. The focus of future studies was established by identifying and classifying disruptions suitable for simulation modeling, as well as outlining the application scope of simulation tools.

Practical implications: Simulation modeling can be applied by manufacturing enterprises to investigate the vulnerability of implemented processes to disruption. The case study was conducted in the mechanical industry. However, the presented approach can be applied to companies in various industries. A potential barrier is the lack of familiarity with simulation modeling tools. Nevertheless, the advantages of analyzing different event scenarios are substantial enough to justify overcoming this challenge.

Originality/value: The literature review found a deficiency of research on process vulnerability using simulation modeling. The research conducted indicates validation and application of the studied approach to manufacturing companies. A significant benefit is conducting analyses without interrupting the actual process, which is especially crucial for manufacturing operations.

Keywords: vulnerability, disruption, simulation modeling, production companies.

Category of the paper: research paper.

1. Introduction

Disruptions in production processes exist from the beginning of the realization of processes aimed at producing various types of products and services. Depending on the size of the disruption and the strength of its influence, the impact on the implementation of individual activities can be minimal, through partial disruption of their course up to even stopping the ongoing production process.

The effect of disruptions on the execution of the production process is particularly strong when crisis situations occur, such as the eruption of the Eyjafjallajökull volcano in Iceland in April 2010 (Harrison, Williams, 2016), which paralyzed the flow of goods through supply chains for several weeks, the blockade of the Suez Canal by the container ship Ever Given in March 2021, which caused delays in shipping products to customers around the world (Popkien, 2021) or the COVID-19 pandemic, which resulted in a massive damage and destruction to global supply chain operations (Sajjad, 2021). The described events have significantly affected manufacturing companies, limiting their operations in the short or longer periods. Most of them are classified as external disruptions, which are difficult for companies to predict and manage. In addition to external disruptions, companies also experience internal disruptions, which are closely related to the operations performed inside the organization and the resources it possesses. Some of the most common disruptions include: machine breakdown, reduced employee efficiency, lack of materials at the workstation, etc.

Disturbances, characterized by a high impact, are capable of interrupting the operation of the production process. Prof. Lis stresses that disruptions cause the course of production processes to deviate from initially accepted assumptions and plans, leading to a reduction in production efficiency and losses for the enterprise (Lis, 1982). Despite the significant negative consequences, many manufacturing enterprises do not focus appropriate attention on possible risks. Such an approach can expose companies to large losses, both financially (penalties resulting from orders not completed on time, reduced incomes resulting from fewer products sold), but also in terms of image (reduced value of the company in the perception of customers). Many enterprises are oblivious to the possible consequences. The companies also show an aversion to taking preventive activities, as they require ensuring an appropriate level of time and resource reserves for the processes in execution. Determining the size of these reserves is often based on the knowledge and experience of employees. Technologies used as part of Industry 4.0 (such as Internet of Things, Big Data, Machine Learning, etc.) can be extremely helpful for companies, however these solutions can most often be afforded by large companies with high investment capital. Most enterprises in Poland consider the mentioned solutions too expensive. When they successfully implement the proposed technologies, it is usually done in a selective and unsystematic manner in response to prevalent opportunities, such as funding from implementation projects. Identifying a tool that allows for straightforward research into

the vulnerability of a process to disruptions is crucial for companies wishing to achieve resilience. A highly effective solution for this challenge is simulation modeling, originally utilized by experts to delve into specific topics across various disciplines. As the 1980s approached, modeling evolved to address unique engineering and design issues. By the early 21st century, its application expanded significantly, leading to the design of simulation-based systems. As of 2015, simulation has become a fundamental component of digital twins, revolutionizing how businesses manage and optimize their processes (Rosen et al., 2015).

The purpose of the presented manuscript is to present the possibility of using simulation modeling to study the vulnerability of manufacturing enterprises to disruption. Section 2 presents the results of literature research conducted in the area of susceptibility, disruptions occurring in manufacturing enterprises and the scope of application of simulation modeling. The research method is described in Section 3. Section 4 features a case study demonstrating the application of simulation modeling to investigate vulnerability in a chosen manufacturing process at a mechanical engineering company. The discussion of the obtained research results is presented in Section 5. Section 6 summarizes the manuscript and outlines potential future research directions.

2. Literature review

Process modeling involves creating a representation of a specific process implemented in the company. In engineering disciplines, mathematical models are often used to represent the real-world phenomena. They provide a simplified representation of the studied phenomenon, system or process using variables, parameters and constraints (or conditions imposed on the variables), or functions. The developed mathematical models can be inserted into dedicated computer software, which approximates the behavior of the analyzed phenomena. Constructed models do not perform successfully in supporting sophisticated processes. As a result, mathematical models are often represented in computer software, using simulation modeling (Smagowicz, Szwed, 2022). Prof. Beaverstock emphasizes that simulation modeling enables a manufacturing process to be constructed in a proper environment to reflect both the machine setup, the number of workers and the duration of each operation. (Beaverstock et al., 2017). Simulation modeling is a set of procedures used to represent the improvements implemented in a real system. The solution details enable a virtual representation of the production process, and concurrently, verify the system's behavior under different scenarios. This enables the results of specific modifications to be predicted, processes to be optimized, and costs to be minimized. (Bangsow, 2016). Simulation models, created with the help of IT tools, accurately reflect the real systems in a computer environment. Simulation allows providing information about, for example, the physical constraints present in the process under study (Rostek, Wiśniewski,

2020). It is important to note that simulation models are often applied to projects where obtaining a solution through traditional analytical methods or direct experimentation is impossible. Simulation modeling also plays a crucial role in ensuring the continuity of production processes. It allows to visualize and analyze the production process without disrupting its stability. For instance, it enables to conduct research without the necessity of stopping the production or reduce labor productivity, making simulation modeling a valuable tool for conducting research.

Most of the production processes implemented are affected by major or minor changes. The changes resulting from intentional efforts can be resolved as part of the organization's continuous improvement. While the changes resulting from non-intentional performance must be adequately prepared for by the enterprise. The disruption in production area is defined as a change in the properties of the objects of the production system or its inputs, not resulting from an intentional behavior, causing undesirable deviations of the flow of the processes of this system from the planned course (Lis, 1982). A related definition is provided by N. Sticker and G. Lanza, who define production disruptions as undesirable, unpredictable and unplanned occurrences that lead to significant deviations between the realized and planned flow of the process (Sticker, Lanza, 2014). A. Ingemannson and G.S. Rolmsjo highlight that disruptions are destabilizing factors in the production process, causing poor performance of the production system (Ingemannson, Rolmsjo, 2004). The research team led by Y. Kim draws attention not only to some differences in the process flow, but even the possibility of a significant obstruction or interruption (Kim, Chen, Linderman, 2015).

Depending on the type of disruption, the enterprise is obliged to take different actions. The main classification of disruptions is the distinction between external disruptions - related to factors located in the system's environment - and internal disruptions - related to factors occurring inside the enterprise (Wirkus, Maciagowski, 2011). Regarding the source of disturbances, we can identify: (1) upstream disruptions (problems with material and semifinished goods shipment, quality, delays), (2) internal disruptions (problems in the flow of information and operation of the control system, operator errors, machine and equipment failures), and (3) downstream disruptions (sudden orders, changes in orders, seasonality of orders) (Matson, McFarlane, 1998). The MASCADA organization emphasizes the nature of disruptions that occurred: (1) abrupt and gradual disruptions, (2) random and systematic disruptions, and (3) time, quality, and cost disruptions (MASCADA, 1997). On the other hand (Kalinowski, Knosala, 2003), classified disruptions in terms of the resulting effects from their occurrence: (1) operation disruptions - preventing the execution of a given operation, but not excluding the possibility of carrying out other operations assigned to a given stand, (2) machine disruptions - eliminating the entire production stand from operation (e.g., due to machine failures), (3) process disruptions - causing immediate or gradual shutdown of the entire process (e.g., in situations of detection of a technological process defect).

Vulnerability is a concept that is particularly commonly referred to in risk management. It refers to the exposure level of a given system, its sensitivity to threats, and its capacity to adapt (Adger, 2006). The literature emphasizes that vulnerability is the probability degree at which a system, subsystem, or component is exposed to harm from both external and internal hazards (Turner et al., 2003). This approach is essential for production systems, where disruptions are classified as external and internal factors affecting the system. Vulnerability is characterized by four main components: exposure (the range of risks to the system), susceptibility (the predisposition of risk elements to hazards), lack of resilience, and hazards to determine the risk of unexpected events (Birkmann et al., 2013). How is it possible to measure a system's vulnerability to undesirable incidents or disruptions? Most significantly, the assessment should be based on the primary factors constraining a given system's ability to respond to hazards, rather than on their adverse effects (Costa, Kropp, 2013). The measurement of vulnerability should focus on more than just identifying the number of elements prone to disruption due to their exposure or lack of sufficient adaptive capacity (Willroth, Massmann, Wehrhahn, Revilla Diez, 2012). It is important to conduct research to measure the ability of different elements to adapt to the changed circumstances or to redistribute risks in the environment (Adger, 2006).

As part of the literature research, the Scopus database was analyzed in search of publications addressing the study of manufacturing companies' vulnerability to disruption using simulation modeling. The concept of vulnerability is strictly related to the fields of risk management (Liu et al., 2012) or cybersecurity (Awotunde et al., 2023; Conti, Donadel, Turrin, 2021). A significant number of studies also emerge on critical infrastructure management (Ani, He, Tiwari, 2017; Chaudhry, Yousaf, Khan, 2020). However, the vast majority of them address the vulnerability to external factors of the organization, especially disruptions causing natural disasters like floods, fires or earthquakes (Ouma, Tateishi, 2014; Shao et al., 2015). Publications frequently present research in the form of case studies, suggesting that the topic remains new and underexplored. In recent years, a notable increase in publications on supply chain management was noticed (Hassija et al., 2021; Das et al., 2022; Vafadarnikjoo et al., 2022). However, these studies tend to focus more on external factors influencing companies rather than on internal hazards. The research did not identify any publications directly addressing the vulnerability of manufacturing enterprises to disruptions through simulation modeling. In recent years, studies of the resilience of manufacturing enterprises to disruptions have been occurring, and the possibility of applying the simulation method is indicated in some papers. However, these studies are described in general terms and often do not refer to identifying specific disruptions or implementing procedures.

Accordingly, the paper's aim of using simulation modeling to study the vulnerability of manufacturing companies to disruptions was considered a new topic and recommended for extensive studies.

3. Research method

The literature survey conducted indicated a lack of studies on the use of simulation modeling in investigating the vulnerability of manufacturing enterprises. However, experience indicates that such an effort can be successfully undertaken for implemented production processes. A case study research method was chosen for this study due to several key characteristics. This approach allows for the analysis of the phenomenon within its natural context, focuses on a contemporary issue, provides an in-depth examination of the complexities involved, and aims to explore the subject thoroughly (Benbast, Goldstein, Mead, 1987). Case studies exert a significant influence on the development of management theory (Eisenhardt, 1989). By leading to the observation and research of the phenomenon relevant to science, case studies enable to conduct a reliable description of its performance, that is, to investigate the real environment (Czakov, Glinka, 2012; Jarvensivu, Tornroos, 2010). The case study methodology is strictly established and homogeneous (Goffin, Ahlstrom, Bianchi, 2019). Although the case study method is well described in the literature, the approach to case study design still differs and is adapted to the individual line of research (Beverland, Lindgreen, 2010). The standard research procedure using the case study method is shown in Figure 1.

In the presented study an exploratory case study was conducted. It focuses on the exploration of the little-known and barely recognized phenomena, which are still in the early stages of recognition (Ellram, 1996).

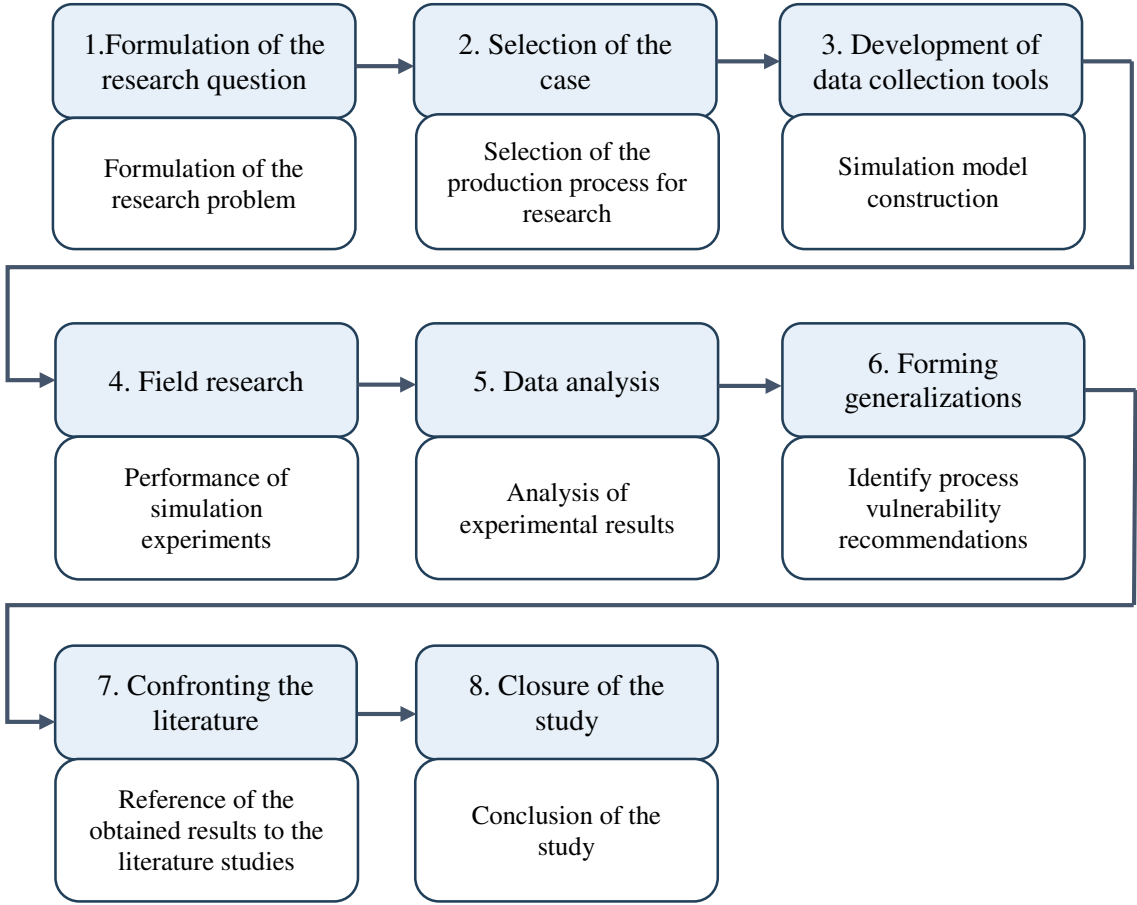


Figure 1. Applied research method.

Source: Czakon, 2006.

The implementation of the first five steps of the research methodology (formulation of research problem, selection of the production process, simulation model construction, performance of simulation experiments and analysis of experimental results) is presented in Section 4. The formulation of recommendations on the vulnerability of the process to disruption, reference of the obtained results to literature studies and conclusion of the study are presented in the discussion in Section 5.

4. Results

The subject under study was the production process conducted in the selected manufacturing company in the mechanical industry. The study was carried out in the form of a case study in according to the research methodology described in Section 3.

Formulation of the research problem

The research problem defined in the conducted study concerned the possibility of investigating the vulnerability of manufacturing enterprises using simulation modeling. According to the literature research performed, such a study has been conducted in a limited manner. Based on the experience of improving manufacturing processes with simulation modeling, it was decided to examine the applicability of simulation modeling tools in a different area.

Vulnerability refers to the susceptibility of a system to disruptions. In manufacturing enterprises, a distinction is made between external disruptions (caused by factors outside the organization) and internal disruptions (caused by factors originating within the organization). The research focuses on the study of selected internal disruptions of a manufacturing enterprise.

The selection was determined by factors that can be analyzed using simulation modeling software.

Selection of the production process for research

One of the core manufacturing processes implemented in the manufacturing enterprise under study was selected. The selection was performed on the basis of the criteria shown in Table 1.

Table 1.

Criteria for enterprise selection for case study research

Criteria	Characteristics
Business process type	Production process.
The implementation period of the process in the company	Process implemented at the company for at least 2 years; it is important to include a stabilized process in the study, after the first improvements have been made.
Cycle time	Short cycle time, less than 1 day, to ensure short simulation time.
Type of operations performed	Operations performed automatically and manually to maximize the number of disruptions possible for research.
Data availability	Ability to collect detailed process data (including measurements).

Source: own study.

The process is composed of thirteen workstations - five workstations require manual operation by an employee, the remaining eight are operated in automatic mode - and one belt feeder. The characteristics for the individual workstations are shown in Table 2.

Table 2.
Characteristics of the implemented process

Workstation	M1	M2	M3	M4	M5	M6	M7
Operation time [s]	180	78	97	121	80	72	117
Availability [%]	98	97	96	99	98	94	96
Operating mode	manual	automatic	automatic	automatic	automatic	manual	automatic
Workstation	M8	M9	M10	M11	M12	M13	C
Operation time [s]	84	63	78	109	190	40	9
Availability [%]	95	93	99	97	96	98	99
Operating mode	automatic	automatic	automatic	manual	manual	manual	automatic

Source: own study.

At three workstations (M3, M6, M8), operations are carried out simultaneously on several semi-products at the same time. The enterprise operates in two-shift mode, with every work shift lasting 8 hours with two breaks of 15 minutes. In the production area, the company employs five workers, who are mostly assigned to operations on a particular machine.

Simulation model construction

The simulation model was built in Tecnomatix Plant Simulation (ver. 15.0.4) software. The model is composed of nearly 30 objects, derived from libraries such as Material Flow, Resources, Tools and User Interface. The used objects represent the operations performed on each workstation. The built digital model was validated, and the obtained results confirmed the correctness of its construction. The simulation was carried out for five working days and the result was 1171 manufactured products. The visualization of the production process in simulation model is shown in Figure 2.

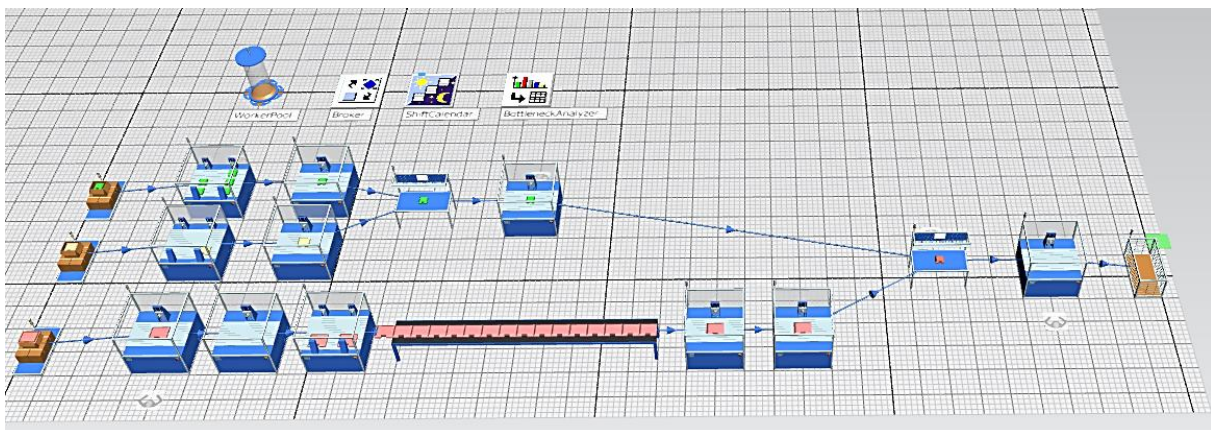


Figure 2. Visualization of the simulation model constructed.

Source: own study.

Performance of simulation experiments and analysis of results

The successful performance of simulation experiments is based on the definition of the assumptions and the purpose of the performed operations. The purpose of the conducted experiments is to investigate the vulnerability of the production process to selected disturbances. Making a selection of factors that are particularly relevant to the disruption of the process, and possibly to be mapped in the built digital model, is essential for the presented research. Table 3 presents the main assumptions of factors selected.

Table 3.

Assumptions for the selection of disruptions to be investigated

Assumptions	Detailed characteristics
Selection of the disruption classification	Classification of disruptions into external and internal. Considering the purpose of the research conducted, the study focused on the investigation of internal disturbances, which include: <ul style="list-style-type: none"> — in the area of equipment (machines/equipment failure, inappropriate maintenance of machines/equipment, inappropriate exploitation of machines/equipment, lack of appropriate equipment), — in the area of labor (high worker absence, decreased worker efficiency, unskilled workers, operators' errors, disorganization of work), — in the area of material resources (lack of materials, incorrect quality of materials, delayed deliveries, disruptions in material flow), — in the area of information resources (data loss, information system failure, cyberattacks, failure in the ICT system, incorrect internal communications), — in the area of energy resources (power outages, reduction of electricity supply, voltage fluctuations), — in the area of financial resources (disrupted cash flow, delays in repayment of debts, sudden changes in exchange rates).
Selection of factors that might be represented in a digital model	Disturbances possible to study within the simulation model constructed: <ul style="list-style-type: none"> — machines/equipment failure, inappropriate maintenance of machines/equipment, lack of appropriate equipment, — high worker absence, decreased worker efficiency, operators' errors, disorganization of work, — lack of materials, incorrect quality of materials, delayed deliveries, disruptions in material flow, — information system failure, incorrect internal communications, — power outages, reduction of electricity supply.
Selection of three disruptions from different areas, especially relevant to the process	<ol style="list-style-type: none"> 1. Equipment area – machines/equipment failure. 2. Labor area – decreased worker efficiency. 3. Material resource area – delayed deliveries.

Source: own study.

Literature research indicates that the original sources of disruptions should be investigated in the unreliability of the primary factors of production, such as labor resources, work objects and employees. Based on the assumptions presented, it was decided to conduct a study for three selected disruptions (machine/equipment failure, decreased worker efficiency, delayed delivery). Simulation experiments were performed in a structured manner, according to the adopted procedure. Each experiment was characterized by features such as: (1) the purpose of the experiment, (2) the determination of the explanatory variables, (3) the determination of the values the explanatory variable adopts, (4) the determination of the response variable, and (5) the tools used to conduct the study. Detailed information about each of the experiments conducted is provided in Table 4.

Table 4.
Assumptions of the conducted experiments

Assumptions	Experiment 1	Experiment 2	Experiment 3
Purpose of the experiment	Verification of the impact of the machine failure on the process	Verification of the impact of employee efficiency on the process	Verification of the impact of delivery delay on the process flow
Determination of the explanatory variables	Availability of the M12 machine (process bottleneck)	Employee efficiency	Time of the delivery of materials to the M1 workstation
Determination of the values the explanatory variable adopts	Range 78-96 [%] (3 [%] increment)	Range 80-95 [%] (3 [%] increment)	Range 170-410 [s] (40 [s] increment)
Determination of the response variables	Number of manufactured products	Number of manufactured products	Number of manufactured products
Tool used to conduct the research	ExperimentManager	Manual simulation	ExperimentManager

Source: own study.

Experiment 1 examined the impact of the machine failure on process efficiency. The investigation was performed on workstation M12 - on which the operation of assembling semi-finished products, supplied from machines M5 and M11, is performed. The workstation was chosen for the experiment because it is the bottleneck of the process. The change in the value of the parameters at other workstations (outside the bottleneck) would not result in a variation in the value of the explanatory variable. Experiment 2 examined the impact of worker efficiency on the process efficiency. Workers perform randomly selected operations within a given production area. The change in efficiency applied to all employees (on both work shifts). Experiment 3 examined the impact of repeated supply delay on the process efficiency. The study was conducted on the supply source for the M1 workstation - because it indirectly affects the process bottleneck. The different ranges of value variations were determined on the data collected from the company. The measure investigated in all experiments was the process efficiency, determined by the quantity of products manufactured. The results derived from the experiments are shown in Table 5.

Table 5.
Results of the conducted experiments

Step of the research	Experiment 1		Experiment 2		Experiment 3	
	Value of the variable [%]	Research result [pc]	Value of the variable [%]	Research result [pc]	Value of the variable [s]	Research result [pc]
Simulation 1 (baseline)	96	1171	95	1171	170	1171
Simulation 2	93	1136	92	1136	210	1171
Simulation 3	90	1098	89	1096	250	1159
Simulation 4	87	1068	86	1063	290	1132
Simulation 5	84	1029	83	1026	330	1109
Simulation 6	81	992	80	987	370	1085
Simulation 7	78	957			410	980

Source: own study.

The experiments show that the analyzed production process is vulnerable to all factors leading to a disruption of the process. However, the strength of the impact varies depending on the disruption. The analyzed process is susceptible to machine failure at the M12 workstation, as already in the first simulation a decrease in the number of manufactured products can be observed (by about 3%). A similar trend occurs in the following simulations, reaching the greatest decrease (about 4% between simulation 5 and simulation 6). A similar susceptibility of the process occurs with a decreasing worker efficiency, where a marginal modification of the value results in a corresponding difference in the process efficiency - by 3-4% on average between following simulations. The delayed deliveries, on the other hand, revealed a varied impact on the process. The initial variation in the delivery of materials did not affect the level of capacity utilization. However, extending the delay time in the following simulations increasingly affected the process - achieving a reduction of nearly 10% in the quantity of products manufactured between simulation 6 and simulation 7.

5. Discussion

The literature analysis indicates that the primary sources of disruptions should be searched for in the unreliability of the basic factors of production, such as means of labor, work objects and workers (Lis, 1982). The research conducted focused on three main factors such as the failure of the machine used in the implementation of the process (Experiment 1), the efficiency of workers in the production area (Experiment 2) and the delay in the delivery of materials to the workstation (Experiment 3).

The second experiment, which examined the influence of a worker efficiency change on the process efficiency, showed the most significant impact on the production process under study. A minimal change in employee efficiency causes significant disruption to the enterprise. Therefore, the company is recommended to take efforts to adequately protect the process from

possible negative consequences. It is particularly important to conduct systematic internal and external training for employees - in the area of assigned production operations. Employee efficiency is characterized by a downward trend, so reactions should be taken at the first symptoms.

The study also investigated the vulnerability of the process to the failure frequency of the machines used. Particularly important is the failure of the bottleneck of the production process, since the throughput of the bottleneck defines the throughput of the entire process (Goldratt, 2004). Even the lowest throughput constraint (for example, in the form of lower machine availability) will reduce the amount of products manufactured. Therefore, the machines should be systematically serviced and maintained to detect defects at an early stage. Employees should react at the first sighting of process anomalies in order to respond to the arising problem as soon as possible. For other workstations, a machine availability variation, at least to some extent, would not significantly affect the process. In the future vulnerability studies, selecting the bottleneck of the process when studying the impact of machine failures is advisable. This approach eliminates the possibility of a false negative vulnerability result.

A minimal increase in the delivery time of materials to the M1 workstation does not adversely affect the process. The delivery time variations within a specific range are acceptable to the company and do not require an immediate response. However, if there is a significant increase in delivery time—beyond 40%—the process becomes responsive to the modifications made. The analysis of the results indicates that as the magnitude of the delivery delay increases, the negative impact on the process under study significantly increases - this tendency is initially minor, and then significantly increases during the execution of the sixth experiment. Therefore, initially, the enterprise may take no action in response to the disruption noticed. However, observing a further increase in the delay between deliveries to the workstation, the situation will require an appropriate response. As a recommendation to the enterprise, it might be suggested to establish a buffer before M1 workstation, or to investigate operations at the component supplier to identify the problems and improve the implemented operations.

6. Conclusions

Simulation modeling can be applied to study the vulnerability of production processes implemented in the enterprise to disruption. Currently, there is a lack of the papers in this research area. However, with the growing impact of Industry 4.0 technology and the growing importance of enterprise resilience, the number of studies conducted will increase. Such studies provide potential practical benefits for the enterprise, especially in supporting the decision-making process. Simulation modeling provides a powerful tool for conducting analysis and research, enabling the right business decisions without disturbing the system in a real

environment. As part of the presented paper, the results of a vulnerability study for typical disruptions occurring in the enterprise are presented. The direction of further work should be an attempt to identify the scope of the application of simulation modeling to the study of vulnerability, both in terms of the disruptions that can be investigated, as well as the identification of specific factors, in order to conduct detailed studies.

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THEORY OF INVENTIVE PROBLEM SOLVING (TRIZ) AND ITS POTENTIAL IN COMMERCIALIZATION PROCESSES

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Purpose: The purpose of the article is to match TRIZ and TRIZ - business tools with the stages of technology development and elements of the commercialization process.

Design/methodology/approach: This paper is conceptual and theoretical. The study reviews key existing literature in areas of TRIZ and TRIZ business as well as commercialization. This was the basis for indicating the role of TRIZ in the innovation process.

Findings: A major barrier to commercialization is the increase in costs at successive stages that bring an idea closer to the marketable product stage. TRIZ can be used to reduce the cost of solving business problems – by assuming that a solution idea can be developed independently of the basic research and also allows to get an idea with high functionality and expect that it will be better received by the end customer.

Practical implications: TRIZ improves idea generation or product and process improvement. Modifications of TRIZ – Business provide tools to understand and solve organizational problems.

Originality/value: The originality of the paper is to relate selected tools of the methods to technology readiness levels and problems of the commercialization process with the use of the TRIZ technique for business activities.

Keywords: TRIZ; innovation; commercialization.

Category of the paper: conceptual paper.

1. Introduction

TRIZ, as one of the recognized engineering methods, has been successfully used in various industries since the middle of the last century. Its practical applications were greatly increased with the collapse of the Soviet system and the process of "exporting" its scientists and technical thought beyond the collapsing Eastern Bloc. Since then, the popularity of the method has grown rapidly, finding its application mainly in innovative industrial companies located both in the Far East (mainly in South Korea with many implementations by business leaders such as

Samsung) and in the United States (where there are many examples of successful implementation in companies, e.g. Boeing).

The popularity of the TRIZ methodology has grown rapidly due to its high effectiveness in rationalizing costs of many activities (mainly of a technical nature), which translates into not only technical or organizational success, but also (and perhaps above all) economic success. Typical engineering applications do not exhaust the entire potential of using the TRIZ methodology in a company. In recent years, there have been more or less successful attempts to use this solution in other business areas, concerning both the company as a whole, as well as its functional departments.

Taking into account the above-mentioned possible applications, as well as considering the potential and significant possibilities of using the TRIZ technique for business activities, the main objective of the current study will be to present the TRIZ methodology for increasing the effectiveness of technology commercialization processes in enterprises and research and development institutes.

2. TRIZ – evolution of the concept

The origins of modern Theory of Inventive Problem Solving (TRIZ) date back to the 1940s. In 1946, Henry Altzuller, employed as a clerk in a patent office, began research on establishing general principles of invention, at first in relation to his own ideas, to devote himself after a few more years solely to discovering the path leading to new inventions (Altzuller, 1972). Altzuller had been interested in technology and invention since childhood. In the course of his technical activities, he came to the conclusion that a method of organizing creative proceedings was lacking, more specifically, the part concerning the solution of technical problems (which was later formulated in the form of, among other things, an algorithm). In order to search for common points in existing solutions, he analyzed several thousand patents to which he had access (Cardenal, 2018).

The question that may arise for the reader who has not yet encountered TRIZ may be as follows: is a system developed in the USSR in the last century still worth something in the world of 21st century capitalism? The answer to this question, based on cases of companies that use TRIZ, such as Samsung or Boeing, is yes. TRIZ does not provide an answer to all problems related to the development of new products, it focuses on the part of creative activity that concerns the manufacturer - the consumer has a supporting role, if an engineer using the method includes him in the so-called super system, i.e. the product environment. The method does not provide for the involvement of end users or marketing specialists at the early stages of the production process, in accordance with the popular concept of design thinking, as it is directed at solving a technical problem without considering the issue of its packaging.

The historical setting of the method was important for the fate of the author - in the Stalinist period, when politics mixed with science Altszuller, who allowed himself to criticize the system supporting invention in the USSR was punished with a stay in the gulag and then, after leaving it, with a ban on work. Seeing no other option, he decided to write science fiction books. A TRIZ-like way of thinking manifested itself by categorizing themes from available literature and applying them to his own work.

The 1950s was a period of formulating a key concepts for the theory: technical contradiction, the ideal final solution, and the precursor of a tool today known as the so-called 9-window system (analysis of a problem in reference to the environment and time) (Karedal, 2018). The idea of the creator was to create an algorithm (i.e. a sequence of repetitive actions) that generates new solutions, eliminating the chaotic search for new solutions and counting on the brilliance of the discoverer. Instead, he proposed rules to guide the potential inventor toward the right solution. The method has been updated several times in subsequent versions.

Until the 1960s, Altszuler's discoveries received little attention from Soviet inventors; a 1959 publication in a journal devoted to problems of invention was a breakthrough (Altszuler, 1972). Growing popularity resulted in a number of workshops held at industrial plants, resulting in the development of numerous patents by participants.

Alshuler presented his method in subsequent publications, lectures, and training sessions, creating a school of his students who further popularized it in the USSR and, after its collapse in 1991, within the TRIZ association.

The most recognizable element of TRIZ, the Technical Contradiction Resolution Matrix currently consists of a list of 39 parameters that we would like to improve in a given facility and a list of parameters that will deteriorate as a result of applying a given technical solution to improve the system.

In the 1980s, the catalog of TRIZ tools was expanded to include, among others (Ikovenko et al., 2017):

- functional modelling (representation of the functions of a technical system),
- trimming, or analyzing functionality in relation to cost in order to optimize,
- cause-and-effect chain of defects (known as CECA or RCA),
- feature transfer (from other systems).

3. The potential use of TRIZ method in business

Given the nature and volume of the study, as well as a wide range of potential translation of the TRIZ methodology into the language of business, the authors do not attempt at present to take a comprehensive look at the possible implementation of TRIZ tools in business. Some areas of implementation seem obvious, they are closely related to improvements made,

for example, in the production processes of the company (which applies to manufacturing companies), where some obvious relationships in the process approach and TRIZ methodology can be seen. Such a translation of the concept seems to be closest to the original approach developed by Altszuller and his successors, due to the close relationship with knowledge of an engineering nature.

However, this does not reflect the whole potential implementation of the concept in business, where for years there have been attempts to develop methods and tools based on the original TRIZ philosophy and their use in other areas of business. For some time, original studies have been appearing that attempt to develop a new use of TRIZ methodology in other areas of business. This indicates the potential of the method and its attractiveness for alternative applications.

One such example is a study by Mueller (2005), where an attempt was made to combine the concept of understanding resources in terms of TRIZ with resources understood from a resourced-based view and present the concept of Management-TRIZ. Three distinct levels of resources were distinguished - elementary, specific and concrete, and then the resources at each of these levels were analyzed in detail.

Another approach was presented by Boratyńska-Sala (2014), where potential areas of application of the TRIZ methodology were indicated in, among others:

- Marketing – where the engineering principle of fragmentation can be used to build segmentation strategies.
- Human resource management – for example, in ways to mobilize top-level management or generate new management ideas.

On the other hand, the use of the potential of the TRIZ methodology was looked at more broadly by Livotov (2008), indicating the potential of using this methodology for thinking at the level of the company's top management. The components of the TRIZ methodology for use at this level for business and management purposes are:

- identification and theoretical exaggeration of conflicts,
- a positive attitude towards complexity,
- consideration of patterns of evolution,
- anticipatory evaluation of risks,
- utilization and expansion of resources and knowledge.

There are many additional potential applications of the TRIZ methodology in business, and one of the most promising areas, which is the primary one analyzed in this study, is the commercialization of new technologies.

4. Commercialization processes – the main problem areas

We can understand commercialization in relation to the activities of scientific entities in two ways. One of them is included in the definition of innovation activities as defined in the OECD Oslo manual (2018) according to which they are: "all developmental, financial and commercial activities undertaken by a company with the intention of developing an innovation for it". This very broad definition allows to classify the entire activity of the enterprise as innovative activity, as long as this is the manager's intention. According to the definition of the PWN dictionary of Polish language, commercialization is:

- "making something commercial"
- "the first stage of privatization of state enterprises (...)".

Point 1 of the PWN definition refers to a wider range of phenomena than the OECD; in the case of scientific entities, it is the process of using assets to achieve profit by the entity. Such assets, apart from know-how or patents, which meet the OECD definition of innovative activities, may be research equipment (making it available for a fee) or the surface of real estate belonging to the entity. This type of activity is of a commercial nature, although in the case of research apparatus, due to its nature, entrepreneurs will belong to industrial units operating in the most modern areas and often undertaking the development of innovative products. Commercialization as the use of scientific infrastructure for the benefit of entrepreneurs is a process that, in order to achieve the expected results, requires taking into account the needs of entrepreneurs at the stage of its purchase and then creating a system within the organization which allows the use of devices in accordance with the needs of the entrepreneur. It is necessary to establish the rules of cooperation, to formulate an offer, to make available the personal resources of the organization and its know-how, to rent offices and industrial space, to meet additional needs of the entrepreneur or even to create a whole system of related additional services (e.g. financial, accounting, leisure and recreation services such as in the Alderley Park in Manchester, UK). Another way to commercialize is to provide unique and science-based manufacturing services, often to conduct scientific research.

Publications on commercialization rely, most often unknowingly, on one of the above definitions. For example, Gwarda-Gruszczyńska (2013) points to 3 general stages of commercialization of new technologies: concept evaluation, development stage and marketization stage, which indicates the understanding of commercialization as a stage of activities that create innovations. In addition, the distinguished stages of model fit the so-called push strategy (i.e. searching for a buyer for the developed technology), however, in the case of the pull strategy (i.e. searching for a solution to the problem coming from the business) it needs to be modified. The commercialization process begins with the entrepreneur's notification of an invention problem to scientists, to which they try to respond by formulating an idea for a solution to be tested in the implementation of the research agenda. In such a process,

commercialization deals with the scientist's know-how, while the entrepreneur provides a problem embedded in a market in which they operate and are familiar with. The evaluation of the concept is done jointly by the entrepreneur and the researchers, but is limited due to the unknown final shape of the technology. Only if the research results indicate the usefulness of the idea will another in-depth analysis be performed. In the remainder of this article, we will use the term commercialization in the sense of activities that serve innovation (the aforementioned OECD definition). Indication of the first stage, which is the beginning of the commercialization process, is conventional. If one undertakes research on the basic manifestations of a phenomenon, expecting that the object may have some as yet unknown properties that will be economically useful (e.g., based on past experience with research on objects of a similar class), then leaving basic research out of the process will be a moot point. An illustration of the above situation may be the currently undertaken basic research on nanomaterials such as graphene. Initially diagnosed potentially useful properties are verified, enriching the knowledge, based on the assumption that, similarly as in the case of e.g. aluminum, after an ultimately long period of research the know-how will be obtained which can more than compensate for the resources devoted to basic research.

With respect to the above, we can distinguish a number of specific problem areas in the commercialization process:

- generation of new ideas, decision on the agenda of basic research, selection of their results for further development,
- IP protection issues, NDAs, patent applications, IP protection strategies and their limitations,
- financing the various stages of the commercialization process,
- seeking out business partners interested in the idea (known as a push strategy) or collaborating on the entrepreneur's idea (known as a pull strategy),
- creation of separate business entities for the development of an idea (start-up), or separate enterprises of a purely productive nature, as well as branches/outlets in places other than the headquarters (other provinces, regions of the world),
- the role of publications in disseminating knowledge about the innovative potential of scientific entities,
- the divergence in priorities between the worlds of science and business,
- cooperation between different entities and its effectiveness (consortia, clusters, networks),
- determinants of implementation success,
- the role of the innovation support environment,
- aspects of cultural and interpersonal problems within the commercialization process (the role of the leader, the team, optimal conditions for cooperation),
- streamlining and breakthrough innovations,

- building organizations that conduct production and research simultaneously,
- culture and working conditions in the organization that foster innovation,
- disruptive innovation as a way to change the equilibrium in a given market,
- innovation as a way to improve a company's image and its value to the customer.

We could imagine the process of commercialization of intellectual property (IP) as a way of transforming an idea (concept) in successive stages into a finished product that finds buyers in the market and achieves success. The subsequent stages of the process generate specific problems, on the solution of which further development depends. The quality of an idea and its potential usefulness do not determine its success. Without solving a number of diverse (technical, legal, organizational, financial) problems, commercialization will fail.

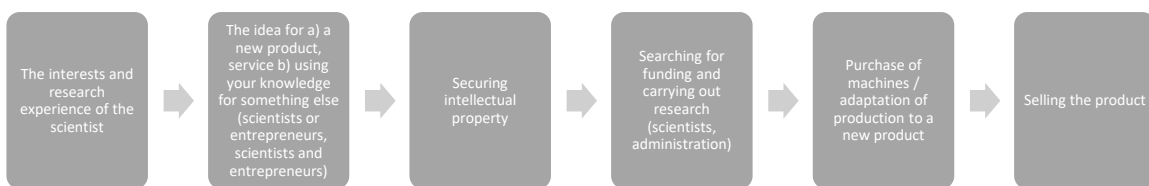


Figure 1. Commercialization process in a research unit.

Source: own study based on previous research.

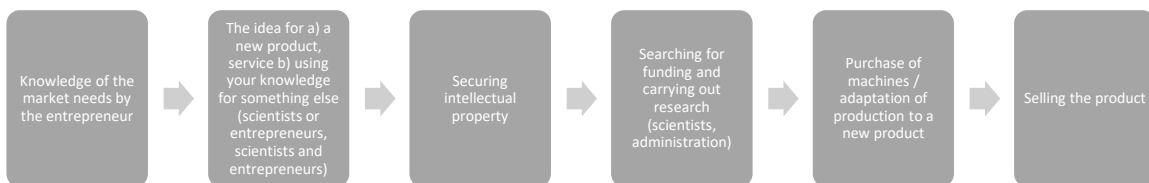


Figure 2. The commercialization process in an enterprise.

Source: own study based on previous research.

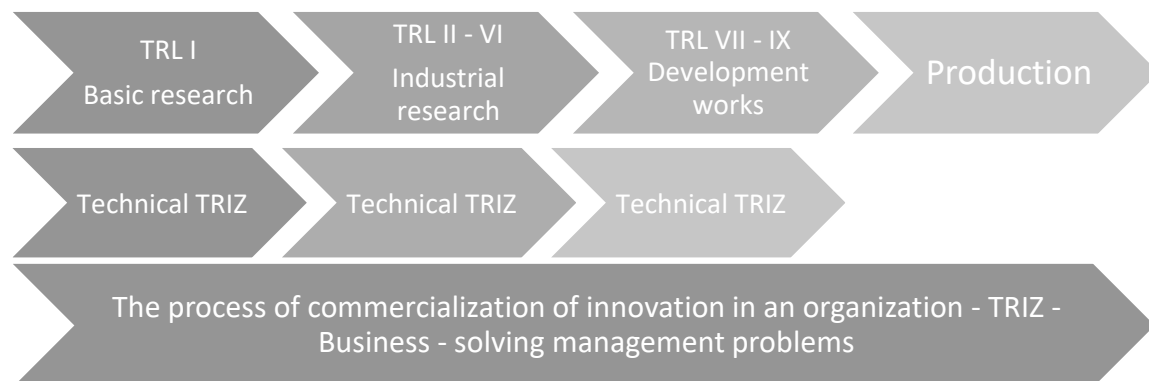


Figure 3. The role of TRIZ in the innovation process.

Source: own study based on previous research.

A commonly used approach to represent the stages of innovation development is the Technology Readiness Level (TRL) scale developed by NASA. Technology development starts at TRL1, i.e. basic research, and ends at level 9, i.e. product ready for sale.

TRIZ can be used to resolve technical contradictions that emerge at subsequent stages (TRL) of technology development. In the case of level two, it can be used to formulate an idea for a new technology, and in the period after the product appears on the market, to improve it. The production process itself, if it requires it, can be optimized (the so-called trimming).

Boeing can be used as an illustration of how to use TRIZ at different TRL levels (according to the company website) (TRL level in parentheses):

- Design Improvements - finding the right power to meet the fuel discharge rate requirements for the KC-767 tanker - (Industrial Research, II - IV TRL).
- Creating inventions - clamping mechanisms for aircraft interiors, rainproof solutions for aircraft and new actuation technologies - (TRL I).
- Creating a technology forecasting strategy - a way to set goals in management.
- Removal of technical contradictions that led to compromise (suboptimal) designs - (industrial research, II - IV TRL).

The classical view of TRL assumes that an invention idea (the beginning of TRL II) emerges spontaneously from basic research (TRL 1). TRIZ assumes that a solution idea is developed independently of the basic research.

5. The possibility of using TRIZ in commercialization processes

Most of the ideas that developers think might be useful to customers will never be realized. Their development into a final product will be stalled by a series of difficulties and problems. A study carried out in Denmark in the 1980s shows that of the patented solutions that were licensed 73% never went into production, and of the 30 licenses that were used for production few had a significant and only one a decisive impact on the turnover of the company (Hansen, 1995). The costs generated by failed ideas are a loss for the company, hence the need to look for ways to reduce them. If, on the other hand, problems of a purely organizational nature stand in the way of the creation of a useful product, it is a loss also for society and an opportunity cost for the entrepreneur. Companies cannot afford to give up on introducing new services and products or improving processes, as this may result in losing the market when the competition does it (according to the concept of breakthrough innovation). At the same time, an entrepreneur investing in innovation must take into account the risk of creating imitations by competitors. Imitations are produced at a cost of 65% of original research and with the help of 70% of original research time (Mansfield et al., 1981). Hence, the logical conclusion should be to keep the cost of creating innovations to a minimum. In the literature on TRIZ, there have been many proposals over the years to use TRIZ and attempts to modify TRIZ towards use for non-technical (organizational) problems.

Using TRIZ tools also allows you to get an idea with high functionality. This allows you to expect that it will be better received by the end customer. The possibility of using TRIZ in commercialization processes appears on several levels.

5.1. Generating an innovative idea

A TRIZ tool to reduce the cost of basic research on solving a diagnosed problem is called functionally directed search (puf).

Instead of conducting research to obtain new product properties, we can look for a solution in other technical systems. The non-obviousness of the TRIZ tool lies in the process of generalizing the function we need from the originally diagnosed problem using another TRIZ tool, Cause and Effect Chain Analysis, similar to root cause analysis (i.e., finding the root problem through a series of questions), and then searching for technical systems for which these functions are key. A similar application, respectively, is the procedure called feature transfer, where we look for technical systems with needed useful features in our system.

Indicating the usefulness of TRIZ for improving existing products, let's analyze the case of the Boeing company, which tried to solve the problem of fading GPS signal on the aircraft (company website). Without going into the details of the developed solution, let us indicate the next steps of the process:

- Initial diagnosis of the problem.
- Attempting solutions by conventional means (unsuccessful).
- Application of TRIZ tools.
- Reformulating the problem by getting to the real cause.
- Laboratory verification of workshop findings.
- Implementation of the solution to the real cause of the problem (already without TRIZ).

5.2. Improving an existing product

The above indicates the usefulness of TRIZ for the correct formulation of a technical problem, improving the utility of the product to the end customer. Research can be used to develop a solution for such a diagnosed problem. TRIZ, in this view, is a tool that functions in the environment of the research process, however, necessary to formulate an economically useful goal for the scientific project and hence indirectly defining expectations of its research agenda.

5.3. Streamlining the commercialization process

Classical (technical) TRIZ is not directly suitable for organizational improvement, however, attempts have been made to transform it in depth and formulate a set of tools for solving organizational problems in management. One way of such transformation is to build a palette of available solutions for a manager based on known business cases. H.J. Harrington

(Harrington, 2017) formulated a comprehensive way to implement the tools of the so-called Lean TRIZ based on, among other things, his own experience in managerial positions in American organizations. In this way, he formulated a finite number of possibilities for improving processes in the organization with respect to the three objectives he defined. In this arrangement, each possible process change action has a positive, neutral or negative impact on one of the three defined objectives. In this way, a contradiction is formulated between the goals of the organization. Working out a solution to a contradiction, as in the original TRIZ, requires conducting workshops in the environment in which it is to be implemented. The 5 proposed tools include among others workshops for the elimination of sub-processes that do not create value for the customer. It seems worth exploring their application in relation to the commercialization process understood as a transition within a single company/research unit from basic research to the final product by presenting the processes-subprocesses on a map and then eliminating those that do not create value for the final product. The second application of Lean TRIZ is used to create or improve products in a reduced time compared to classical TRIZ.

5.4. Overcoming organizational barriers to commercialization

Classical TRIZ (as explained earlier) was not created with the intention to solve management problems, including those that arise during the commercialization process. However, some of the tools of the method can be used almost unchanged. Creating a chain of cause and effect defects (CECA) is an extension of root cause analysis (RCA) within TRIZ. The essence of the tool is to inquire through a series of questions what are the real sources of the diagnosed problem. At the end we can formulate them in the form of contradictions to be solved using the resource categories described in 'classical' TRIZ: time, space, system, environment (super system), information (Soukhov, 2007). A simple application of TRIZ to a business problem is to treat its tools as inspiration, rather than detailed rules and algorithms. Mann (triz-journal.com) proposes this view of the 40 inventive principles of technical TRIZ for developing one's own solutions to a given management problem. Importantly, the problem must be correctly formulated according to the same technique used for technical problems.

Importantly, the problem must be constructed in accordance with the technique used in the case of technical problems - that is, we define the state we want to achieve and then indicate what the obstacles are. The analysis of the proposed solutions by the author shows that the number of generated variants will depend on the knowledge of management issues. One should be aware that such an approach plays a role similar to the so-called ice-braker technique during meetings - it is supposed to break mental inertia and established ways of thinking about the problem. The author's interpretation of the 40 principles often changes the technical understanding of a term to a metaphorical use (e.g. atmosphere in terms of chemical composition changed to atmosphere in the organization). If one keeps in mind the obvious limitations of such a procedure then this use of the 40 inventive principles can be useful. In cases where the generated management solution is intertwined with the use of technology

such a treatment may be closer to classical TRIZ, which was supposed to propose a generalized solution to a class of problems (e.g., if we talk about creating a virtual copy of some product for customer use, using a principle suggesting the creation of virtual copies in technical TRIZ). A major barrier to commercialization is the increase in costs at successive stages that bring an idea closer to the marketable product stage. TRIZ can be used to reduce the cost of solving business problems.

One of the ways may be to perform an analysis of resources derived from the classic TRIZ extended by human resources (Mueller, 2005) so that the solution can be developed based on the resources available to the company, not taken into account before the analysis, which gives a chance to reduce the cost of the developed solution.

6. Summary and conclusions

The article analyzes the role of TRIZ in the innovation process. A major barrier to commercialization is the increase in costs at successive stages that bring an idea closer to the marketable product stage. TRIZ can be used to reduce the cost of solving business problems.

First of all, TRIZ assumes that a solution idea can be developed independently of the basic research.

Using TRIZ tools also allows to get an idea with high functionality and expect that it will be better received by the end customer.

The possibility of using TRIZ in commercialization processes appears on several levels:

- A TRIZ tool to reduce the cost of basic research. Instead of conducting research to obtain new product properties, we can look for a solution in other technical systems.
- TRIZ is a tool useful to formulate expectations towards research agenda.
- Lean_TRIZ could be potentially useful for streamlining commercialization process. The second application of Lean TRIZ is used to create or improve products in a reduced time compared to classical TRIZ.
- Creating a chain of cause and effect defects (CECA) could be useful for resolving commercialization process problems.
- TRIZ resources analysis tool extended by human resources gives a chance to reduce the cost of the developed solution.

TRIZ approaches presented in the article are primarily an attempt to move away from a purely intuitive approach to the problem of creating innovations and managing the problems of the commercialization process to standardized methods, providing starting points for development within the own work of research and management teams. Their application gives hope for faster and cheaper development of a more useful innovation for the customer.

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HUMAN SMART CITIES: SMART CITIES CO-CREATED BY CITIZENS

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Purpose: The main objective of the study is to gain insight into the effectiveness and challenges in the implementation of projects of funded from the "Human Smart Cities. Smart Cities co-created by residents" competition for local government units.

Design/methodology/approach: A survey of all cities participating in the Human Smart City competition was planned and conducted using the CAWI method in September 2024.

Findings: The analysis of the survey data revealed challenges currently faced by Polish cities. Local government officials respond to them by seeking new solutions capable of improving the quality of public services and contributing to sustainable development. The role of local governments is to educate the public and implement solutions that support sustainable development. This publication is intended as a contribution to the public discourse on the state of Polish cities and an inspiration for further research on the development of smart city solutions in Poland. We also hope that it will advance knowledge in this field and encourage the implementation of new initiatives.

Research limitations/implications: The article does not address all issues that are relevant to its topic, but it can certainly serve as a starting point for further research. An interesting continuation of the underlying study would be a survey of residents' opinions on the use of intelligent solutions to turn a city into a livable space, for which the residents are also responsible.

Practical implications: The article is relevant to the development and management of cities, as it enables the creation of more efficient application procedures and better preparation of municipalities to implement innovative city projects.

Social implications: The results of the study can increase residents' participation in decision-making processes, consequently strengthening their social responsibility and improving the quality of life through better alignment of projects with local needs.

Originality/value: The article brings in a new perspective on the challenges and effectiveness of smart city projects implemented in Poland, especially those involving cooperation between municipalities and residents. Its value lies in providing practical conclusions and recommendations that can support public administration and organizations in developing innovative urban solutions.

Keywords: Smart city, Innovative urban solutions, Involvement of citizens, Sustainable urban development, Human Smart Cities competition.

Category of the paper: Research paper.

1. Introduction

The development of smart cities is influenced by global policy trends aimed at balancing socio-economic and environmental goals. The dynamic development of civilization, increasing urbanization, and the growing demands of modern society, make it necessary for Polish municipalities to constantly seek answers to questions about the directions of future urban development. In this context, the interdisciplinary studies of the concept of sustainable cities, considering its various aspects such as ecology, urban mobility and innovative supportive technologies, are conducted (Wieczorek, 2023). Modern theories of urban development emphasize the key role of advanced information and communication technologies (ICT) in building efficient and intelligent urban management systems (Ciupa, Hołubowicz, Orłowski, 2024).

The implementation of the systems is prerequisite to undertaking harmonized activities guided by clearly defined goals, which are part of the assumptions underlying multifaceted and sustainable development. A key element of this process is dialogue and cooperation among various community groups, which allows the creation of solutions capable of responding to the dynamically changing needs. In this article, the term "smart city" is understood as equivalent to "intelligent city". Its ambiguity and broadness results in different social groups having different perceptions of it and expecting different solutions. Some of them see the smart city concept as necessary to find savings in the municipal budget, while others view it in terms of more accessible and better public services, increased resident safety and more efficient and less-pollutant public transport. A common point of reference for all involved parties is the need to build digital society.

Central to the smart city concept seems to be the creation of appropriate financial and intellectual capital. Planning and designing a smart city requires a thorough understanding of the needs of its users and developing effective policies to address them (Januszkiewicz, Cywiński, Chojnacka, 2019). A key role in this process is played by residents, whose daily consumption choices, use of environmental resources and transport, and waste disposal practices are significant for the quality of the environment whose. Equally important is residents' involvement in various forms and procedures of public participation, through which they can co-create the framework and directions of urban policy. All this leads to the conclusion that sustainable urban development is determined by both passive users of urban resources and publicly active citizens, including formal and informal groups, organizations and public institutions (Augustyn, 2020).

By definition, designing and implementing a smart city involves substantial financial investments. Until recently, the prevailing belief in small towns and medium-sized cities, was that investing in smart solutions was not only not a priority but also, in many cases, superfluous. The perception was mainly due to the dominance of traditional forms of financing

the purchases of equipment or advanced software directly from tight local budgets (Jonek-Kowalska, 2018). A much more effective, although still unpopular, approach to financing smart city projects makes use of public-private partnerships (PPPs), which give municipalities access to private capital and expertise without exacerbating local budgets' deficits. An interesting alternative is the contingency funding model, under which municipalities do not pay for a given service becoming available but for pre-agreed outcomes. This solution is essential in the case of projects seeking long-term cost reductions. A case in point is smart lighting systems, which can significantly lower municipal electricity bills (Kowalski, Weresa, 2018). In financing smart city projects, the key role is played by external funds available from several entities, including the Polish Development Fund, the Department of Local Government Investment (DIS) responsible for facilitating local governments' investments in modern technologies (among its programs were Energy from Waste, PPP Consultancy, EPC+, Municipal Technology Exchanges, etc.), and Bank Gospodarstwa Krajowego (the Strategic Investment Program, etc.) (Wieczorek, 2023). An initiative of special importance among projects involving smart cities following the latest trends is the "Human Smart Cities. Smart cities co-created by citizens"¹ competition announced by the Ministry of Funds and Regional Policy and Regional Policy. The competition emphasizes the use of advanced technologies in combination with active public participation. In this way, the Human Smart City (HSC) is not only an opportunity to raise funds but also to help create cities that are friendlier and more responsive to the needs of their inhabitants. In the HSC approach, technology is not an end but a tool to improve the quality of life, involving local communities in the design and implementation of solutions.

The main objective of the paper is to gain an insight into the effectiveness and challenges of projects funded from the "Human Smart Cities. Smart Cities Co-Created by Residents" competition meant for municipalities. Using a questionnaire survey of the competition participants, the authors try to bring a new perspective on the challenges and effectiveness of smart city projects implemented in Poland focusing on the cooperation between municipalities and citizens, and present practical conclusions and recommendations for public authorities and organizations committed to developing innovative urban solutions.

2. Methods and Results

In September 2024, a survey of 24 cities using the CAWI (Computer Assisted Web Interview) technique was conducted to analyze cities' projects implemented within the "Human Smart Cities. Smart Cities Co-Created by Residents" competition. The survey tool was

¹ The then-Ministry of Development, now the Ministry of Funds and Regional Policy, announced on July 18, 2017 a grant competition for local government units to undertake the preparation of cities to implement smart and innovative technological and social solutions in the form of a pilot.

developed using the Microsoft Office 365 Forms application. Requests to complete the online survey were sent electronically with a link through the Electronic Platform for Public Administration Services (ePUAP). Completed surveys were returned by 16 cities² (67% of the survey participants). The survey consisted of 17 closed-ended and semi-open-ended questions, and rating questions provided with a five-point Likert rating scale, on various aspects of the process of preparing, implementing and evaluating smart city projects. The survey's main purpose was to gain an understanding of the effectiveness of implementing projects funded by the "Human Smart Cities. Smart Cities co-created by citizens" competition meant for local government units and related challenges.

The respondents represented a variety of local government units. An analysis of their positions and units showed that most of them were employed at municipal offices and departments responsible for urban development and management. In response to the question about how many people were engaged in the preparation of an application, as many as 8 respondents stated that teams consisted of 4 to 8 people, which indicates that half of the projects were carried by medium-sized teams. In several cases, smaller teams consisting of fewer than 3 people were indicated, which was probably associated with smaller projects or municipalities limited interest in them. Two respondents, from Nakło nad Notecią and Żuromin, stated that their teams had between 9 and 12 members.

The majority of the respondents confirmed that the application preparation process involved cooperation with external partners, including public institutions, NGOs, and universities. This approach testifies to local governments' openness to implementing projects through cooperation with others and the integration of available resources and knowledge. As regards the length of time that teams needed to complete an application, most respondents pointed to two months. However, there were also cases of projects requiring more than three months to complete the application, probably because of their greater complexity. It is worth noting that in three cities (Lublin, Ostróda, Siemianowice Śląskie), teams consisting of 4-8 people managed to complete applications just in one month.

Table 1.
Time spent on application preparation

Town/City	One month	Two months	Over three months
Boguchwała		X	
Ełk		X	
Kielce			X
Kołobrzeg			X
Krosno			X
Lublin	X		

² The survey required participants to state the date of signing the agreement by each city participating in the project. The first agreement was signed on June 11, 2019 (Boguchwała, Kołobrzeg, Ostróda), and the last one on November 19, 2020 (Rawicz). The value of the projects ranged from PLN 500,000 to over PLN 2,000,000. Most cities implemented projects worth between 1,000,000 and 2,000,000 PLN; there were also several projects (Kielce, Rawicz, Sierpc and Zdunska Wola) that were worth more than PLN 2,000,000.

Cont. table 1.

Naklo nad Notecią			X
Nowa Ruda			X
Ostróda	X		
Rawicz		X	
Siechnice			X
Siemianowice Śląskie	X		
Sierpc		X	
Zakliczyn		X	
Zduńska Wola		X	
Żuromin		X	

Source: elaborated by the authors based on the survey data.

Asked about the complexity of the competition's application process, most survey participants found it to be moderate, and several (from Naklo nad Notecią, Rawicz and Sierpc) described it as complicated. In contrast, respondents from Kolobrzeg, where the application took more than three months to complete and respondents from Lublin and Siemianowice Śląskie (1 month) found that the application process was not very complicated. A respondent from Zduńska Wola, where the application preparation process stretched over two months, saw the process as straightforward. The different perceptions of the complexity of the application process could be related to different experiences of local government units, determined by their different levels of expertise and available resources. This implies indicate that more efforts are necessary to simplify the application process and ensure a level playing field for all applicants.

The eight respondents who found the application process uncomplicated had no comments on it, stated that they did not remember the details, or were unable to provide an unambiguous assessment of it. The other respondents pointed to several problem areas in the application process, such as the detailed application requirements, which required the organization of an informational meeting to clarify the critical aspects of the application process. Also indicated was a need for the competition organizers to provide more precise guidelines on expected output and result indicators, the onerousness of the multi-stage procedure, and tight local budgets hindering project implementation. Other problems included difficulties with predicting expenditures and application forms offering insufficient space given the amount of information required, which also pointed to need to optimize the application process further. Respondents also frequently referred to technological problems arising from implementing new solutions and the insufficiency of human resources given the scale of the project tasks. In five cases, communities' resistance to change was mentioned, clearly pointing to the importance of this problem.

Some respondents indicated obstacles to project implementation other than enumerated in the survey, including numerous challenges posed by the COVID-19 pandemic, such as problems with installing water meter radio modules in residents' homes and carrying out initiatives requiring their participation, which mainly affected the town of Krosno. Zakliczyn

and Lublin particularly suffered from pandemic-related restrictions on residents' mobility, translating into problems with holding public consultations. Respondents also referred to contractors failing to comply with the terms of their contracts and the time-consuming nature of public procurement procedures, delaying the implementation of tasks. In many cases, e.g., in Zdunska Wola, the pandemic had a generally adverse effect on the programs and organization of project activities. All these difficulties point out that in addition to having to overcome epidemiological restrictions, projects implemented during the pandemic were significantly affected by procedural requirements.

Table 2.
Main challenges in project implementation

Town/City	Insufficient financial resources	Insufficient human resources	Public resistance	Technological difficulties	Problems with the coordination and management of the project	Others
Boguchwała				X		
Ełk					X	
Kielce	X	X	X	X	X	
Kołobrzeg		X		X		
Krosno	X			X		X
Lublin						X
Nakło nad Notecią		X	X			
Nowa Ruda	X	X		X		
Ostróda				X		
Rawicz				X	X	
Siechnice		X		X	X	
Siemianowice Śląskie		X	X			
Sierpc	X	X	X			
Zakliczyn						X
Zduńska Wola						X
Żuromin		X	X			

Source: elaborated by the authors based on the survey data.

Public consultations with the residents was viewed positively by respondents, with 63% of them finding this form of communication with the local respondents to be effective. The main problems hindering public consultations were insufficient engagement of the residents, their limited knowledge about smart cities, and the lack of local leaders who could initiate and guide community activities. The respondents also pointed to a problem with encouraging new communities to participate in consultations, which was not included in the available options. Reduced seniors' interest in consultations during the pandemic made it even more challenging to build engagement among the residents.

Table 3.*Problems encountered during public consultations on projects*

Town/City	Residents showing no or limited interest in participation	Residents' limited knowledge of smart cities	Lack of local leadership	Distrust in the effectiveness (results) of authorities' actions	None	Others
Boguchwała		X				
Ełk			X			
Kielce				X		
Kołobrzeg	X	X	X			
Krosno	X					
Lublin						X
Nakło nad Notecią	X	X	X	X		
Nowa Ruda		X				
Ostróda	X					
Rawicz				X		
Siechnice			X			
Siemianowice Śląskie			X			
Sierpc	X					
Zakliczyn		X				
Zduńska Wola					X	
Żuromin	X					

Source: elaborated by the authors based on the survey data.

Respondents' answers revealed several forms of communicating consultations' outcomes to the public. In most cases, reports were published on the office's website, which could be accessed through a project-dedicated bookmark. Also used were newspaper articles, social media announcements, mobile apps, and events such as webinars, open days, or forums. Occasionally, additional educational activities were provided or best practice³ manuals were distributed. Some respondents stressed the need to make residents aware of consultations' outcomes.

The experience the respondent gained during the implementation of the projects made it possible for them to identify problems and obstacles, as well as formulate recommendations.

³ Most of the respondents pointed to the "Handbook of Good Practices" published in 2022.

Table 4.
Recommendations for towns and cities considering similar projects

Town/City	Recommendations
Boguchwała	The schedule of activities should be appropriately planned.
Elk	The implemented solutions should be evaluated and reserve funds need to be available to modify them as necessary after the end of the project.
Kielce	The procurement criteria should be used as a source of inspiration; a good approach is to create a network of TSUs that will exchange their experiences and good and bad practices. The use of teamwork is recommended.
Kołobrzeg	The needs of the target group need to be established; the project should take into account all objectives and activities and its budget should be carefully estimated.
Krosno	The partners should be carefully selected and tasks should be assigned based on competencies; regular meetings to monitor progress and identify risks are recommended.
Lublin	Cities' good practice manuals can be a valuable source of useful information. In order to share lessons learnt in the course of project implementation, the Local Government Academy of Strategic Management was established in Lublin to promote participatory management as an effective method of building relationships and making decisions about a smart city.
Nakło nad Notecią	A worthwhile approach is to find and engage active community groups, utilize good practices and organize study visits to places where solutions similar to those planned have already been implemented.
Nowa Ruda	The use of technical support, including engineers, is recommended to ensure an adequate level of expertise for the project.
Ostróda	It is advisable to carefully discern the technological capabilities planned in the project at the application stage to ensure their feasibility and compatibility with the objectives.
Rawicz	Cooperation with other institutions is recommended. For instance, cooperation with the police under the monitored city project resulted in the CCTV cameras being used by the municipality not only for analytical purposes, but also to combat vandalism and crime.
Siechnice	The goals to be achieved by the project should be specifically laid out to ensure its effective implementation and measure progress.
Siemianowice Śląskie	Implementing a project requires "out-of-the-box" thinking, engaging officials, and allowing time to share good practices. It is also important that the project leaders are open-minded and view project activities as a learning and development process and supports them, even if mistakes are made.
Sierpc	None
Zakliczyn	Applications involving innovative projects should be prepared based on expert analysis and public consultations with organizations and groups of residents to benefit from them.
Zduńska Wola	The recommended projects are those that bring the satisfaction of working closely with people, even if they are time-consuming.
Żuromin	Both the assumptions of the project and its intended results need to be carefully considered.

Source: elaborated by the authors based on the survey data.

According to the above, the survey participants found it advisable to prepare a schedule of activities and precisely estimate the budget, taking into account the specific needs of the target group. The implemented solutions should be evaluated and adequate funding should be secured to appropriately adjust them after the end of the project. It is also essential to draw inspiration from existing good practices and to create a network of municipalities to exchange experiences. The respondents also recommended engaging active community groups, making study visits to places where similar solutions were implemented, and ensuring the availability of technical assistance. Creative thinking that encourages innovative solutions was found critical, likewise systematic monitoring of the project progress and close cooperation with other institutions. The initiation of the project was recommended to be preceded by a thorough analysis of available technologies in order to ensure their compatibility and feasibility. The importance of holding extensive consultations with the residents to benefit from the project was also

emphasized as a means of aligning the project with the community's real needs and making its implementation more efficient.

3. Summary and conclusions

Changing political, economic and technological circumstances require a redefined approach to making urban policies, whose main objective is to sustain economic growth and improve the quality of residents' life through activities appropriate to local conditions (Pluta, 2019). This means that regardless of how successful solutions developed in other geographical, natural, political or socioeconomic conditions were, they should not be thoughtlessly copied elsewhere. According to Florida, cities function as a sort of warehouses containing knowledge and ideas and providing conditions and appropriate infrastructure for their efficient dissemination (Florida, 1995). These processes play a crucial role as catalysts for economic growth and provide the basis for innovation and sustainable development.

This article is a response to the need for a new research arising from several challenges faced by modern cities. As the challenges require an approach capable of seamlessly combining socioeconomic and environmental goals and modern technology, an interdisciplinary and multidimensional analysis of urban issues is necessary (Krysiński, 2020). Today's cities increasingly reach for innovative solutions offered by the Smart City concept, which are beneficial for both residents and municipalities, as they make urban life easier and enable more efficient management of towns and cities. It needs to be noticed, however, that implementing Smart City solutions is a complex process that, in addition to being stretched in time, also requires a multifaceted approach and making changes simultaneously at different levels of the urban structure. It is also important to remember that the solutions should consistently improve the quality of residents' lives while ensuring environmental sustainability and respecting the needs of the generations' to come.

The presented research was undertaken to learn more about the effectiveness of Smart City projects and the challenges they face. Its findings will be used to disseminate the results of the Human Smart City competition and promote good practices among all parties interested in building social trust and increasing residents' participation in the activities of local governments. The knowledge of problems that are likely to be encountered in the course of project implementation may improve the process of applying for funds and consequently promote the competition as the method of raising funds for the implementation of Smart City solutions and contribute to its wider use in Poland. The survey results showed differences among local governments regarding the level of their involvement and resources allocated to project implementation (most of them used project teams of 4-8 people). The use of external partners was a common practice, and the average time spent on preparing an application was

two months. Although process of applying for funds was found to be moderately complicated, the need of more precise guidelines and simplification of the process was indicated. The main challenges reported by the survey participants included technological problems, insufficient human resources and public resistance, especially during the pandemic. Public consultations as a form of communication with communities were assessed positively, but the limited participation of the residents and a lack of leaders who could initiate activities were underscored.

The conclusions from the study point to the need to prepare precise plans of activities and budgets, to systematically monitor the project's progress, to engage local communities, and to draw inspiration best practices. While the study does not cover all issues that are relevant given the topic of this article, it can serve as a starting point for further research. A smart city can be seen as an ecosystem of innovations and entrepreneurship, enabling a dynamic exchange of ideas and activities addressing urban needs. The stakeholders' active participation in the process of creating innovative solutions and integrating them with information and communication technologies enhances the potential of the "wisdom of the crowd", which promotes the introduction of social innovation. This leads to bridging the gap between technology and urban communities and offers more space for civic initiatives. Consequently, cities become more open to the needs of their inhabitants and create space for the joint development of solutions that contribute to their sustainable development. Given that, it would be interesting to analyze urban residents' opinions on creating a city as a livable space for which they are also responsible through intelligent solutions.

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PREDICTING THE DEVELOPMENT OF GENERATIVE ARTIFICIAL INTELLIGENCE IN INDUSTRY

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Purpose: The aim of this article is to attempt to predict the development of generative artificial intelligence in industry.

Design/methodology/approach: The study uses a foresight approach with a scenario methodology. It includes literature and industry document analysis to identify key factors influencing GAI development. A survey of academic and industry experts highlighted two main driving forces, and scenario method steps were applied to explore alternative futures.

Findings: The study concluded that the advancement of AI technologies and the establishment of social trust are fundamental to the future of GAI in industry. The scenarios developed illustrate the manner in which distinct combinations of these factors can affect the pace of implementing GAI in industry.

Research limitations/implications: The scenarios, based on expert opinion, limit generalizability. Future research could use quantitative methods, empirical data, or study public trust and ethics in GAI over time.

Practical implications: The results suggest that GAI can improve industrial efficiency, but requires investment in model transparency and data security. Appropriate regulation is also needed to enable the safe and ethical integration of GAI.

Social implications: The development of GAI will affect privacy and the labor market, and a lack of social trust may limit its development. Companies must consider social responsibility to minimize ethical and environmental risks.

Originality/value: The study presents scenarios highlighting the role of social trust and technological progress, offering value to researchers and practitioners planning long-term GAI implementation.

Keywords: generative artificial intelligence, technological foresight, industry, scenarios.

Category of the paper: Research paper.

1. Introduction

Current times are characterized by a significant increase in the impact of technology on people's lives. One of the most exciting technologies is artificial intelligence, which is present in most spheres of our lives – we find it not only in complex computer systems and robots, but also in washing machines and smartphones (Bieroński, 2020). However, many researchers note that the development of AI is challenged by the presence of ethical issues related to, among other things, taking responsibility for the results of AI activities (Stylec-Szromek, 2018) and the surveillance of society (Sroka, 2019). According to the 2019 survey, Poles have many concerns about the performance of AI. More than 60% of respondents indicated that citizens' privacy is their biggest concern related to the spread of AI. The second-biggest concern of respondents was an increase in unemployment, which was indicated by more than 40% of them (Nask, 2019).

In industry, artificial intelligence is used to optimize production processes, among other things. By monitoring real-time data, AI can suggest various types of improvements. Additionally, it is used in the maintenance of a production plant. AI systems support predictive maintenance by anticipating potential failures and detecting all kinds of machine irregularities and suggesting, for example, the replacement of appropriate parts. Furthermore, AI in industry is also used for inventory management, as it helps to avoid shortages and downtime by monitoring stock levels and demand (Korbiel, Czerwiński, Kania, 2023). However, in industry, as in other sectors, it is important to look at technology development from a long-term perspective. For this purpose, Future-Oriented Technology Analysis (*FTA*) is used, which, among other things, enables an organization to prepare for future changes and challenges and to make appropriate decisions related to investing in the most influential technologies. One of the techniques used in *FTA* is technology foresight, which could be defined as an evaluation and examination of the influence of current technological developments on society (Halicka, 2016).

Despite the growing body of research on artificial intelligence, the specific pathways and development trajectories of Generative Artificial Intelligence within the industrial context remain underexplored. Existing literature often focuses on the technical capabilities of AI systems or their broad societal implications, leaving a gap in understanding how GAI can be effectively integrated into industry while addressing its ethical, environmental, and socioeconomic dimensions. This study seeks to address this gap by adopting a scenario-based approach to predict the development of GAI in industry, identify the factors driving its growth, and provide actionable recommendations for its responsible and effective implementation.

The increasing importance of GAI necessitates a comprehensive understanding of its potential and the challenges it presents. By examining the interplay between technological advancements, public trust, regulatory frameworks, and ethical considerations, this study aims to contribute to the discourse on fostering balanced and sustainable AI development. The findings are intended to serve as a valuable resource for researchers, policymakers, and industry practitioners striving to harness the transformative potential of GAI while mitigating its risks.

2. Literature review

One of the landmark events in the history of artificial intelligence was the Turing Test conducted in 1950. Its author, A. Turing, stated that if a machine is able to carry on a conversation indistinguishable from that of a human, then that machine can be considered intelligent. The Turing Test is considered the first major suggestion in the philosophy of artificial intelligence (Skalfist, Mikelsten, Teigens, 2020). However, its actual beginning is considered to be a conference that took place at Dartmouth in 1956. Its organizers – J. McCarthy, M. Minsky, N. Rochester and C. Shannon – described a project to create artificial intelligence (*AI*). Their main goal was to make a machine behave in a way that could be called intelligent if a human behaved that way (Berente et al., 2021). Although artificial intelligence emerged as early as 1956, it developed slowly due to immature computing technologies (Szpilko et al., 2023). Over the following decades, the term has been defined by various researchers, but still no single, agreed and consistent definition of artificial intelligence has been developed (Holmes, Tuomi, 2022).

One example of AI definition, provided by researchers N. Berente, B. Gu, J. Recker and R. Santhanam, represents AI as a process rather than as a phenomenon in itself. In their definition, artificial intelligence is the frontier of computational progress, which refers to human intelligence in solving increasingly advanced decision-making problems. It thus represents what humans do next in terms of data processing. The researchers also add that artificial intelligence is not a single recognizable thing, a set of tools, a device, a program or an algorithm. Rather, it is an idea, a concept that reflects a constantly evolving phenomenon (Berente et al., 2021).

Artificial intelligence is a multidisciplinary field, which means that many disciplines are related to it and contribute to its development. These include mathematics, biology, psychology, computer science, electronics, computer engineering or linguistics, among others (Arias, 2022; Siuta-Tokarska, 2021). Taking that into consideration, the definition that, according to the authors, best captures the essence of artificial intelligence in the context of considerations related to the topic of the paper is the one describing AI as the ability of a system to accurately

interpret external data, learn from it and use the resulting conclusions to accomplish specific objectives through flexible adaptation (Haenlein, Kaplan, 2019).

The field of AI encompasses a multitude of subfields. It is essential to recognize that AI pertains to the creation of intelligence that is not natural, or the emulation of human intelligence through computer programs. Given the multifaceted nature of intelligent behavior, AI is similarly characterized by a multitude of subfields. The principal subfields include machine learning, natural language processing, expert systems, computer vision, and robotics. It is noteworthy that these subfields are not mutually exclusive, with frequent interconnections between them (Arias, 2022).

One subfield of artificial intelligence is generative artificial intelligence (*GAI*) is focused on developing systems that are capable of generating original and creative outputs, including images, music, text, and other forms of content. By employing deep learning techniques, particularly generative models, these systems are able to produce content that is comparable to that which is created by humans (Ramdurai, Adhithya, 2023).

Generative artificial intelligence models can be divided into two main categories: unimodal and multimodal. Unimodal models are designed to process instructions of a single input type, for instance text-to-text. In contrast, multimodal models are capable of integrating data from multiple sources, enabling the generation of outputs in diverse formats. Multimodal models are applicable to a range of data modalities, including text-to-image, image-to-audio and so on (Feuerriegel et al., 2024).

The *GAI* models can use a variety of data processing techniques. These include, for example, Generative Adversarial Networks (*GAN*), Generative Pre-trained Transformer (*GPT*), Generative Diffusion Model (*GDM*) (Jovanovic, Campbell, 2022), Variational Autoencoders (*VAE*) and Convolutional Neural Networks (*CNN*) (Yu, Guo, 2023).

Generative adversarial networks are based on the training of a pair of networks. In essence, one network can be conceived of as an art forger, while the other can be regarded as an art expert. In this context, the former is referred to as a generator, which strives to create images that are as realistic as possible. In contrast, the expert network, which is referred to as the discriminator, compares the images created by the generator with authentic images and attempts to distinguish between them. The two networks are trained concurrently, engaging in a competitive process. The generator is unable to access the real images directly, therefore its sole method of learning is through interaction with the discriminator. The expert network receives an error signal indicating whether the image is generated or genuine. When the discriminator's performance is at a satisfactory level, it is possible to halt training of the discriminator, while continuing to develop the generator (Creswell et al., 2018).

Another type of *GAI* model is *GPT*, which is one of the deep learning models. This model is pre-trained on large text datasets and uses a self-attention mechanism. Thus, it is able to take into account the context of the entire sentence to generate the next word. This improves the

qualitative capabilities of the model, which can be adapted to specific tasks such as language generation, text classification or machine translation (Yenduri, 2024).

The diffusion model has recently emerged as a technique that has gained considerable popularity. The operation of such models is based on three fundamental steps. At the outset, the user inputs prompts, which may be keywords or a textual description of the desired image. Based on these inputs, the model retrieves images from the Internet or from a previously defined dataset. Next, random noise is added to mask the selected information in the image, thereby creating a variation. Finally, a diffusion process is carried out to produce new images that conform to the user's prompts. Each image created in this way is original, because even if the same prompts are entered, the model will randomly select images from the database, making further changes to them (Zhang, Liu, 2024).

Different types of models are used in many practical GAI solutions, i.e. in systems and applications such as ChatGPT or Midjourney (Hwang, Chen, 2023).

ChatGPT is a widely used generative artificial intelligence chatbot. To interact with this tool, the user poses questions to the model, which responds in a conversational manner. The model's responses are designed to appear realistic, for instance, by acknowledging mistakes or declining to answer inappropriate questions. Additionally, the generated content can assume various forms, including news articles, film scripts, software codes, business plans, and poetry (Budhwar et al., 2023). ChatGPT was created by OpenAI, basing the tool on a deep learning model that was trained on a large data set. As a result, it understands the context of the entire conversation and adapts responses in terms of the use of appropriate language and style (Deng, Lin, 2022). ChatGPT reached the one million user threshold in five days and is now estimated to be used by around one hundred million people, generating one billion visits per month (Baytak, 2024).

Midjourney is a text-to-image generator that employs a diffusion model. The model generates four initial images based on user-entered prompts, such as keywords and specific parameters. Subsequently, it is possible to generate additional images based on the same prompts or adjust them to achieve needed results. The system offers the capacity to generate images in a diverse array of styles, including vintage, or in styles associated with a particular artist. Moreover, Midjourney possesses the capability to manage scenes comprising multiple objects and characters (Zhang, Liu, 2024).

Regardless of the system type, the prompt entered by the user plays a pivotal role in the system's operation. The prompt is the starting point for the model that generates the response and is therefore a key factor in determining the accuracy and value of the result. The process of providing clear, purposeful and effective prompts to GAI models is known as prompt engineering. Its aim is to develop instructions and commands in such a way as to lead to the generation of content that meets the needs of the user (Ekin, 2023).

A correct prompt should contain four key elements: role, task, output and context. The role is one of the most important elements of the prompt. It is intended to provide the model with the perspective in which it should place itself. For example, phrasing the role as ‘recruitment expert’ suggests that the response generated should have professional overtones and be oriented towards the area of human resource management. The second aspect of the prompt is the task, i.e. specifying precisely and clearly what the model is supposed to generate. Then, the prompt should include the context, which is any additional information that may influence the receipt of a more precise answer. The fourth element of the prompt is the output. Its inclusion is optional and depends on the topic being addressed. The output may specify a particular format, language or structure of the answer. Understanding and incorporating these elements into the creation of the prompt is essential to receiving a correct and valuable answer (Ministerstwo Cyfryzacji, 2024).

Many different applications of generative artificial intelligence can be found in the literature. Some industries are using GAI widely, while some are only just identifying areas where performance can be improved by such models. Nevertheless, they are attracting an increasing number of specialists from a variety of backgrounds.

For instance, GAI is used in education, where several applications can be distinguished. The first example is an intelligent learning system that can generate personalized learning plans. It automatically adapts the content of the course and its difficulty by offering tasks that are suitable for a specific user. An intelligent tutoring system can operate on a similar principle, but in addition it suggests learning strategies based on the student's learning habits and needs. Based on its results, the system creates assignments and practice questions. Another example is a homework assessment system that allows not only checking the correctness of the completed assignment, but also generates feedback and suggestions to enable students to understand their mistakes. A final example is an intelligent speech interaction system that, by analysing historical data and continuous learning, creates a knowledge base and algorithm model, thus achieving intelligent speech recognition and synthesis. The learner communicates with the system through voice by asking questions and expressing their needs, and the system recommends resources for learning and practice (Yu, Guo, 2023).

Additionally, GAI is applied in the quality control process, which becomes more accurate and efficient. The tool detects defects, anomalies or deviations from the accepted quality standard and then reports them in real time, reducing the risk of a defective product being delivered to the customer. Furthermore, by analyzing historical data, GAI can predict potential defects before they occur. By having this type of information, manufacturers are able to take proactive action to prevent a problem from occurring (Doanh et al., 2023).

Generative artificial intelligence can also be used in the field of agriculture and environmental protection. Chatbots are not only able to spread information on pest control, effective irrigation methods and other sustainable farming techniques, but are also able to analyze data on soil quality, weather patterns and crop condition. All of these tips are valuable

for increasing yields and reducing wastage. Specialized systems trained in this area, can analyze extensive biological data and identify endangered species and habitats, promoting responsible land use and biodiversity conservation (Rane, 2024).

An interesting example of the use of GAI is the creation of digital twins and avatars, such as Eva Herzigová's 3D avatar. Generative artificial intelligence is able to generate, among other things, photorealistic animation of body movement and texture and motion animation of clothing (Lăzăroiu et al., 2024).

GAI tools are also used in the marketing industry. Specialists use both widely known models such as ChatGPT or Midjourney, but also those created specifically for marketing purposes. Generative artificial intelligence is used, among other things, to personalize content. For example, banks use it to analyze customer data, including their risk profile, and offer personalized investment advice. Retailers, too, use GAI to create recommendations that would influence customers to buy more products (Kshetri, 2024).

GAI is also used in medicine. Singh points out that it significantly improves diagnostic processes, for example in hospitals. This is because the technology is able to transform low-quality scans into highly detailed, high-resolution images. Additionally, models trained on large medical datasets can detect anomalies and identify the early stages of various diseases. Currently, algorithms are successfully diagnosing conditions such as skin cancer, hidden bone fractures and Alzheimer's disease. In addition, the use of GAI provides quick access to answers to medical queries. Instead of searching for information in textbooks, the doctor asks the system a question, which by processing huge amounts of data generates an answer in a short period of time (Singh, 2023). This can be particularly useful for staff who are not fluent in English, as many documents on medical advances are written in that language (Ooi et al., 2023).

The existence of such a large number of models, various systems that are applied in a variety of fields, is testament to the significant advancements made in generative artificial intelligence. Its future development may be influenced by a number of factors. One such factor is the need to build trust in artificial intelligence systems, which researchers say is essential for their wider adoption and integration in a range of fields. This primarily concerns the provision of transparent and comprehensible explanations for decisions, projections or recommendations generated by artificial intelligence (Jangoan et al., 2024).

3. Methodology

The process of building scenarios for the development of generative artificial intelligence in the industry involved the use of a variety of research methods that made it to accomplish the goal set in the work. The research process was divided into four individual phases.

This division, along with an indication of the research methods used in each phase and the outcome of each phase, is shown in Figure 1.

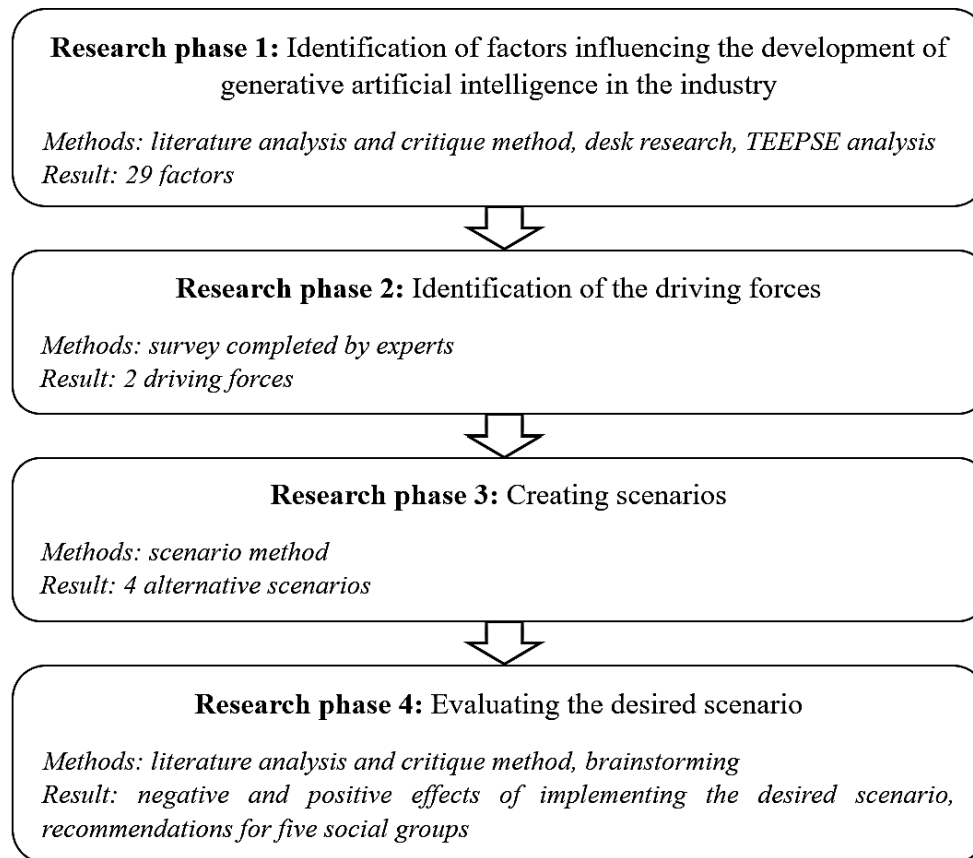


Figure 1. Methodology.

Source: own elaboration.

The research methods used in the study included literature analysis and critique method, desk research, TEEPSE analysis, survey, scenario method and brainstorming. The literature analysis and critique method is based on analysing the data already contained in the literature, which can lead to finding research gaps. This method also enables organizing the available knowledge (Mróz-Jagiełło, Wolanin, 2013). The article also benefits from desk-based research, which involves finding and analysing data available from a variety of sources, such as statistical sources, expert statements, online articles, company databases and other (Bednarowska, 2015).

The TEEPSE analysis was employed to identify the specific factors that drive GAI development within the industry. Its application enabled the factors to be grouped into six categories, the initial letters of which form the name of this analysis: technological, economical, environmental, political, social and ethical factors (Ejdys, Szpilko, 2023). This analysis was selected, due to the inclusion of ethical factors, which are not present in other analyses and represent a significant aspect of GAI technology development. Another research method used was a survey, which allowed identified factors to be assessed by experienced experts.

The scenario method was employed to investigate potential future developments in the growth of GAI within the industry. The scenario method is based on the assumption that the future will evolve in accordance with a pre-established pattern, which is the scenario. It is an outcome of the assumptions that are made regarding the future development and the factors that are influencing the forecast. In light of these considerations, the necessary steps to achieve the desired outcome can be identified (Santarek, 2016).

Finally, a brainstorming method was carried out, which is a method of generating a large number of ideas in a short period of time and selecting the most beneficial ones (Helman, Rosienkiewicz, 2016).

The first phase of the research identified factors influencing the development of generative artificial intelligence in the industry. This was done using desk research, which took into account such sources as academic articles, electronic articles, monographs, expert blogs, European Parliament documents, among others. As a result, twenty-nine factors were obtained, which were then subjected to TEEPSE analysis. This made it possible to assign the factors to six groups based on the area they cover.

Then, in the second phase of the research, a questionnaire was constructed, through which experts evaluated the factors by selecting one of four responses, following a four-point Likert scale: definitely has no impact, rather has no impact, rather has impact, definitely has impact. The survey was completed by twelve experts from both academia and industry. Subsequently, a point scale from 0 to 3 was assigned consecutively for the four response possibilities. Thus, two factors emerged as the driving forces behind GAI's growth in the industry.

The third phase of the study created four alternative scenarios for GAI's development in the industry over a 10-year horizon. The two driving forces identified earlier were used for this. Names for the scenarios were also proposed, with the acronym GAI forming the acronym.

The final phase of the study allowed the identification of the desired scenario and analysis of its effects. Possible negative and positive effects of implementing this scenario were identified for five groups (GAI developers, researchers, the public, government and industry). In addition, the article presents recommendations aimed at the same five groups. The application of the recommendations could result in the realization of the desired scenario and the acceptance of GAI technology by various groups in society.

4. Results

To identify key factors which have a significant impact on the development of GAI in the industry, sources such as academic articles, electronic articles, monographs, expert blogs, company websites, European Parliament documents and the Republic of Poland website were

reviewed. As a result, twenty-nine factors were obtained, which were then divided into six TEEPSE groups:

1) Technological factors:

- artificial intelligence development (Chan, 2023),
- the level of productivity enhancement of creative work using generative artificial intelligence (Haase, Hanel, 2023),
- the amount of data produced and available in companies (European Parliament, 2023),
- cloud computing development (Keskin, Isik, 2023),
- ability of the GAI model to provide an explanation of the response generated (Przegalińska, Jemielniak, 2023),
- computing power (Kwapisz, 2023),
- the level of reliability of the responses generated (Wang et al., 2023),
- the level of reduction in the diversity of solutions to specific issues when using the GAI model (Snodgrass, 2024).

2) Economical factors:

- cost of employing the staff (Gorzowska, 2022),
- the productivity level of enterprises (Raj et al., 2023),
- the level of competition in the GAI market (Rudolph, Tan, Tan, 2023),
- the value of an index reflecting the readiness of countries to implement artificial intelligence tools (Nzobonimpa, Savard, 2023),
- number of corporations entering into partnerships with companies offering GAI (e.g. Coca-Cola, Microsoft, Amazon) (Kubera, 2024).

3) Ecological factors:

- the level of restrictions to reduce greenhouse gas emissions (Biswas, 2023),
- the environmental cost of using GAI (George, George, Martin, 2023),
- natural resource consumption and the impact of AI on biodiversity (Ligozat et al., 2022),
- climate change adaptation and mitigation through GAI models (Vinuesa et al., 2020).

4) Political factors:

- the level of protection of personal data guaranteed by GAI models (Sebastian, 2023),
- availability of national funding (Serwis Rzeczypospolitej Polskiej),
- the level of regulation by the European Parliament (European Parliament, 2020),
- the level of support for innovation by the European Parliament (European Parliament, 2021).

5) Social factors:

- availability of qualified staff (Chuang, 2024),
- the level of public confidence in artificial intelligence (Łapińska et al., 2021),
- impact of the use of GAI models on social equity (Zajko, 2022),
- changes in the labor market structure brought about by GAI models (Joamets, Chochia, 2020).

6) Ethical factors:

- the level of alignment of artificial intelligence with the organization's culture and values, e.g. in the context of employee monitoring (Przegalińska, Jemielniak, 2023),
- the number of redundancies associated with the replacement of human labour by GAI models (Konstantis et al., 2023),
- transparency of GAI models and their explanatory power (Haresamudram, Larrson, Heintz, 2023),
- autonomy and human control over decisions taken by artificial intelligence (Cavalcante Siebert, 2023).

The most numerous group of factors is technological. As many as eight were identified, which may indicate their importance in the context of the problem studied. In second place in terms of numbers are the economic factors, of which five were identified. In the other four groups, the authors identified four factors each.

Based on the identified factors, a questionnaire was prepared in Microsoft Forms. The survey was based on a four-point Likert scale. Participants were able to select one of four responses: definitely has no impact, rather has no impact, rather has an impact and definitely has an impact. The identified factors were then assessed by twelve experts. Seven of them are academics from the Bialystok University of Technology, while five experts come from industry and work in a variety of industries: packaging, FMCG/supply chain, automotive, heating appliance manufacturing and the furniture industry. They also hold diverse positions, such as product development and sales manager, last mile and warehousing procurement manager, product leader SCADA & digital solutions, head of organization and production management and production engineering specialist. These experts evaluated all factors by selecting one of four possible answers.

In addition, point values were assigned to the responses in order to assess which factors were considered by the experts to be key. For this purpose, the following scoring scale was used for individual responses:

- definitely has no impact – 0 points,
- rather has no impact – 1 point,
- rather has an impact – 2 points,
- definitely has an impact – 3 points,

This resulted in the values shown in Table 1.

Table 1.
Assigning points to factors

Group	Factor	Definitely has no impact		Rather has no impact		Rather has an impact		Definitely has an impact		Sum
		no. of responses	points	no. of responses	points	no. of responses	points	no. of responses	points	
TECHNOLOGICAL	Artificial intelligence development	0	0	0	0	4	8	8	24	32
	The level of productivity enhancement of creative work using generative artificial intelligence	0	0	1	1	7	14	4	12	27
	The amount of data produced and available in companies	0	0	4	4	5	10	3	9	23
	Cloud computing development	0	0	1	1	8	16	3	9	26
	Ability of the GAI model to provide an explanation of the response generated	0	0	1	1	7	14	4	12	27
	Computing power	0	0	2	2	3	6	7	21	29
	The level of reliability of the responses generated	0	0	0	0	6	12	6	18	30
	The level of reduction in the diversity of solutions to specific issues when using the GAI model	0	0	2	2	9	18	1	3	23
	Cost of employing the staff	0	0	2	2	7	14	3	9	25
ECONOMICAL	The productivity level of enterprises	0	0	4	4	6	12	2	6	22
	The level of competition in the GAI market	0	0	1	1	9	18	2	6	25
	The value of an index reflecting the readiness of countries to implement artificial intelligence tools	0	0	4	4	7	14	1	3	21
	Number of corporations entering into partnerships with companies offering GAI...	0	0	1	1	10	20	1	3	24
	The level of restrictions to reduce greenhouse gas emissions	1	0	6	6	4	8	1	3	17
ECOLOGICAL	The environmental cost of using GAI	0	0	5	5	5	10	2	6	21
	Natural resource consumption and the impact of AI on biodiversity	2	0	4	4	5	10	1	3	17
	Climate change adaptation and mitigation through GAI models	1	0	4	4	7	14	0	0	18

Cont. table 1.

POLITICAL	The level of protection of personal data guaranteed by GAI models	0	0	2	2	8	16	2	6	24
	National funding availability	0	0	4	4	4	8	4	12	24
	The level of regulation by the European Parliament	0	0	1	1	8	16	3	9	26
	The level of support for innovation by the European Parliament	0	0	1	1	9	18	2	6	25
SOCIAL	Qualified staff availability	0	0	2	2	8	16	2	6	24
	The level of public confidence in artificial intelligence	0	0	1	1	5	10	6	18	29
	Impact of the use of GAI models on social equity	0	0	7	7	5	10	0	0	17
	Changes in the labor market structure brought about by GAI models	0	0	1	1	11	22	0	0	23
ETHICAL	The level of alignment of artificial intelligence with the organization's culture and values, e.g. in the context of employee monitoring	0	0	4	4	7	14	1	3	21
	Number of dismissals related to the replacement of human labor by GAI models	0	0	0	0	10	20	2	6	26
	Transparency of GAI models and their explanatory power	0	0	2	2	4	8	6	18	28
	Autonomy and human control over decisions taken by artificial intelligence	0	0	1	1	8	16	3	9	26

Source: own elaboration.

By using a point scale and multiplying the number of responses by the number of corresponding points, the two factors that were rated highest by the experts were identified. A criterion of factors from different groups was taken into account in the selection. These factors are highlighted in red in the table. These factors are: artificial intelligence development and the level of public confidence in artificial intelligence.

Identifying these two driving forces enabled the construction of four alternative scenarios for the development of generative AI in industry in a 10-year timeframe:

- Scenario 1 – rapid development of artificial intelligence and high level of public confidence in artificial intelligence.
- Scenario 2 – rapid development of artificial intelligence and low level of public confidence in artificial intelligence.

- Scenario 3 – slow development of artificial intelligence and low level of public confidence in artificial intelligence.
- Scenario 4 – slow development of artificial intelligence and high level of public confidence in artificial intelligence.

The authors named the scenarios with the acronym GAI: Scenario 1 – **Gigantic And Ingenious**, Scenario 2 – **Great Anomaly of Innovation**, Scenario 3 – **Gnarly Assistant Improvisation**, Scenario 4 – **Gradual Approval of Integrity**. The research process carried out made it possible to construct brief descriptions of these scenarios:

- Scenario 1 (**Gigantic And Ingenious**) – In the year 2034, generative artificial intelligence (GAI) is a tool used widely across many industries. Its rapid and fast development enables continuous improvement of GAI models. Consequently, these models produce inspiring graphics and provide reliable and credible information that meets the needs of users. This contributes to the high level of public confidence in GAI. In large industrial companies, it is responsible for more than half of the creative work.
- Scenario 2 (**Great Anomaly of Innovation**) – The rapid development of artificial intelligence does not go hand in hand with the generation of trustworthy answers, and focuses mainly on increasing the functionality of systems and improving interfaces. The lack of regulation and safeguards on the part of system developers leads to systems generating false information and low levels of data protection. This, in turn, translates into skeptical users and businesses lacking confidence in the technology. Generative artificial intelligence in 2034 is therefore used sporadically in the industry, mainly to create interesting information graphics. Increasing the reliability of responses and the security level of users could lead to scenario 1, while a lack of progress in this area will result in a move to scenario 3.
- Scenario 3 (**Gnarly Assistant Improvisation**) – The lack of transparency of systems and their generation of false information results in user reluctance and mistrust. In a 10-year timeframe, industrial companies are reluctant to use technology that is inaccurate and potentially dangerous, for fear of its negative impact on production processes and the leakage of key data. The artificial intelligence market is growing very slowly due to a lack of interested users. GAI also faces a lack of public acceptance and investment difficulties. Only improving the level of reliability of the answers generated and the protection of the data could be a start to gain the trust of investors and businesses, and consequently move towards scenario 2.
- Scenario 4 (**Gradual Approval of Integrity**) – Stricter rules and regulations significantly increase the level of data protection. The reliability of the answers generated is also improving. In the year 2034, industrial companies are more willing to use GAI technologies, as they allow quick access to reliable information, with a high level of security at the same time. On the other hand, strict regulations are significantly slowing

down the development of artificial intelligence, which has also become very expensive. This leads to an insatiable market, as there is a lack of specialized systems tailored to the specific functions required by industry. Subsidies to IT companies could accelerate the development of GAI systems, which will result in a gradual transition to scenario 1.

The scenarios are also presented in the form of a matrix composed of graphical representations of the scenarios generated in the ChatGPT chatbot (Figure 2).

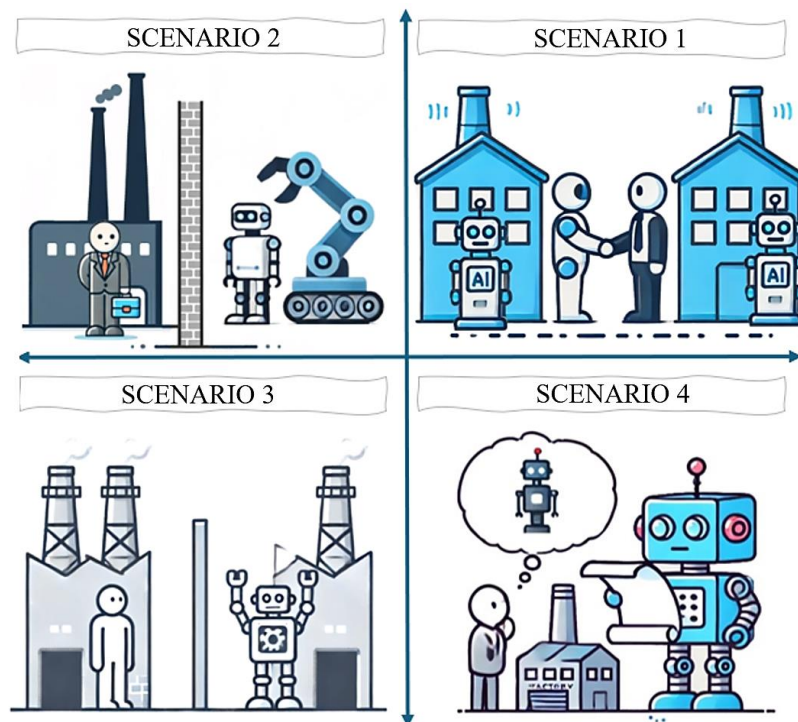


Figure 2. Scenarios for the development of generative artificial intelligence in industry.

Source: pictures generated in ChatGPT chatbot.

The most desirable scenario is Scenario 1. Therefore, its description has been made more specific:

In scenario 1, the rapid development of AI is driven by a high level of public confidence in the technology. Indeed, in a 10-year perspective, the rapid development of AI is driven, among other things, by the high level of interest from manufacturing companies. As a result, increasingly advanced models are being developed that are able to process and analyze huge amounts of data. Nevertheless, the IT companies behind the construction of these models are concerned about respecting copyright and protecting user data. As a result, confidence in generative artificial intelligence is very high and more and more organizations are choosing to use it. Artificial intelligence experts note the emergence of the GAI trend. In line with market requirements, dedicated systems are being built to meet the needs of specific companies and their specificities. Personalization is therefore increasing and the individual preferences of each actor are being taken into account. According to this scenario in 2034, generative artificial intelligence is used in many manufacturing companies, where it is used, for example, to design new products, analyze the market, improve production processes and manage the supply chain.

Additionally, it is commonly used to create marketing content and analytical reports. As a result, in many companies, positions consisting mainly of repetitive and routine tasks have been eliminated as they have been replaced by the GAI system. Some employees were redeployed to positions involving the creation and operation of systems, which required additional training. In addition, GAI has become a decision support tool. It is used for operational decisions by managers and strategic decisions by the boards of directors of the respective organizations. In summary, having a generative artificial intelligence system that not only automates but also streamlines individual processes and introduces new creative and analytical capabilities is a major competitive advantage for a company. Industrial organizations are keen to invest in GAI solutions because the expense has a relatively quick payback.

In order for Scenario 1 to become a reality in 10 years' time, it is necessary to take comprehensive measures to support the development of artificial intelligence and to raise the level of public confidence in GAI technology. Accordingly, the authors has formulated specific recommendations aimed at five groups that have a significant impact on the development of generative artificial intelligence in industry. These groups include: scientists, society, government, GAI developers and industry representatives. Recommendations have been developed based on desk-based research, which has enabled data collection, analysis of current trends and challenges in the area of generative artificial intelligence. The implementation of the identified actions would result in the further development of the studied technology and its acceptance by various social groups.

Recommendations for scientists:

- Exchange of knowledge and experience with industry through, for example, Technology Transfer Centers (Konfederacja Lewiatan, 2024).
- Commercialization of the results of scientific activity (Lampart, 2023).
- Creation of directions related to the creation, handling and interpretation of generative artificial intelligence results (Kotval).

Recommendations for the society:

- Participate in training sessions outlining the benefits and risks of using GAI (Gerbert et al., 2018).
- Openness to re-branding (Aigolab).
- Applying GAI to everyday tasks (European Parliament, 2020).

Recommendations for the government:

- Increasing the stringency of data protection law (General Data Protection Regulation).
- Removal of barriers and creation of legal conditions for the development of AI (Ministerstwo Cyfryzacji, 2023).
- Use of financial incentives such as tax breaks or subsidies for AI development projects (Konfederacja Lewiatan, 2024).

Recommendations for GAI developers:

- Certification of systems to increase protection, differentiation and, consequently, popularity (AI Ethics Certification).
- Turning attention towards ethical risks and opportunities in the development of new models and systems (AI Ethics Lab).
- Creating models who refuse to answer questions that spread hatred (Zewe, 2024).
- Focus on cyber security (Gerbert et al., 2018).

Recommendations for industry representatives:

- Adaptation of staff to new technologies related to GAI by, among other things, improving their competence in this area (Śledziwska).
- Implementation of new structures including increased storage, processing power and bandwidth (Gerbert et al., 2018).
- Building an organizational culture that encourages the implementation of various AI solutions (Szarański).

The recommendations formulated represent a kind of guideline for the respective groups. Their application within 10 years may contribute to the rapid development of artificial intelligence and increase the level of public confidence in generative artificial intelligence, which could consequently lead to the desired scenario. In addition, the recommendations can serve as a reference when creating a plan for GAI development in the industry.

Additionally, the authors highlighted the potential impacts of the indicated scenario, which could be visible in 2034. These were identified by brainstorming with people of different ages and experience in different industries. These impacts were again grouped into five groups, considering scientists, society, government, GAI developers and industry representatives (Table 2).

Table 2.*Potential impacts of the scenario*

Negative impact	Positive effects
for the scientists	
<ul style="list-style-type: none"> • Pressure to achieve rapid technological solutions. • Possible shift in priorities from scientific breakthroughs to commercial projects. • Ethical dilemmas related to social responsibility for discoveries in the artificial intelligence sector. • Potential threat of copyright violation. 	<ul style="list-style-type: none"> • Research funding and grants related to the development of GAI. • Opportunities for cooperation between science and business. • Opening up new areas of research. • Ability to analyze large data sets simultaneously.
for the society	
<ul style="list-style-type: none"> • Elimination of some jobs, especially those involving routine tasks. • The need to adapt one's skills to new technologies. • High dependence on technology. • Possible discrimination based on gender, color, orientation, language, etc. 	<ul style="list-style-type: none"> • Personalization of products and services. • High demand for people qualified as e.g. prompt engineer, data engineer. • Potentially greater availability of services and products. • Improved quality of life through automation of routine activities.

<ul style="list-style-type: none"> • Sense of insecurity - significant overemphasis on human competence by GAI. • Widening social inequalities. 	<ul style="list-style-type: none"> • Potential breakthroughs in medicine, renewable energy, etc.
for the government	
<ul style="list-style-type: none"> • The rapid development of GAI may be outpacing regulatory updates. • Disinformation - spreading false information. • Risk of monopolization of the market. • Problem of establishing responsibility for critical errors made by artificial intelligence systems. 	<ul style="list-style-type: none"> • Economic growth. • Greater transparency of operations and the ability to monitor individual actors. • Improved management of crisis situations. • Automation of public administration tasks, which can increase efficiency and reduce costs. • New tools to fight crime. • Facilitation of decision-making.
for GAI developers	
<ul style="list-style-type: none"> • Strong competition. • Ethical dilemmas related to the impact of technology on the labor market and user privacy. • High responsibility for correct and continuous operation of systems. • Risk of losing control of technology. 	<ul style="list-style-type: none"> • High demand for GAI systems. • Attracting investors. • Expansion into many markets. • Possibility of extending the systems' functionality to other areas of life.
for industry representatives	
<ul style="list-style-type: none"> • High dependence on technology. • Accountability of managers for decisions made by the system. • Increasing the advantage of large companies over medium and small companies that do not have sufficient resources to introduce GAI systems. • The need to recruit new staff skilled in artificial intelligence. • Need to invest in protection systems (cyber security). 	<ul style="list-style-type: none"> • Increased efficiency of production processes. • Innovation of products and services. • Facilitated personalization. • Reduced production costs. • Complete automation of many processes. • Acceleration of sales cycles. • Making better business decisions.

When analyzing the identified impacts of the implementation of the desired scenario, it can be seen that the number of potential negative and positive impacts in each group is very similar. In addition, the identification of negative impacts can contribute to a scenario implementation strategy such that the likelihood of their occurrence is as low as possible. Some negative impacts can be avoided altogether – for example, the potential copyright infringement of scientists can be mitigated through the application of appropriate legal regulations relating to GAI models. Positive impacts, on the other hand, can be a motivation for further development of generative artificial intelligence for all groups highlighted.

5. Discussion

The findings of this study offer a comprehensive insight into the factors that shape the development and deployment of generative artificial intelligence (GAI) in industry. The analysis of the views of experts from both the academic and industrial sectors has not only identified the key factors, but also provided an understanding of the complex interplay between

technological, social, economic, environmental, political and ethical factors that will shape the future development of GAI. The scenarios presented illustrate how these factors can either accelerate or slow down the adoption of GAI in industry, with significant implications for stakeholders.

The development of artificial intelligence and public trust have emerged as the two main factors influencing the future of GAI scenarios in the industry. The rapid advancement of artificial intelligence and the growing public trust in its capabilities will enable the widespread adoption of GAI in industry, leading to significant increases in productivity and innovation. On the other hand, slow progress or low levels of trust could result in GAI being used only in a limited number of niche applications. These findings are in line with research indicating that public trust is a key factor in the long-term development of AI technologies (Jangoan et al., 2024).

The generative AI development scenarios outlined in this study reflect concerns identified in the existing literature regarding data security and reliability in AI applications (Sebastian, 2023; Kwapisz, 2024). The anticipated reliance on regulatory and security measures in the GAI trajectory supports the claim that GAI adoption depends not only on technological advances, but also on public mood and ethical alignment (Łapińska et al., 2021; Konstantis et al., 2014).

6. Conclusions

The rise of Generative Artificial Intelligence (GAI) signifies a paradigm shift in industrial operations, offering a spectrum of possibilities for innovation, productivity, and societal transformation. This study underscores the interplay between technological advancements and public trust as critical drivers shaping GAI's development trajectory. The scenarios developed illustrate how these factors can influence the speed and scope of GAI adoption in industry, providing valuable insights for stakeholders navigating this transformative landscape.

GAI's potential is immense: it can revolutionize industrial processes by enabling predictive maintenance, enhancing resource management, and personalizing customer experiences. However, the path to realizing this potential is fraught with challenges. Ethical concerns, such as the transparency of AI systems, accountability for their decisions, and the potential for misuse, must be addressed. Additionally, the socioeconomic implications, including job displacement and skill realignment, necessitate proactive measures to prepare the workforce for an AI-driven future.

The study emphasizes the importance of a collaborative approach involving academia, industry, government, and society to ensure the responsible development and deployment of GAI. Policymakers must establish robust regulatory frameworks that balance innovation with ethical considerations, fostering an environment conducive to trust and safety. Industry leaders

must prioritize investments in secure and transparent AI systems, while embedding AI into their organizational cultures in ways that respect human dignity and creativity. Researchers should continue to explore the multifaceted dimensions of GAI, integrating technological, ethical, and societal perspectives to guide its sustainable development.

Future research could extend this study by employing quantitative forecasting methods, analyzing sector-specific adoption patterns, and conducting longitudinal studies on public trust in AI. Additionally, examining the environmental impact of AI technologies and exploring ways to mitigate their resource intensity will be critical for sustainable development. Stakeholders should also monitor evolving societal attitudes toward AI, ensuring that public engagement and education remain central to GAI's growth.

In 10 years, the realization of the most desirable GAI scenario—characterized by rapid technological development and high public trust—could significantly enhance industrial efficiency, drive innovation, and improve the quality of life. However, achieving this vision requires concerted efforts to address ethical and societal challenges. By fostering transparency, accountability, and inclusivity, stakeholders can ensure that GAI contributes to a future that balances technological advancement with human values.

Ultimately, this study provides a roadmap for navigating the complex and dynamic landscape of GAI development. It highlights the need for cohesive, interdisciplinary approaches that prioritize ethical and sustainable growth. As GAI continues to evolve, its successful integration into industry will depend on the ability of all stakeholders to collaborate, innovate, and address the broader implications of this transformative technology.

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THE POSSIBILITIES OF USE INFORMATION TECHNOLOGY TO IMPROVE THE PROCESSES OF ENERGY ENTERPRISES

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Purpose: The objective of this paper is to examine the potential of selected information technologies to facilitate the implementation of business processes in power sector companies during the energy transition.

Design/methodology/approach: The stated objective was achieved through an in-depth examination of the challenges that energy companies are facing as a result of the transformation, a comprehensive analysis of the core processes of these companies, beginning with their current state, and the identification of information technologies that can facilitate these processes. In order to achieve the stated objective, a case study method and a critical literature analysis method were employed. Additionally, complimentary unstructured interviews were conducted. The scope of the paper encompasses the analysis of scientific and industry literature, the execution of the research, a discussion of the results, and the formulation of theoretical and practical conclusions. Furthermore, the paper presents the author's perspective on the issues raised.

Findings: The work identified and evaluated selected elements of the application and development of the process approach in energy companies during the transition period. It also identified the information technologies and the scope of their use. The effectiveness of the case study method for solving this type of problem was practically proved.

Research limitations/implications: The work carried out indicates the need to extend the quantitative scope of the research and to cover different categories of energy companies in the energy supply chain. The results obtained can be applied primarily to electricity system operators involved in electricity distribution, in terms of planning and operation processes of the electricity grid, and RES producers.

Practical implications: The findings indicate the necessity for enterprises to promptly identify, develop and implement novel processes. Without such implementation, enterprises will be inadequately prepared to meet the legal, regulatory and factual requirements for ensuring the continuity of energy supply to consumers in a transition environment. Furthermore, the core business processes of these enterprises will not be effectively implemented.

Social implications: The failure to implement the proposals could result in a disruption to the supply of electricity to consumers and businesses. This could have a detrimental impact on the quality of life of residents and impede the operational capacity of businesses, thereby reducing their competitiveness.

Originality/value: The primary focus of the paper is to identify the essential processes that must be put in place during the transition period and to suggest the most appropriate information technologies that can be used within these processes. The paper is intended for researchers engaged in the field of process management in power sector companies and for managers of these companies who are responsible for planning and operating the power grid.

Keywords: process approach, power sector companies, energy transition, information technology.

Category of the paper: case study, point of view.

1. Introduction

The energy sector, in conjunction with the armed forces, security services, and those responsible for the protection of public health and safety, constitutes a vital component of the infrastructure necessary for the continued functioning of the state. The primary objective of the energy sector is to guarantee the uninterrupted and dependable delivery of fuels and energy to consumers, encompassing citizens, businesses, and institutions. This entails guaranteeing the sufficient provision of a specific energy carrier and ensuring the availability of the means of transporting this energy carrier. It is imperative that sufficiency is guaranteed at all times, both at the point of supply and in the future.

The energy sector could be comprised of two subsectors: fuel and electricity. The fuel subsector encompasses the supply of liquid, gaseous, and solid fuels, while the electricity subsector is responsible for the generation and distribution of electricity. The electricity subsector, within the broader context of the energy supply chain, encompasses a range of activities, including fuel supply, electricity generation, energy transmission and distribution, and wholesale and retail energy trading. The subject of this paper is mainly energy distribution, which encompasses the transportation of energy from the transmission network to consumers connected to the distribution network.

For a number of years, the energy sector, and in particular the electricity subsector, has been undergoing a process of energy transition. In essence, the objective of energy transformation is to enhance the utilization of energy derived from renewable sources, optimize energy efficiency and mitigate adverse environmental impacts. The specific goals and scope of the transformation in different countries are the result of political decisions. In Poland, for example, the implementation of EU and national climate policy (NECP, 2019) has been a significant driver of change. The energy transition has a very strong impact on the business processes implemented in power sector companies. This encompasses both the generation of electricity from primary fuels and the control of these sources, the collection and analysis of process data, the provision of IT security, and the support of energy trading.

Information technology has been a key enabler of business processes in power sector companies for many years. This includes database systems, production planning and optimization systems, and dedicated control systems, including real-time systems (SCADA). In the present era, advancements in information technology have facilitated the integration of novel technologies, including cloud computing, artificial intelligence, machine learning, and the Internet of Things. Furthermore, it is possible to develop and enhance existing technologies, for instance, towards their autonomization.

In this context, it is essential to identify the key research and practical needs. The research needs may include the selection of appropriate methods and the execution of studies to identify the expected extent of support for the implementation of business processes in power sector companies by modern IT technologies and the possibilities for their implementation. Practical needs may include the identification of conditions that facilitate the effective and efficient utilization of technology within enterprise contexts, particularly in the context of market conditions. The following paper seeks to provide responses to these needs and suggest avenues for further research.

A suitable starting point for analyzing the current state of affairs in terms of classifying and detailing the processes carried out in power sector companies would be the classification developed and elaborated by the organization *American Productivity & Quality Center* (APQC Cross-Industry, 2024). This classification identifies and describes more than a dozen groups of processes, ranging from vision and strategy development to production and sales management and business capability development. Furthermore, the proposed classification can be adapted to a specific class of companies belonging to the utility category. In this category, a dozen process groups are also defined, most of which overlap with the general classification. These are the following processes (APQC Utilities, 2023):

1. Develop Vision and Strategy.
2. Develop and Manage Products and Services.
3. Market and Sell Products and Services.
4. Manage Procurement and Logistics.
5. Manage Customer Service.
6. Develop and Manage Human Capital.
7. Manage Information Technology.
8. Manage Financial Resources.
9. Acquire, Construct, and Manage Assets.
10. Manage Enterprise Risk, Compliance, Remediation and Resiliency.
11. Manage External Relationships.
12. Develop and Manage Business Capabilities.
13. Operate Utility Assets.

The aforementioned classification is of a general nature and, in practice, should be adapted to the specifics of the activity carried out by a given energy company under given market and regulatory-legal conditions. In the Polish context, three principal categories of energy market participants can be identified: generation companies, system operators (at the distribution and transmission levels) and electricity trading companies (IRiESP, 2024).

Among the generation companies, a distinction can be made between those that utilize conventional energy sources and those that utilize renewable energy sources (RES), the latter of which have emerged as a direct consequence of the energy transition.

The principal business processes of each of these groups of companies are aligned with their core business activities. For conventional generators, the principal business processes are those associated with the procurement of fuel, the generation and sale of electricity in the energy market, and the sale of system balancing services in the balancing market. In the case of renewable generators, the aforementioned processes pertain to the injection of energy into the electricity grid. In the case of distribution system operators, the processes in question pertain to the operation of the grid. In the case of transmission system operators, the processes relate to the planning and operation of grid operations and system balancing (Biolcheva et al., 2022).

The energy transition gives rise to the necessity of defining the processes of RES generators and of redefining and complementing the processes of other utilities. For conventional generators, the processes of maintaining production assets, which are subject to gradual decommissioning as the transition progresses, assume greater importance. For system operators, the processes of network operation planning and system balancing present a challenge due to the increase in the share of RES sources. In essence, the power balance, and for RES generators, all business processes must be defined and enhanced in the energy market, which is undergoing transformation as a result of the transition (Mihailova et al., 2023; Bryant, 2018).

The novel and modified processes are distinguished by markedly elevated quantitative complexity. These processes entail a considerably larger number of generation sources (distributed and relatively small-scale RES sources), the necessity of making them observable and controllable, the requirement for secure transmission of a substantial amount of data, including commercial transaction data, and an increase in real-time activities (Losada-Agudelo et al., 2024).

The aforementioned characteristics of the processes in question necessitate the utilization of efficacious information technology. To date, energy companies with a direct involvement in the operation of the electricity system and the functioning of the energy market (exclusive of the broader corporate processes) have predominantly utilized database technologies, real-time systems (SCADA) and dedicated data teletransmission systems (Wu, 2006). As the energy transition progresses, there is an increasing need for data processing, secure data transmission and the autonomization of parts of the processes. This necessitates the utilization of

contemporary information technologies, whose characteristics are aligned with these requirements (Arévalo et al., 2024; Nambiar et al., 2022; Singh et al., 2023).

The literature on the subject does not contain comprehensive and detailed analyses, both in the area of defining or redefining business processes in the aforementioned groups of power sector companies during the transition period, nor has there been any cross-sectional research on the selection of new technologies that could support these processes. The research gap thus identified is very extensive and requires a great deal of research and analysis, which is significantly beyond the scope of a single paper. For this reason, the intention of the paper is to start filling the research gap first of all by proposing key processes in the area of electricity system and energy market functioning in Poland, the emergence or change of which is a result of the transformation. The second proposed element is to identify IT support needs and to propose IT technologies that can support these processes, complementing the currently used technologies.

The scope and layout of the paper is as follows. Chapter 2 characterizes the research methods used to address the problem. Chapter 3 presents the results of the research. Chapter 4 discusses the results and presents the author's position on the issues raised. The final chapter deals with the evaluation of the research and its practical relevance. Directions for further work are also presented.

2. Methods

The findings of the literature review revealed a dearth of a systematic methodology for the delineation of novel processes in energy enterprises and the discernment of information technologies that can facilitate them. It was thus decided to conduct original research in a number of selected energy companies. It was assumed that the nature of the research conducted in the enterprises should meet the following premises:

1. Focus on energy transformation.
2. Examine different enterprises simultaneously.
3. Analyze the phenomenon in the context of the company's functioning in the business environment.
4. Explore in depth the complexity of the phenomenon under study.

The characteristics of the study thus defined correspond to the typical features of the case study method (Benbasat et al., 1987), which was chosen as the primary research method. Case studies focus on the study of real-life phenomena (Yin, 2018) and their methodology is strictly defined and homogeneous (Goffin et al., 2019). Unstructured interviews were adopted as a complementary method due to the reciprocal impact of processes in one group of companies on other companies. This research method should provide information to capture the broader context of the phenomenon under study (Flyvbjerg, 2006).

The basic research procedure – the case study method runs as follows (Czakoń, 2006):

1. Formulation of research question.
2. Selection of case/cases.
3. Development of data collection tools.
4. Field research.
5. Data analysis.
6. Formulation of generalizations.
7. Confrontation with the literature.
8. Closure of the study.

The complementary research procedure, the unstructured interview method, is conducted in the following manner (Babbie, 2020; Silverman, 2017):

1. The formulation of issues for discussion is initiated.
2. The motivation of the respondent to answer honestly and extensively is elicited.
3. Responses are obtained and recorded.
4. The responses are analyzed to formulate conclusions.

3. Results

A single distribution system operator (DSO) in Poland was selected for the study using the case study method. The unstructured interview method was employed to conduct research on three companies: one distribution system operator in Germany and two national power companies. The research was confined to the domains of power grid operation management and source control for the system operators and power companies, respectively. The research procedures utilized were delineated in the methodology, as presented in Chapter 2.

For the case study (Method 1.), the subsequent steps of the procedure are illustrated in Table 1.

Table 1.
Steps of the case study procedure

No	Step	Description
1.	Formulation of research question.	(a) What is the impact of the energy transition on the company's operations in the context of process management in the area of grid operation management? (b) What new processes are being identified and what modifications to existing processes are needed in the area under analysis? (c) What are the related business needs and which IT technologies can be applied to support the implementation of these processes?
2.	Selection of case/cases.	In the case study, information was available on the power grid operation management process currently in place, the resources and the IT tools used in the process. The study emphasized the level of detail of the business requirements for the target process flow.
3.	Development of data collection tools.	Typical data sources used in network operation management were used. Data was extracted in several successive iterations, according to the state of knowledge of the process.
4.	Field research.	The research was carried out primarily during visits to the company, interviews with staff responsible for network traffic management, ICT tools and development, desk research and analysis of publicly available company data.
5.	Data analysis.	The analysis of the data consisted of isolating changes or additions to the ongoing process and identifying the resource support needs of the process implementation. On this basis, it was determined what IT support would be needed. A set of modern IT technologies that are currently in commercial use was then identified. Using the review method, technologies were matched to the expected scope of IT support. The technology proposals were then confronted with the company's expectations and the necessary adjustments were made. Finally, a preliminary analysis was made of the possibilities of implementing the technologies in the enterprise.
6.	Formulation of generalizations.	On the basis of the analysis carried out, technology was assigned to the processes carried out in the company.
7.	Confrontation with the literature.	The results obtained were related to the conclusions of the literature review on new or modified processes in energy companies in transition and the use of modern information technologies.
8.	Closure of the study.	

Source: own study.

For the unstructured interviews (Method 2), the next steps of the procedure are shown in Table 2.

Table 2.
Steps of the unstructured interview procedure

No	Step	Description
1.	The formulation of issues for discussion is initiated.	(a) What is your view of the impact of the energy transition on the company's operations in the context of process management in your area of responsibility? (b) What new processes are being identified and what modifications to existing processes are necessary in the area under review? (c) Which information technologies can be applied to support the implementation of these processes?
2.	The motivation of the respondent to answer honestly and extensively is elicited.	Free conversation, referring to the respondent's experience and competence.
3.	Responses are obtained and recorded.	Form of notes.
4.	The responses are analyzed to formulate conclusions.	On the basis of the analysis carried out, changes or additions to the implemented process were identified, IT support needs were identified and technology was assigned to the processes implemented in the company.

Source: own study.

For the 4 companies, a total of 8 new processes or processes in need of change, 7 requirements for information systems and 6 technologies that can support process implementation were identified. The results are summarized in Table 3.

Table 3.
Results of the study

No	Company (Method)	Indicated processes	Requirements	Technology proposed
1.	System Operators (Method 1. and Method 2.)	(A) Identification of technical constraints (B) Identification of balancing limitations (C) Data security	(01) Real-time processing of large data sets (02) Securing the integrity and sequencing of data transmission	(i) Technological cloud (iii) Integrated cybersecurity tools
2.	RES Producer (Method 2.)	(D) Generation forecasting and planning (E) Data exchange with system operators (F) Ongoing control of the installation	(01) Real-time processing of large data sets (03) Ensuring observability of individual generation plant components (04) Predictive generation of power plants (05) Autonomous control of RES plant operation	(i) Technological cloud (ii) IIoT (iv) AI and ML (v) Autonomous control systems (vi) Blockchain
3.	Conventional Power Plant (Method 2.)	(G) Continuous assessment of facility availability	(01) Real-time processing of large data sets (03) Ensuring observability of individual generation plant components	(i) Technological cloud (ii) IIoT
4.	Trader (Method 2.)	(H) Commercial balancing of resources	(01) Real-time processing of large data sets (02) Securing the integrity and sequencing of data transmission (06) Autonomous balancing of customer demand (07) Customer demand forecasting	(i) Technological cloud (ii) Integrated cybersecurity tools (iv) AI and ML (v) Autonomous control systems (vi) Blockchain

Source: own study.

A schematic illustration of the results can be found in Figure 1.

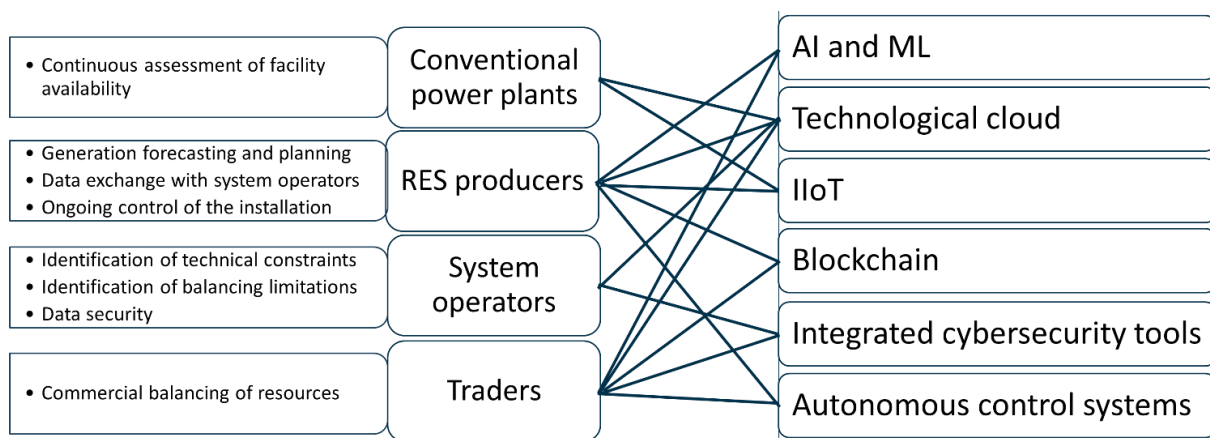


Figure 1. Assigning modern technologies to companies (processes).

Source: own study.

4. Discussion

The study conducted for system operators revealed the necessity for the implementation of three novel processes. Process (A) pertains to the identification of potential constraints that may emerge on the grid as a consequence of renewable energy generation exceeding the grid's capacity. Process (B) pertains to the necessity of maintaining equilibrium between the generation of energy from renewable sources and the demand for it, in instances where the former exceeds the latter. Process (C) pertains to the necessity of ensuring the confidentiality and integrity of data transmitted regarding the control of renewable energy installations.

The necessity for ensuring adequate capacity to process substantial quantities of system state data and to determine suitable control signals for system users is an inevitable consequence of these processes. Given their volume and the necessity of access via open communication systems, these signals must be adequately secured.

To facilitate the implementation of these processes, two technologies were identified as adequate: (i) Technological cloud and (iii) Integrated cybersecurity tools. The private technological cloud on the operators' side, for the sake of cybersecurity, is to ensure adequate data processing parameters (performance, speed, no errors). Cybersecurity tools should be integrated on the operators' and RES Producers' side.

Additionally, three processes have been identified for RES producers. Process (D) pertains to the forecasting of the operational status of the entire renewable power plant, as well as the determination of the actual quantities of energy that are scheduled to be fed into the grid. Process (E) pertains to the transmission of data regarding the operational status of the power plant to the system operators, accompanied by the receipt of control signals from said operators. Process (F) pertains to the routine supervision of the operational status of the discrete generating units within the power plant.

These processes imply the necessity for the processing of extensive data sets pertaining to the operational status of the plant, for the purposes of forecasting and planning. It is therefore essential to ensure the collection and assembly of data on individual installations (e.g. wind generators). Forecasting generation requires the consideration of variable and uncertain meteorological and historical data for analogous power system operating conditions. The complexity and quantity of data necessitates the use of adaptive and/or self-learning algorithms, according to the incremental information about the power plant's operating history.

In order to facilitate the implementation of these processes, five technologies have been identified as being suitable for this purpose. (i) Technological cloud, (ii) Industrial Internet of Things, (iv) Artificial Intelligence and Machine Learning, (v) Autonomous control systems, and (vi) Blockchain. The processing of large data sets will be most efficiently conducted in the technological cloud. The Industrial Internet of Things will facilitate two-way communication between individual plants and the central system. Artificial intelligence (AI) tools will support

forecasting processes, and the autonomous control system will be oriented towards optimizing the operation of the entire power plant, taking into account system and market conditions.

For conventional generators, a process (G) has been identified for the ongoing monitoring of the status of individual generation facilities in a situation of anticipated plant decommissioning and the minimization of resources for plant maintenance. The objective of this process is to ensure the collection, gathering and processing of data on individual generation plant components, primarily to identify components that may fail and lead to curtailment or cessation of operation.

In order to facilitate the implementation of this process, two technologies have been identified as being suitable: (i) The technological cloud, and (ii) the Industrial Internet of Things. The Technological Cloud will perform analogous functions to those previously discussed, while the Internet of Things will facilitate bidirectional communication between individual installations and the central system.

For traders, process (H) has been identified as a necessity for the ongoing balancing of source generation and customer demand within the customer portfolio managed by these operators.

One consequence of this process is the necessity for the processing of data, including forecasting, at an extremely short notice, of the instantaneous demand of groups of customers and groups of generation sources, with due consideration of historical profiles and information on the current status of the system and weather conditions. The complexity of the issue requires the use of self-learning algorithms. The transmitted data, due to its commercial sensitivity, requires protection in terms of both integrity and confidentiality.

In order to facilitate the implementation of this process, five technologies have been identified as being suitable for this purpose. (i) Technological cloud, (iii) Integrated cybersecurity tools, (iv) AI and ML, (v) Autonomous control systems, and (vi) Blockchain. It is anticipated that the technological cloud and AI tools will facilitate the expeditious processing of extensive data sets pertaining to both customers and generators within the portfolio of a trader. The implementation of autonomous control systems will facilitate the rapid balancing of customers and generators, while cybersecurity and blockchain tools will ensure secure and integrity-compliant data communication between participants in the process.

In conclusion, the greatest number of new processes were identified at RES generators and system operators, with the greatest support from modern IT technologies expected by RES generators and traders. Furthermore, cloud technology was identified as the most popular technology.

For companies, this signifies the necessity to alter existing business models in order to align them with the requirements of the energy transition. This entails the development and implementation of new processes, as well as modifications to existing ones. It also necessitates a significant investment in the implementation of IT systems and the training of employees in their utilisation.

From a social perspective, this will entail an increase in electricity prices, potential disruptions in energy supply until businesses become more stable, a deepening of a kind of 'dependence' on IT tools and an increase in competence requirements for business employees. Alternatively, it may initiate a process of autonomization of business operations. The aforementioned factors can be described as the social cost of achieving the political objectives of the transformation. However, it is important to consider the benefits of the energy transition as declared by politicians in order to achieve a balanced perspective.

5. Summary

The objectives set forth in the paper were successfully achieved. The research was conducted effectively in a number of selected energy companies. The research methods were appropriately selected to meet the stated objectives.

The discussion of the results indicates the necessity for enterprises to identify, develop and implement new processes. In the absence of such implementation, enterprises will be ill-prepared to meet the legal, regulatory and factual requirements for ensuring the continuity of energy supply to consumers under transformational conditions. Furthermore, the core business processes of these enterprises will remain ineffective. From a social perspective, the energy transition, in addition to its purported benefits, may also result in some tangible costs for consumers, primarily in the form of increased electricity prices and uncertainty regarding the continuity and reliability of supply.

It should be noted that the research was conducted with a limited scope and that the conclusions may require revision once a more comprehensive quantitative analysis is conducted, encompassing a wider range of energy companies within the energy supply chain. This does not diminish the qualitative significance of the conclusions, particularly for electricity system operators.

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THE SPECIFICS OF SHORT-TERM RENTAL PROPERTY MANAGEMENT

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Purpose: The research presented in this article was carried out in order to identify the peculiarities of short-term rental property management, i.e. to answer the question about the main challenges, the management strategies undertaken and the expectations and plans of property owners and managers.

Design/methodology/approach: It was possible to realise the aim of the study by using the method of literature analysis, legal acts and information from Otodom reports and the survey questionnaire used as a research tool.

Findings: The research found that digital marketing tools and booking platforms to support customer acquisition and optimise operational processes are key to managing short-term lettings. The biggest challenges relate to the seasonality of demand, maintenance costs and maintaining high service standards, while seeking to maximise efficiency and grow the business.

Research limitations/implications: The most significant limitation of the survey process is the lack of a nationwide register of short-term rental housing as a source of information for conducting reliable and credible surveys. Regulation (EU) 2024/1028 of the European Parliament and of the Council of 11 April 2024 provides the basis for future developments in this area. This provides a determination to undertake further research that will be supported by results from nationwide reports in addition to the results obtained using the questionnaire.

Practical implications: The research presented here can be used by owners and managers of short-term rental properties to evaluate their actions. The results of the survey may provide a voice in the discussion on legal regulation concerning the creation of a register of short-term rental housing.

Social implications: The results of the research allow a review of the activities of property owners and managers with regard to short-term rentals.

Originality/value: This study is an independent analysis of the short-term rental activities of property owners and managers. In view of the scarcity of literature and analyses based mainly on data from websites, the study carried out fills a research gap and adds to the body of work on the topic under analysis.

Keywords: real estate, short-term rental, real estate management.

Category of the paper: Research paper.

1. Introduction

The real estate market is a system of relationships concerning objects with a number of specific, unique characteristics that are unparalleled in other markets and which determine the functioning of the market mechanism. According to various classifications, based on the subject criterion, this market can be divided into segments including residential, commercial, industrial, agricultural and other real estate (Dębniewska, Tkaczuk, 2002).

In addition to its primary function of providing a person with the need for security and the opportunity to meet other needs naturally, residential property is also regarded as a part of property that can generate income. One form of using residential property as a source of income is renting, including short-term rentals. This rental model, which involves making a property available for a period of a few days to a few weeks, has gained importance as an alternative to the traditional forms of accommodation offered by hotels or guest houses.

The rental market, which is part of the residential property market, is characterised by the difficulty of conducting detailed analysis. This is due to two main factors. Firstly, its structure is complex, multi-faceted and opaque, involving a variety of property types and contract forms. Secondly, leases usually do not require a strict legal form, leading to them being concluded both in writing and orally. In addition, they are rarely registered or reported for tax purposes (Kokot, 2019). As a result, there is a lack of comprehensive and reliable data that can accurately characterise this segment of the market, and extracting such information on short-term rentals is particularly difficult and methodologically challenging. It is difficult to estimate the scale of the activity, as such estimation is mainly done by analysing the offers of flats for rent in the main advertising services, which allows to assess the scale of the phenomenon, but this assessment cannot be accepted as definitive and definitely reliable.

In the European Union, a regulation on the collection of data on short-term rentals was adopted in April 2024 (Regulation of the Parliament..., 2024). This piece of legislation formulates the conditions for platforms to provide data to state authorities. The EU regulation represents an opportunity to create a register of dwellings covered by short-term rentals and to access data from digital platforms, which will enable the preparation of precise analyses (Gyódi, Hardy, Mazur, 2024).

2. Literature review

The purchase of housing for investment and tourism purposes is becoming increasingly popular, and property investment is part of personal financial management (Zienkiewicz, Zalewska, 2023). The reduction in the role of public home ownership, the prevalence of

mortgages and the internationalisation of the property market has led to an increase in the number of people owning more than one residential property, which in turn has led to an increase in the number of dwellings not used to meet basic housing needs. This change has also fostered the development of the short-term rental market and the transformation of undeveloped dwellings into attractive facilities for tourists and business travellers (Doling, 2019; Kadi, Hochstenbach, Lennartz, 2020).

Oktaba, Grzywińska-Rapca i Wójtowicz (2024) indicate that short-term rentals have mainly flourished in regions with high tourist demand, i.e. those traditionally associated with leisure, nevertheless, high demand for tourist accommodation also persists in large cities. This is due to both the increasing number of business trips and short leisure stays. The authors emphasise that the popularity of this rental model is largely linked to the ability of property owners to generate income, at a higher level than in the case of long-term rentals. There is also greater flexibility in property management, as owners can decide on rental availability and price. The paper also highlights the role of the internet and platforms such as Airbnb, which have facilitated access to potential tenants and contributed to the internationalisation of the market.

Similar observations were made by Kokot (2019) presenting the short-term rental market as an important sub-segment of the residential property market. The author notes the growing interest of investors in this form of rental, which is associated with potentially higher returns compared to long-term rentals. He points out that, in addition to tourist trips, short-term residential rental also supports professional traffic, which can be sporadic or cyclical. At the same time, he stresses the importance of technological developments, such as booking platforms, which have significantly facilitated access to a wide range of tenants.

Mrozińska (2022) analyses the supply of short-term rentals in the Wielkopolska region on the example of Airbnb users. The author points to the dynamic development of this market segment, which is driven by the growing interest in short-term rentals among tourists and business travellers. According to the author, companies specialising in managing holiday rentals, which enable owners to make effective use of their properties, are also crucial. Mrozińska emphasises that the specifics of short-term rentals fit perfectly with changing consumer preferences and trends in the sharing economy.

The onset of the COVID-19 pandemic has triggered a crisis in the global tourism industry (Gössling Scott, Hall, 2021). Studies indicate that the pandemic itself, and the associated measures to reduce the spread of the disease, have not only reduced tourism, but have also altered tourism preferences (Park et al., 2021; Zawadka et al., 2021). Adamiak (2022) analysing the impact of the COVID-19 pandemic on the short-term rental sector in Poland, points out that there was a significant drop in bookings during the pandemic, which affected the profitability of this market segment. At the same time, it notes that property owners were forced to introduce new strategies, such as medium-term rentals or price reductions. The analysis also shows that the pandemic highlighted differences in the adaptation of property owners to this type of change depending on location and property type. Similar conclusions are reached by Samorek and

Cichocki (2023) reviewing the Polish residential property market, consider segments of it such as short-term rentals. The authors note that the COVID-19 pandemic had a significant impact on this sector, reducing bookings during the lockdown period, but at the same time increasing interest in renting in less busy locations. Travellers chose locations that allowed them to keep their distance, resulting in tourist rentals regaining momentum after the initial pandemic-related decline, growing faster than the competitive, typical hotel industry (Sanford, DuBois, 2020). The predictions from the beginning of the pandemic, forecasting an imminent crisis in the short-term tourist rental sector, therefore did not come true (Dolnicar, Zare, 2020).

The specifics of short-term rental regulations are discussed by Kozuba and Stalmach (2023). They pointed to legal challenges, such as the need for clear regulations that balance the interests of property owners, tenants and local communities. The authors note that the dynamic growth of this sector leads to numerous conflicts and misunderstandings, especially in the context of housing communities, which often see short-term rentals as a source of problems. Also Gubański (2023) presents different narratives on the housing market in Poland, considering the importance of developer investments and their impact on the availability of rental housing. In the context of short-term rentals, the author points out that the development of this segment may lead to tensions between the interests of investors and local communities, which do not always perceive short-term rentals as beneficial. The issue of housing communities adopting resolutions restricting or prohibiting short-term rentals is addressed by Kaźmierczyk (2022). The author points out the differences in the approach to regulating this sector in different countries, analysing the example of France and Portugal. In the article, she highlights that regulation is becoming a key factor influencing the operation of short-term rentals, which requires the adaptation of landlords' actions to local regulations and the specificities of the sharing economy.

Latko (2021), on the other hand, analyses the housing crisis caused, among other things, by rising property and rental prices and the influence of speculative capital. He points to various models of regulation that can limit the negative effects of short-term renting.

Szlęzak-Matusiewicz (2008) presents real estate rental as a subject of economic activity and discusses the tax aspects associated with short-term and long-term rental. He emphasises the importance of proper tax management in this sector.

Short-term rental is a complex segment of the real estate market, requiring both an appropriate management strategy and adaptation to dynamic changes in the legal and market environment. Considering management issues, it is important to emphasise that short-term rental, unlike long-term rental, requires constant guest services, cleaning, maintenance and booking management. In addition, there is the management of multiple sales channels and different platforms. It is therefore necessary to find a balance between automating processes and personalising the guest service. Many owners choose to work with rental management companies, which, however, incurs additional costs. On the other hand, automation of processes

such as bookings, payments or cleaning can lead to increased efficiency and improved guest satisfaction (Short-term Rental..., 2024).

Unlike long-term rental, managing short-term rentals requires a different approach that combines elements of property management with intensive customer service, a marketing strategy and the flexibility to adapt the offer to changing market conditions. Effective organisation of aspects such as bookings management, maintaining a high quality of guest service, as well as ongoing maintenance and aesthetics of the property are crucial. At the same time, dynamic changes in demand due to seasonality, local events or traveller preferences require property owners or managers to be able to react quickly and make sound strategic decisions. Compliance with legal and tax regulations, which vary from country to country, region to region and even from municipality to municipality, also remains an important challenge.

In the light of the literature presented, the problems specific to short-term letting and the management of properties for this purpose mainly focus on selected aspects, such as income issues, legal regulations, including taxation, the impact on local housing markets, repercussions on social relations, adaptability to changing conditions and those related to the ways in which properties are managed on an ongoing basis.

The limited number of publications in this area determines the need for further research that takes into account the changing legal, social and economic conditions associated with the dynamic development of the short-term rental market. Only such an approach will allow a better understanding of its peculiarities, which will support the effective management of facilities within this segment.

3. Methodology

The study is based on three complementary research methods:

1. Literature review. The research involved a literature review, taking into account academic studies, market reports and industry publications on short-term rental management. Legal regulations and their impact on property management practices were also analysed, allowing the identification of the main problem areas and research directions in this sector.
2. Market data analysis. Market data derived from reports of websites such as Otodom and other industry sources were used to assess the rental market in Poland. The analysis covered the number of residential offers for rent and the level of offer rental rates in selected Polish cities and their change in relation to previous periods.

3. Questionnaire method. A questionnaire survey was conducted to obtain detailed information on the management of short-term rental properties. A questionnaire was sent to 186 people who own or manage this type of property. 152 respondents (81.7%) answered the survey. The questionnaire consisted of five sections including general information, operational aspects of management, marketing activities and customer relations, as well as finance and legal regulations and information on future tenant intentions. The data collected in the survey made it possible to identify the strategies and tools used by the respondents, as well as their plans related to the managed properties. The collected results were presented by indicating the structure of the answers given.

The use of these research methods made it possible to achieve the aim of the study, combining theoretical knowledge with the practical experience of property owners and managers.. In this way, the study provides information on the specific characteristics of short-term rental management in the surveyed collective..

4. Results

Given that there are no reports reflecting the situation in the residential property market in terms of short-term rentals, as a background to the detailed research carried out using a research tool in the form of a questionnaire, the authors presented the results of the analysis on rentals in Poland carried out by the Otodom service.

According to Otodom data, at the end of January 2024, the number of active offers of flats for rent in Poland amounted to 22,700, an increase of 14% compared to December 2023 and of 38% compared to January 2023 (Table 1).

Table 1.

Number of rental housing offers in Poland in 2024

Month and year	Number of offers	Change from previous month	Change from previous year
January 2024	22700	+14%(December 2023)	+38% (January 2024)
February 2024	27000	+15.93% (January 2024)	+34% (February 2023)
May 2024	26000	not available	no data available

Source: Otodom rental market report (January, February and May 2024),

https://www.otodom.pl/wiadomosci/dane/raport-z-rynku-najmu-maj-2024?utm_source,

https://www.otodom.pl/wiadomosci/dane/rosnie-liczba-ofert-na-rynku-najmu-czy-rok-2024-bedzie-rekordowy?utm_source,

https://www.otodom.pl/wiadomosci/dane/sytuacja-na-rynku/raport-z-rynku-najmu-styczen-2024?utm_source.

In February 2024, the base of flats for rent continued to grow, reaching over 27,000 active listings, an increase of 15.93% compared to January and 34% compared to February 2023. It is worth noting that in May 2024, the number of active flat listings for rent on Otodom was 26,000.

It should be noted that the number of residential rental offers in Poland is variable and depends on many factors, such as seasonality, the economic situation or demographic changes.

In October 2024, the average cost of renting a unit in Poland's largest cities was PLN 2682, up 1.5% on September and up 1.3% on October 2023.

The most expensive location remains Warsaw, where the average monthly rental price reached PLN 5008 (Table 2).

Table 2.

Rental rates in selected Polish cities (status: October 2024)

City	Monthly rent [PLN]	Change from previous month [%]	Change from previous year [%]
Białystok	2121	-1,0	0,3
Bydgoszcz	2088	2,9	5,3
Katowice	2423	0,5	0,9
Kielce	2018	-0,8	3,4
Kraków	3347	-1,1	-0,6
Łódź	2110	0,2	2,3
Lublin	2559	-0,5	2,7
Olsztyn	2229	3,3	6,9
Opole	2279	0,3	-0,6
Poznań	2608	0,8	2,9
Rzeszów	2687	0,0	-1,3
Szczecin	2804	2,7	3,0
Trójmiasto	3156	-1,9	-0,4
Warszawa	5008	0,1	-1,9
Wrocław	3102	-0,1	-4,0
Zielona Góra	2375	1,3	13,0

Source: Otodom rental market report, October 2024 https://www.otodom.pl/wiadomosci/wp-content/uploads/2024/11/OTOD_raportzryнку_PAZ2024.pdf?utm_source.

In the Trójmiasto and Kraków, rental costs were around PLN 3200-3300, while in Wrocław the average rate was PLN 3100. In Szczecin and Rzeszów, prices fluctuated around PLN 2800, while the lowest rates were recorded in Kielce, where renting cost an average of PLN 2000.

Price changes on a monthly basis ranged from -1.9 in the Tri-City to 3.3 in Olsztyn compared to September levels. Interestingly, Olsztyn also saw the largest increase in the number of offers, which, contrary to expectations, did not translate into a decrease in prices. On a year-on-year basis, the largest increase in offer rental rates was recorded in Zielona Góra, where rental prices rose by 13%. The marked percentage changes in cities such as Zielona Góra and Olsztyn may be due to the limited number of available flat offers, resulting in greater price fluctuations compared to larger markets. In ten of the sixteen markets analysed, offer rental rates increased compared to the same period a year earlier, while in the remaining cities they decreased (from -0.4% for the Trójmiasto to -4.0% for Wrocław).

The analysis of the data in the report was supplemented by data from a detailed survey conducted using a questionnaire research tool. The survey was addressed to 186 owners and managers of short-term rental properties. Responses were received from 152 respondents (81.7%). The survey elicited responses from respondents regarding their demographic

characteristics, professional experience, tools used in the property management process, challenges encountered and marketing and financial activities undertaken, as well as planned activities.

The data presented in Figure 1 illustrates the gender structure of the respondents who took part in the short-term tenancy management survey. Of the 152 survey participants, the majority are male (55%), while women represent 45% of respondents.

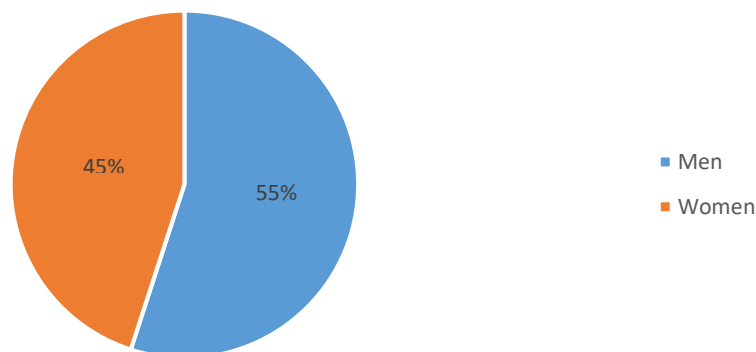


Figure 1. Structure of respondents by gender.

Source: own study.

The largest age groups taking part in the survey are those aged 45-54 (40 people, or 26% of respondents) and 35-44 (38 people, or 25%). Younger people, aged 25-34, make up 21% of respondents, while the group of people aged 55-64 comprises 16% of respondents. The smallest proportions of respondents are over 65 (5%) and those aged 18-24 (7%). There were no participants under the age of 18 in the survey (Figure 2).

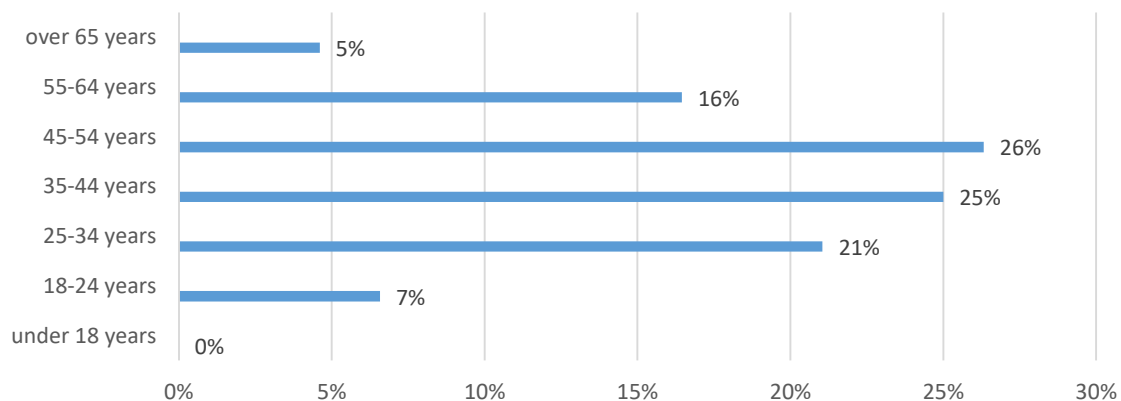


Figure 2. Structure of respondents by age.

Source: own study.

The survey shows that the largest number of respondents has a Master's degree, which was indicated by 39% of the respondents, showing the dominance of those with a high level of education in the short-term rental management process. The next largest groups of respondents are those with a doctorate or higher and a bachelor's/engineering degree (18% each). Respondents with secondary education account for 13% and those with vocational education for 11%. The least numerous group are those with primary education, who account for only 1% of (Figure 3).

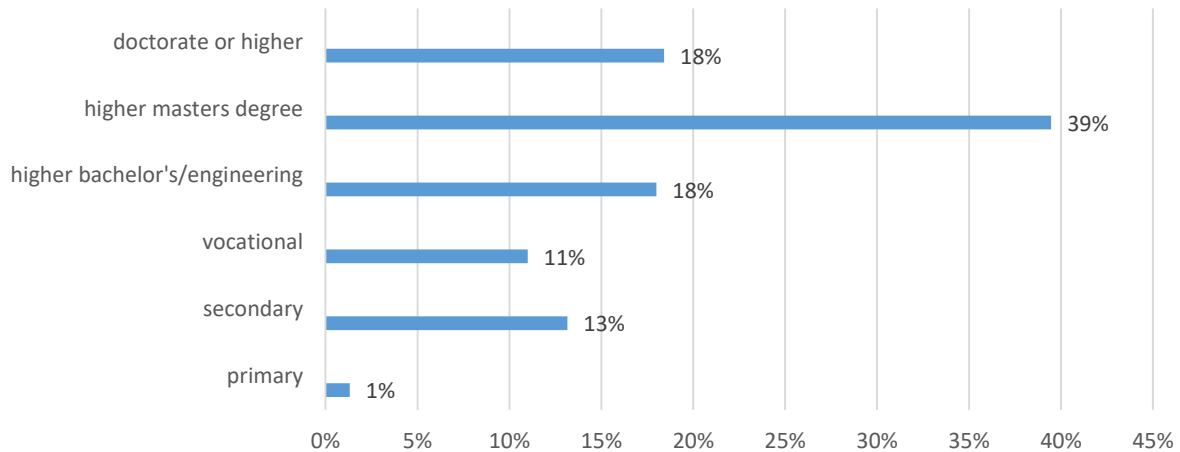


Figure 3. Structure of respondents by education.

Source: own study.

Based on the data presented, it can be concluded that the highest percentage of respondents live in cities with a population of 100-500 thousand (35%). The second largest group are residents of cities with a population of 50-100,000 (28%), and the third are residents of cities with a population of up to 50,000 and over 500,000 (16% each). The smallest percentage, 5%, are respondents living in rural areas (Figure 4).

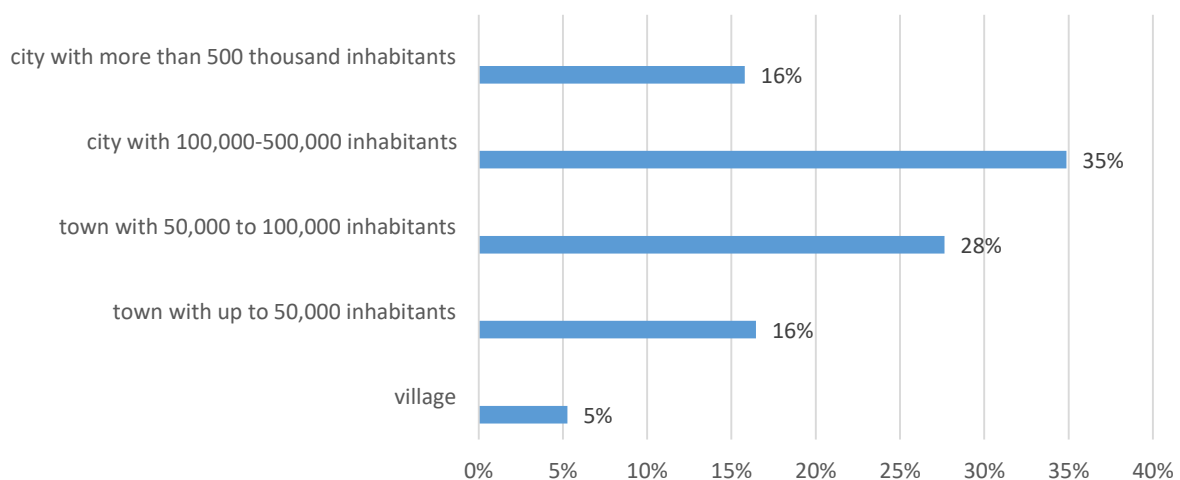


Figure 4. Structure of respondents by place of residence.

Source: own study.

Among those who responded to the survey, the largest group of respondents are self-employed (45%). In second place are the employed, who account for 30%. Pensioners make up 22% of respondents, while pupils and students account for 2%. The smallest group of respondents are unemployed (1%) (Figure 5).

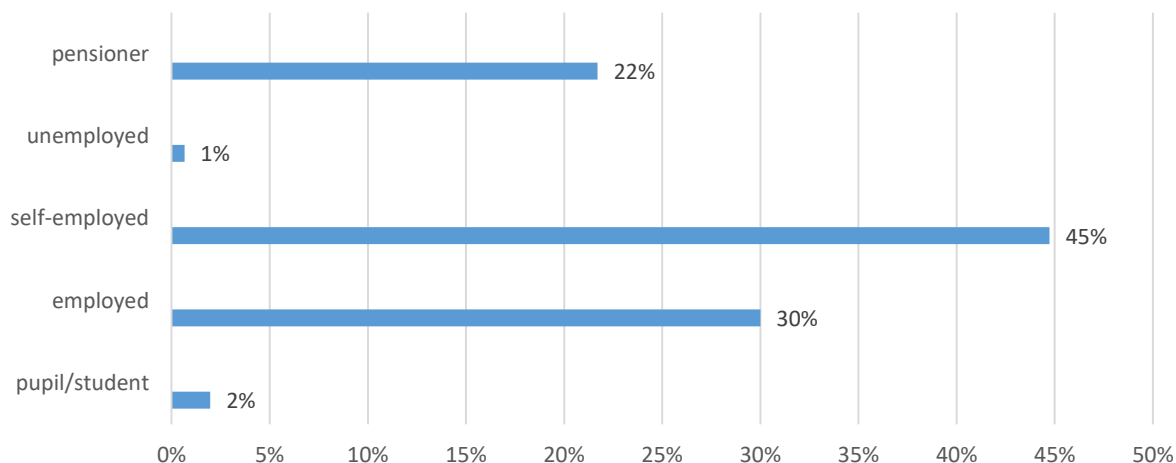


Figure 5. Structure of respondents by occupational status.

Source: own study.

Most respondents (33%) manage 6-10 properties, making this group the dominant one in the survey. Another large group (30%) are those operating 2-5 properties. Managing more than ten properties is declared by 27% of respondents, while only 10% limit their activity to one property. This structure shows that the majority of respondents are handling several properties at the same time (Figure 6).

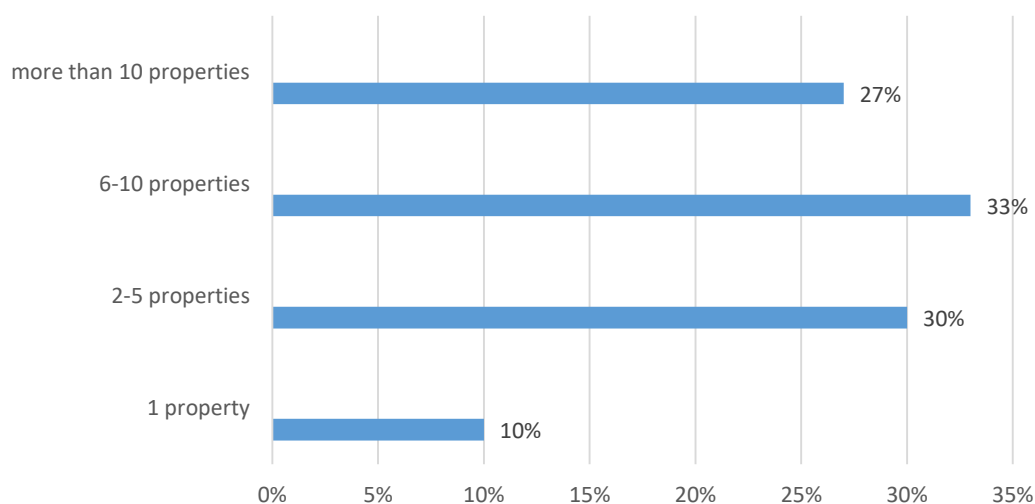


Figure 6. Structure of respondents by number of properties managed under short-term rental.

Source: own study.

Based on the survey, it can be concluded that the majority of respondents have significant experience in managing short-term rental properties. Indeed, those with between 6 and 10 years' experience account for 48% of respondents, indicating the dominance of those with established practice in the industry. Another significant group are those with more than 10 years' experience (34%). The less experienced group, i.e. those with between 1 and 3 years' experience, accounts for 13% of respondents. The least numerous group are managers with less than one year's experience (5%) (Figure 7).

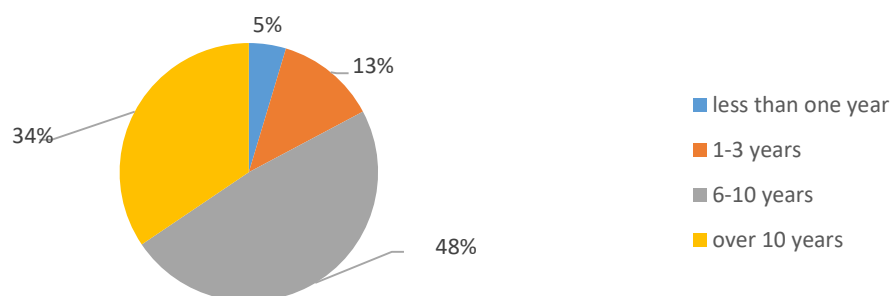
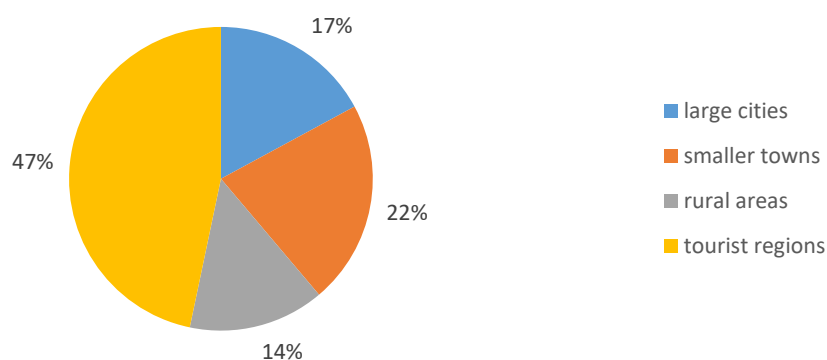


Figure 7. Struktura respondentów według długości stażu w zarządzaniu krótkoterminowym najmem.

Source: own study.

The data presented shows that the largest number of properties (47%) are located in tourist regions, indicating the dominant role of these locations in short-term rentals. Smaller towns account for 22% and large cities for 17% of respondents' indications. The fewest short-term rental properties are located in rural areas, with 14% of respondents' indications (Figure 8). The data presented highlights the importance of attractive tourist destinations in short-term rental activity.

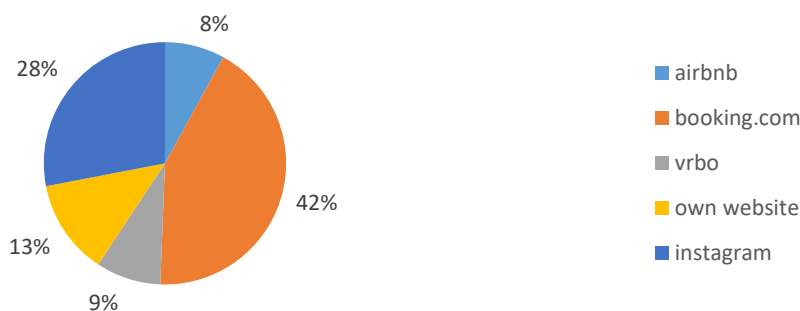


Note: Respondents could indicate more than one answer.

Figure 8. Short-term rental properties by location [%].

Source: own study.

The research carried out shows that the platform most frequently used to manage bookings is Booking.com (42% of respondents' indications), followed by Instagram (28%). The own website was highlighted in 13% of respondents' indications, while Vrbo (9%) and Airbnb (8%) are less popular (Figure 9). The data shows that global booking platforms dominate, but social media and own sites also play an important role in managing bookings.

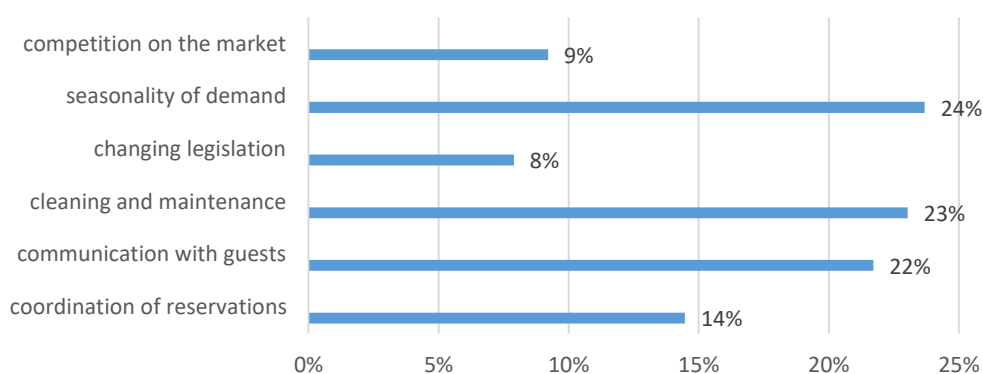


Note: Respondents could indicate more than one answer.

Figure 9. Platforms used to manage bookings [%].

Source: own study.

Among the challenges in the day-to-day management of short-term rental properties, seasonality of demand was cited most frequently by respondents (24%), followed closely by cleaning and maintenance (23%) and communication with guests (22%). Co-ordinating bookings was a challenge for a smaller number of respondents (14% of indications), while market competition and changing legislation were cited at 9% and 8% respectively (Figure 10). The data highlights that the biggest difficulties in the day-to-day management of short-term rental properties relate to the seasonality of demand and the operational aspects of guest services and property maintenance.



Note: Respondents could indicate more than one answer.

Figure 10. Challenges in day-to-day property management [%].

Source: own study.

The data presented shows that the majority of respondents (61%) use professional rental management companies, indicating the importance of outsourcing in this sector. However, it should be noted that a significant proportion of respondents (39%) prefer to handle property management themselves (Figure 11).

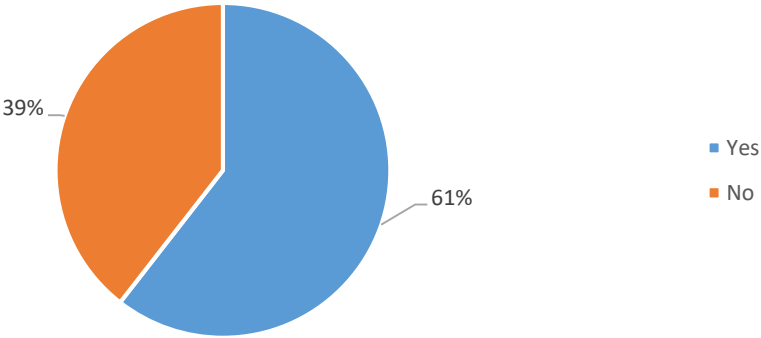


Figure 11. Structure of respondents according to whether they use a professional external rental management company.

Source: own study.

The survey showed that the largest group of respondents (57%) update prices less than once a month, indicating a moderate dynamic of price changes in their business. Among the respondents, 32% make changes once a month and 9%, update prices once a week. Daily updates are rare (1%), as is the absence of any price changes (1%). The results indicate that the majority of managers adjust prices at medium or long intervals (Figure 12).

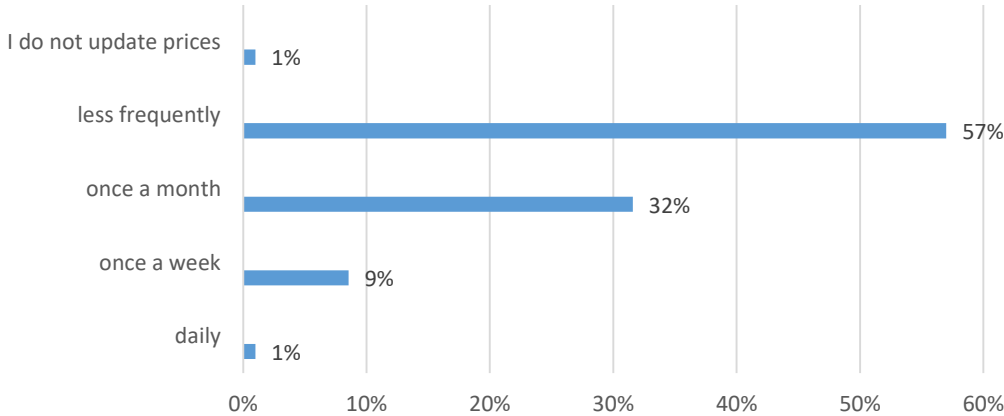
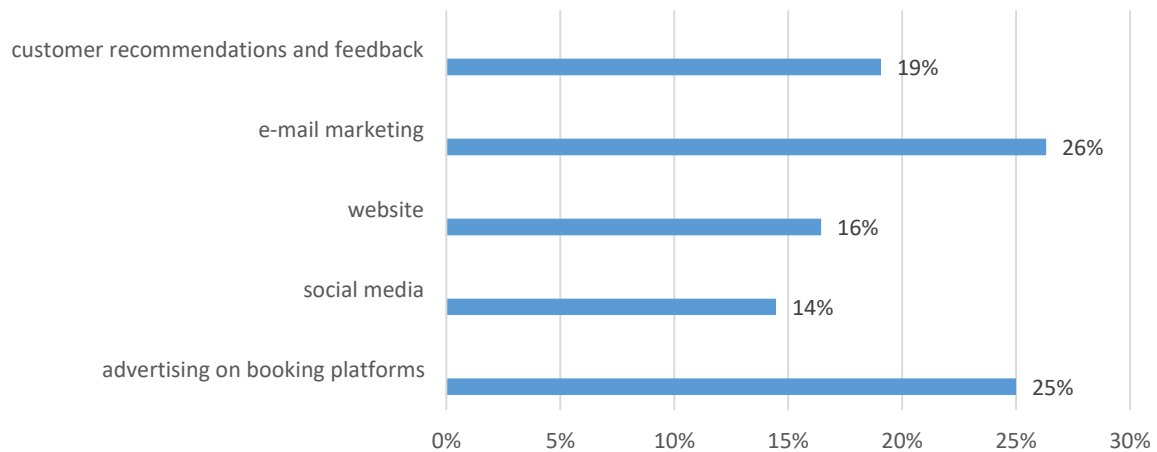


Figure 12. Structure of respondents by frequency of rental price updates by demand and season.

Source: own study.

Based on the results of the survey, the most popular marketing activities for promoting short-term rental properties are email marketing (26%) and advertising on booking platforms (25%). Customer referrals (19%) and websites (16%) also play an important role in this process, while social media is the least popular promotion tool (14%) (Figure 13).



Note: Respondents could indicate more than one answer.

Figure 13. Marketing activities undertaken to promote the property [%].

Source: own study.

The survey found that 41% of respondents rate the difficulty of maintaining high quality customer service at a neutral level, indicating that there is no apparent difficulty or ease in doing so. In contrast, 39% rate it at: 'difficult and very difficult', suggesting that for a significant proportion of managers this is a demanding task. On the other hand, 20% of respondents see it as an easy and very easy task (Figure 14). The results show the variation in respondents' feelings about the difficulties associated with the quality of customer service.

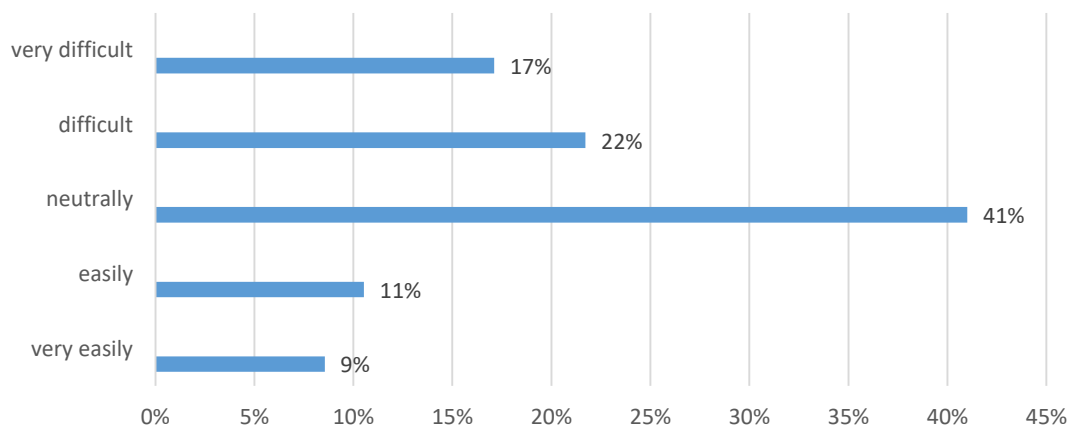
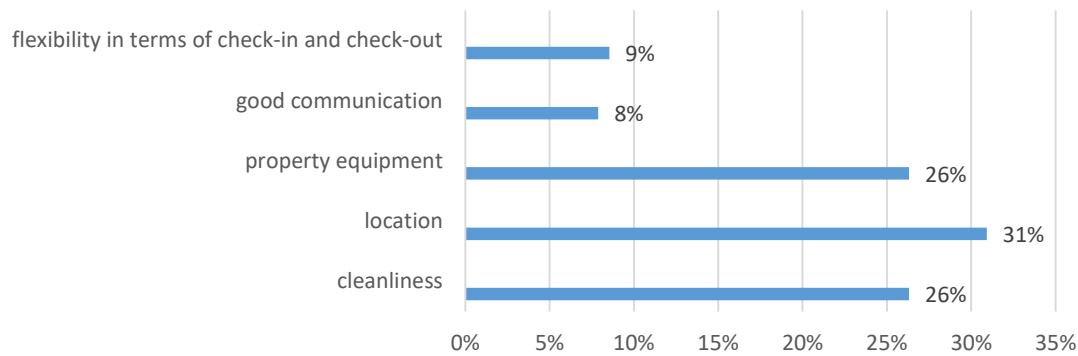


Figure 14. Structure of respondents according to level of difficulty in maintaining high quality customer service.

Source: own study.

The survey also highlighted the most common expectations of guests renting properties for a short period of time. It is clear that location was the feature most frequently indicated by respondents (31%). The next most important aspects were cleanliness and property amenities (26% each). Less important for guests are features related to flexibility in checking in and out (9% of indications) and good communication (8% of indications) (Figure 15).

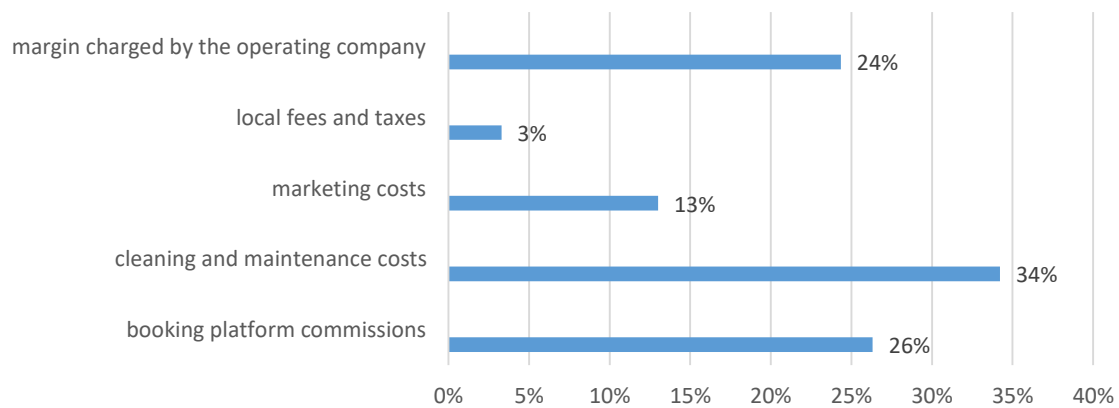


Note: Respondents could indicate more than one answer.

Figure 15. Most common expectations of guests renting a property on a short-term basis [%].

Source: own study.

Based on the survey, it can be concluded that the biggest cost associated with short-term rentals is the cost incurred for cleaning and maintenance, which accounts for 34% of respondents' indications, making it the dominant financial burden. Booking platform commissions rank second among the financial burdens of short-term rentals (26% of indications), closely followed by the margin charged by the operating company with 24% of indications. Marketing costs (13%) and local fees and taxes (3%) play a lesser role in the cost structure (Figure 16).



Note: Respondents could indicate more than one answer.

Figure 16. Costs in short-term rental management [%].

Source: own study.

The data shows that the largest financial burden comes from operational costs, related to property maintenance and the use of booking platforms and third-party services. Of lesser importance are marketing expenses and local fees and taxes.

In the survey conducted, respondents also answered open-ended questions by providing the following answers:

1. What do you consider to be the greatest advantage of managing a short-term rental property?
 - the possibility of regular price changes and flexibility to adapt the offer,
 - the ability to inspect the condition of the property after each client and make ongoing repairs,
 - control of the property,
 - higher returns compared to other forms of rental,
 - the flexibility of this form of earning and payment in advance of the client's stay,
 - an attractive form of capital investment.
2. What changes would you like to see in your business over the next 2-3 years?
 - purchase of an additional flat, e.g. in the mountains,
 - renovation of one of the current flats to raise its standard,
 - reduce your own involvement in servicing the flats, for example by employing a cleaner,
 - addressing the nuisance associated with the long distance to the property (120 km).
3. Would you like to add any other comments on the management of short-term tenancies?
 - short-term rental is a great form of additional income that offers higher returns than other types of rental,
 - flexibility in management and the ability to control the property add to the convenience of this business,
 - making appropriate changes, e.g. to the handling of flats, can further increase the efficiency and convenience of management.

Analysing the answers given, it can be concluded that they mainly reflect the advantages associated with managing short-term tenancies.

5. Discussion

Short-term property rental management in Poland is a rapidly growing form of business that requires managers to be flexible, innovative and able to adapt to changing market conditions. The survey results provide a comprehensive picture of the specifics of this activity, taking into account key operational, marketing and financial aspects, as well as the expectations of guests and the challenges of owners and managers. They confirm the demands described in the literature.

The analysis shows that the respondents are mainly people with extensive experience in tenancy management, with the majority operating several properties at the same time. They are mainly located in tourist regions, smaller cities and large agglomerations. This structure indicates the dominance of professionals who have concentrated their activities in attractive locations characterised by high demand.

An analysis of the tools used to manage bookings indicated that global platforms such as Booking.com are the most popular, complemented by social media and in-house websites. At the same time, marketing efforts focus on email marketing, advertising on booking platforms and using customer reviews as a key element of the promotional strategy. This points to the importance of digital communication channels in the short-term rental industry.

Among the key challenges, property managers most often point to the seasonality of demand, the costs associated with property maintenance and the need to maintain a high quality of guest service. Cleanliness, location and appropriate property amenities are the primary expectations of customers, demonstrating that guests prioritise comfort, hygiene and convenient location. Maintaining these standards often requires a significant commitment from managers, who pay attention to the need to optimise operational activities.

In terms of costs, the biggest burden is placed on cleaning and maintenance expenses, booking platform commissions and the margins charged by professional rental service companies. At the same time, respondents see numerous advantages in this activity, such as higher returns compared to other forms of rental, flexibility of management and the possibility to control the condition of the property after each client.

Future plans among respondents range from business expansion (e.g. acquisition of new properties) to optimising current processes, including reducing their own involvement by delegating some of their responsibilities. These results indicate that property managers are looking to increase the efficiency of their business and to remain competitive in the dynamic short-term rental market.

6. Conclusions

Short-term property rental management is a rapidly growing industry. Research shows that digital marketing tools and booking platforms that support customer acquisition and optimise operational processes are key in this type of business. The biggest challenges in this business relate to the seasonality of demand, maintenance costs and maintaining high service standards, while seeking to maximise efficiency and business growth. The results of the presented research are not only a basis for a better understanding of the industry, but also a valuable resource for property managers and policy makers.

In the context of the research carried out, it should be emphasised that of great importance in the analysis of the specifics of short-term rental management is the lack of information sources of a national evidential nature, which makes it impossible to carry out reliable and credible analyses. The available literature on short-term rental property management is still limited, making it difficult to fully understand the dynamics of this market. The research conducted among a limited number of short-term rental providers confirms the need for continued analysis in this area, particularly with regard to the impact of changing regulations, new technologies and evolving customer expectations. These will enable the identification of best practice in the sector and, with the development of a national register of short-term rental accommodation, will provide the basis for a robust analysis of changes in the sector.

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APPLICATION OF LEAN MANAGEMENT IN RETAIL: A RESEARCH AGENDA

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Purpose: The implementation of Lean Management continues to pose challenges, particularly in sectors that differ significantly from mass production. The aim of this study is to identify and systematize areas of uncertainty and obstacles encountered when applying Lean methodology to retail operations.

Design/methodology/approach: The study primarily employs a scoping literature review methodology. Full-text scientific databases were utilized for source research. Identified knowledge gaps were analysed, evaluated, and subsequently systematized.

Findings: The findings of the study identify eight key areas for further research in Lean Retail. These areas encompass all aspects of Lean methodology, beginning with Lean philosophy and extending to continuous improvement. The recognized key areas are crucial for the ongoing development of Lean methodology in the retail sector. The investigation suggests that the concept of waste is, in fact, the most significant starting point for implementing Lean practices in retailing.

Research limitations/implications: The study is limited by the number of literature sources on Lean implementations in retailing, alike proposed conceptualizations. Numerous promising and important field have not been extensively studied by the literature to date.

Originality/value: The article offers a visualization of desired research areas in Lean Retail research related to the Toyota Way model.

Keywords: retail, Lean Management, Lean Retail, Lean principles, waste.

Category of the paper: literature review, conceptual study.

1. Introduction

The retail industry focuses on selling goods and services to individual consumers to meet their needs and expectations. It plays a crucial role in the economy by facilitating the connection between producers and final consumers. Retailing encompasses a diverse range of store formats and sales platforms, including both physical and online operations.

The store features a wide array of offerings, including a diverse selection of products. This range encompasses everyday items, durable goods such as electronics and furniture, as well as various services. Retailers may specialize in specific product categories or provide a comprehensive assortment of goods, as seen in supermarkets and hypermarkets. The necessity of maintaining close contact with customers compels retailers to adapt their product ranges and strategies to align with changing consumer preferences. This adaptability is achieved through the implementation of various marketing strategies and the provision of high-quality customer service. Essentially, the concept of Lean in retailing focuses on responding swiftly to fluctuations in demand rather than maintaining large inventories (Lukic, 2012).

Retailers face significant competition, particularly in larger urban centres and on digital marketplaces. These businesses compete on various factors, including price, product quality, shopping experience, technological innovation, and customer service. The expansion of e-commerce has heightened the necessity for companies to invest in digital technologies and adopt new business models. Large retailers can leverage economies of scale and extensive resources to gain a competitive advantage (Noda, 2015).

The effectiveness of a retail business is closely tied to the efficiency of its supply chain and logistics management. Key factors that contribute to a business's overall success include the ability to deliver products on time, optimize warehouse utilization, and monitor stock levels. Enhancing the supply chain leads to a quicker response of supply to actual sales (Lukic, 2012).

Modern retail is increasingly leveraging technology to enhance the customer experience and optimize operational efficiency. The analysis of large data sets serves as a primary tool for predicting consumer trends and managing inventory levels effectively. This analysis is typically employed alongside process automation in logistics and order processing. In their study, Wolniak et al. (2024) present an evolutionary analysis of grocery shopping from a technological perspective. They identify and describe the transformations that have occurred in the shopping process, ranging from traditional shopping and self-service checkouts to solutions based on artificial intelligence and augmented reality. The advent of digital transformation in grocery shopping has reconfigured consumer roles, with consumers now actively participating in the co-creation of their shopping experience (Wolniak et al., 2024).

2. Research method

The study employs the scoping literature review method. Scoping reviews are invaluable tools, particularly for researchers in the early stages of exploring a topic. These reviews aim to map the existing literature, identify gaps, and help clarify research questions (Grant, Booth, 2009). A scoping literature review provides a comprehensive overview of the current state of

research, enabling researchers to orient themselves within the subject and formulate more targeted research questions.

This research commenced with a comprehensive search of various full-text databases for studies documenting the application of Lean concepts by retailers. The second stage of the research process involved searching for studies and conceptual work that were either directly or indirectly related to Lean Retail (LR). These studies were deemed particularly relevant to the research topic due to their emphasis on process improvement methodologies within retail sectors. The objective of this stage was to identify significant research issues or directions pertinent to the specifics of retail activities. The collected research challenges were analysed, evaluated, and subsequently systematized.

3. Lean Management concept

Lean Management was first widely elaborated by James P. Womack and Daniel T. Jones. This concept focuses on eliminating waste and creating value for the customer. The fundamental principles of this management concept are articulated in the seminal text **Lean Thinking** (Womack, Jones, 1996), which outlines five core principles:

1. Value: The starting point is to understand what is genuinely valuable from the customer's perspective and what they are willing to pay for. All activities that do not add value should be identified as waste.
2. Value Stream: This is a principle for analysing all the steps involved in creating a product or service. It facilitates the visualisation of the entire process and the flow of resources and information. It is used to monitor and eliminate waste (Bonaccorsi et al., 2011).
3. Flow: The optimal work flow of products, services or information through the various stages of the product or service creation process, without periods of inactivity or delay. Overcoming barriers to the flow of resources and information is a fundamental aspect of improving operational efficiency.
4. Pull system. A pull system is one in which the customer initiates production or services by placing an order. The intention of manufacturing is to produce goods and services according to actual demand, thereby avoiding unnecessary accumulation of overstock and overproduction (Ballard, Tommelein, 2012; Hicks, 2007).
5. Perfection: The essence of the Lean methodology is a commitment to continuous improvement. Once changes have been implemented, there is always room for further waste elimination and process improvement. These five principles form the foundation of the Lean approach and help organisations to optimise processes, improve quality and reduce costs (Womack, Jones, 1996).

The Toyota Production System (TPS) was developed by Taiichi Ohno at Toyota Motor Company in the 1950s. The primary objective of TPS is to reduce costs and enhance productivity. This is accomplished by eliminating waste, which encompasses excess inventory. The integrated systems approach has gained widespread acceptance in manufacturing industries globally and has subsequently been adopted by various non-traditional sectors (Lander, Liker, 2007).

In his seminal work, **The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer**, Jeffrey Liker outlines 14 principles that illuminate the Toyota approach to management and philosophy (Liker, 2004). These principles are encapsulated within a four-point framework represented by the acronym 4P. The four pillars of the Toyota Way are Philosophy, Process, People and Partners, and Problem Solving. These principles reflect Toyota's approach to managing production, processes, and organizational culture. A fundamental tenet of the Lean model is the idea that an organization should be guided by a long-term philosophy when making decisions, often prioritizing this over short-term gains. The following section addresses the topic of processes. The associated principles advocate for the implementation of a continuous process flow, the use of a pull system to prevent overproduction, the balancing of workloads (heijunka), the establishment of a culture that encourages stopping to address issues to ensure quality from the outset (jidoka), the standardization of tasks to facilitate training and continuous improvement, the deployment of visual control mechanisms, and the exclusive use of validated technology to enhance the capabilities of individuals and processes (Liker, Morgan, 2006).

The subsequent pillar comprises a set of principles aimed at supporting individuals and external partners whose contributions are invaluable in the context of a Lean transformation process. It is essential to cultivate leaders who possess a thorough understanding of the work and can effectively share this knowledge with others, including outstanding individuals and teams that align their actions with the company's core values. Furthermore, it is vital to strengthen positive relationships with partners and suppliers by offering them the necessary support to foster their growth and development (Liker, Franz, 2011).

The final three principles of the fourth pillar focus on problem resolution. It is advisable to make decisions slowly but implement them quickly (nemawashi) to gain a comprehensive understanding of the situation and observe it directly (genchi genbutsu). The goal is to evolve into a learning organization through the practice of continuous reflection (hansei) and ongoing improvement (kaizen). Collectively, these 14 principles form a management system that emphasizes process efficiency, respect for individuals, continuous improvement, and long-term thinking. In practice, these principles have significantly contributed to Toyota's status as one of the world's leading automotive manufacturers (Liker, 2004).

4. Lean in retail companies

The concept of LR was introduced in 1999 by Abernathy, building on earlier research related to Lean Thinking. This research demonstrated that Lean practices are instrumental at various levels of the retail sector, including sales, purchase monitoring, inventory management, and supply chain management (Jimenez, Bedoya, 2021). The fundamental principle of LR is the elimination of waste. In line with the tenets of Lean Manufacturing, the primary sources of waste in the retail sector are identified as excess inventory, product defects, unnecessary movement, underestimated labour hours, and wasted time.

The optimization of both internal and inter-organizational processes is a fundamental principle of the LR concept. As part of the Effective Consumer Response strategy, manufacturers and retailers aim to enhance the flow of products and information throughout the value chain, starting at the point of sale and leveraging comprehensive demand data (Lukic, 2012). The front-end of this strategy focuses on pricing and creating value for customers, while the operational strategy, which emphasizes cost optimization and value creation for operators, constitutes the back-end. The integration of activities from both areas into a cohesive corporate strategy is designed to minimize sales volatility and reduce operating costs (Noda, 2015).

In their case study, Čiarnienė and Mančas (2024) present an analysis of a retail entity that employed the Lean approach to minimize some losses. The authors examine a range of typical Lean management tools, including 5S, Value Stream Mapping, visual management, and Kanban. They conclude that, despite the overall favourable assessment of the Lean program, several barriers related to Lean persist. These barriers include employee resistance to change, a lack of knowledge about Lean principles, and insufficient support from management (Čiarnienė, Mančas, 2024).

A significant study on the implementation of Lean methodology in the retail sector was conducted at the well-known convenience store chain 7-Eleven. This study focused on the movement of goods from a holistic perspective that encompassed the entire supply chain, aligning with the Lean program being implemented. The adoption of the Lean program led to an increase in delivery frequencies while simultaneously reducing the number of trucks used, thereby optimizing logistics and minimizing resource waste (Naruo, Toma, 2007). The establishment of a combined distribution centre enhanced the flow of goods and reduced waste associated with storage and transportation. Additionally, inventory levels were decreased, and obsolete units were eliminated, creating space for new items and reducing wasted space. The company even developed and introduced own method called Tanpinkanri, the method allows as item-by-item control. This approach involves managing each commodity with the goal of determining the optimal number of stock-keeping units in trade (Naruo, Toma, 2007).

A study conducted in a Portuguese hypermarket utilized Value Stream Mapping (VSM) and Kanban methodologies (Marques, Jorge, Reis, 2022). The VSM methodology was employed to redesign the replenishment process in the fruit and vegetable department, which exhibited the highest incidence of stock shortages. Kanban was implemented in an e-commerce warehouse with the objective of enhancing inventory management. The implementation of these methodologies resulted in significant improvements across several key performance indicators, including a reduction in stock shortages from 10% to 4.2%, a 33% decrease in the time required to replenish shelves, and an increase in the order fulfilment rate in the e-commerce store from 90% to 93% (Marques, Jorge, Reis, 2022).

It is evident that the concept of LR is inadequately explained in the existing literature. The available studies, which aim to provide a comprehensive understanding of the operations of retail entities, are fragmented, addressing only select areas and issues (Čiarnienė, Manča, 2024). Nevertheless, the current research indicates that there is significant potential for implementing Lean methodology in retail operations. This includes the distribution of goods, their movement through store warehouses, and placement on display shelves, as well as the organization of work and the enhancement of quality and efficiency across all processes undertaken by retailers.

5. Desired research issues for LR

Nevertheless, despite the relatively limited literature sources on LR, there are studies that explicitly identify significant research directions and essential challenges for implementing Lean principles in retail operations. It is also important to consider more comprehensive works that address the field of distribution as a whole, including services, within which retail operations are clearly encompassed. Similarly, regarding related methodologies associated with continuous improvement, such as Six Sigma and Lean Six Sigma, references to these will highlight significant research issues for LR as well.

Čiarnienė and Mančas (2024) argue that implementing Lean principles in the retail sector presents a more complex set of challenges compared to manufacturing operations. This complexity arises from the unique characteristics of the industry, such as the need to align supply with demand, the simultaneous production and consumption of services, and the active involvement of customers in the production process. The researchers emphasize the need for further investigation into the barriers to implementing Lean in the retail sector. They categorize these barriers into three main groups: those related to people, those related to the organization, and those related to processes (Čiarnienė, Mančas, 2024, p. 95).

Another study conducted a morphological analysis of research gaps, defined as opportunities for further investigation regarding the application of Lean Six Sigma in service sectors (Sunder et al., 2018). The authors identified a total of 355 research gaps, which they systematically categorized and analysed. In their conclusion, they highlighted particularly relevant research directions, some of which also pertain to commercial activities. The aforementioned gaps include the following:

- Adaptation of models for implementing Lean Six Sigma methodologies in organizational contexts typical of commerce, specifically focusing on the adaptation of Lean implementation in inbound logistics, outbound logistics, customer service, and other relevant areas.
- Adaptation of the Lean toolkit for the service sector (applicability, ease of use, and preferred application in various core and support functions within the trade sector).
- Verification of the assumption that Lean practices serve as a catalyst for incremental innovation and a continuous improvement orientation within retail organizations.
- To evaluate whether the implementation of Lean principles in retail organizations enhances customer satisfaction and employee satisfaction. If it does, what are the key attributes, influencing factors, and measures of success?
- Evaluation of the various tangible and intangible outcomes achieved through the implementation of the Lean approach in retail contexts.
- The impact of Lean implementation on retail' competitiveness and market share.
- How can the success of Lean implementation among retailers be evaluated? This includes conceptual models, preferred applications, and validation within retail companies (Sunder et al., 2018, p. 168).

Other authors adopt an urban supply logistics perspective to highlight the research and application challenges associated with implementing the Lean approach (Escuder et al., 2022). One of the most significant challenges is the lack of comprehensive research on the application of Lean principles in urban logistics, particularly concerning the retail phase. Therefore, it is essential to adopt a holistic approach to managing goods flows in urban environments. The authors emphasize the necessity of analysing the specific waste generated in this context and the benefits that can be derived from reducing various types of waste, particularly in the supply logistics phase. Similarly, other researchers underscore the importance of optimizing processes both within commercial organizations and between different organizations, as well as across various distribution links (Lukić, 2012).

Taking a customer experience and service system perspective, the authors (Serravalle, Pantano, 2023) formulate several research questions. Particularly significant in the context of applying the Lean approach, these questions include:

- What is the significance of delegating greater responsibility and authority to retail employees and customers?
- Is there a correlation between higher employee satisfaction and increased customer satisfaction, particularly regarding the value perceived by the customer?
- Will empowering employees and customers enhance the performance of retail businesses?
- How can retail shops effectively measure and mitigate negative customer behaviour, which is a specific form of waste?
- Which advanced technologies most effectively support service management, and what criteria should be used for their selection? In what ways can artificial intelligence contribute in this context? (Serravalle, Pantano, 2023, p. 3).

With reference to the last bullet point above, it is important to emphasize that other authors highlight the significance of technology in optimizing inventory management and enhancing efficiency in retail (Lukić, 2012). A study by Wolniak et al. (2024) indicates that retail establishments will become smarter and more interconnected through technologies such as artificial intelligence, augmented reality, and the Internet of Things. For instance, artificial intelligence can personalize the shopping experience by providing tailored recommendations, promotions, and product information, as well as improving inventory management and automating checkout processes. Additionally, retailers will adopt environmentally friendly technologies, such as carbon footprint calculators, to assist customers in making more sustainable choices.

The differences between services and manufactured products are significant and have serious implications, making a focused examination of the theory of value co-creation in services essential. This analysis leads to the identification of research challenges that are directly relevant to retail activities. It is crucial to achieve a comprehensive understanding of customer value, which includes both tangible and intangible elements, as well as relational aspects (Urban, 2016). A key issue then is implementing changes that streamline organizational processes typically for Lean methodology and at the same time making enhancements of customer experience. Redefining waste in standard retailing processes and understanding organizational culture's role in customer-facing businesses is essential. Lean tools, such as standardization, should be tailored to retail operations (Urban, 2016, p. 598). Some other Lean tools and policies have to be redeveloped as equivalents, as for example Just-in-Time and Kanban (Naruo, Toma, 2007, p. 391).

A significant number of retailing entities are structured as large organizations with hundreds of locations, each facing a variety of unique constraints in their daily operations. One common issue is the financial limitations encountered by employees, often resulting from downsizing

strategies aimed at enhancing profitability. Another prevalent challenge is the high staff turnover rate, which has been observed to reach as much as 35% (Madhani, 2020). Such circumstances make it difficult to engage personnel in change initiatives and to sustain the changes that have been implemented. Typically, changes are introduced at the corporate level; however, due to the autonomy of individual spots, these changes may face considerable challenges in being adjusted to the specific needs of each retail site. Additionally, there is a pressing need to respond to evolving customer preferences, which often requires frequent modifications to retail environments. Furthermore, a particular type of waste is associated with information access, specifically the lack of access to data or its misuse (Madhani, 2020). The simultaneous submission of change requests by various corporate departments complicates the decision-making process for shop managers, making it difficult to determine whether to implement, disregard, or postpone these requests. This can turn even the simplest changes into a complex process, which becomes itself a distinct form of waste.

Another common issue in retail is the use of price promotions. Noda (2015) argues that price promotions can contribute to waste. A reduction in price aimed at stimulating sales often leads to significant fluctuations in demand, which in turn can result in overstocking and shortages. This situation generates additional storage and handling costs, which are clearly wasteful (Noda, 2015). Investigating the effects of pricing strategies on process flow and the incidence of waste is a critical issue that aligns with the fundamental principles of the Lean approach, particularly the goal of stabilizing processes and eliminating all forms of waste. Escuder et al. (2022, p. 561) note that the accumulation of excessive quantities of goods in warehouses at both the distributor and retail levels leads to over-utilization of warehouse space and decreased employee productivity, resulting in high levels of waste.

Some studies have indicated that price promotions in the retail sector may contribute to waste on the part of consumers (Farr-Wharton et al., 2014). This primarily refers to excessive and misguided food purchases; however, it can also occur with durable goods, where unnecessary purchases are driven by promotional factors. Furthermore, investigating waste issues and pursuing strategies to reduce this waste are significant research topics, particularly in the context of the Green Lean concept (Amani et al., 2015).

The authors emphasize the importance of identifying methods to eliminate waste, including overstocking, product defects, unnecessary movements, overstaffing, and wasted time, across various trading activities (Lukić, 2012). The literature also identifies additional potential sources of waste in retailing that require particular attention. These sources include defects in the selection of goods and/or quantities, which can lead to either an under-supply or over-supply to customers (Escuder et al., 2022, p. 562). However, there is a lack of comprehensive systematization of waste in retail operations, based on in-depth empirical research, as well as an estimation of its magnitude across different types of retail formats.

6. Discussion

Despite the limited cross-sectional research on LR, a review of the current literature, along with the fundamental assumptions of Lean methodology, allow to reveal several critical issues essential for the development of this approach. These issues hold both theoretical and practical significance. Additionally, they are of application and consulting interest due to the potential business benefits associated with the Lean concept in retail, especially considering its current slight presence in the sector. Based on the findings presented in the previous section, several key thematic areas emerge that require further investigation within the field of LR as figured out below.

1. Adaption of models and tools to LR.

It is essential to adapt the methodologies and tools developed by Lean Management to the specific conditions typical of retail organizations. Where necessary, new tools should be created to address particular challenges faced in the retail sector, as demonstrated by Naruo and Toma (2007) in their Lean program at the 7-Eleven chain. (References: Escuder et al., 2022; Sunder et al., 2018; Urban, 2016; Naruo, Toma, 2007).

2. Define and measure LR effects.

Developing potential effects offers a response to the fundamental question of why LS should be utilized. The governing rules of commercial activities are inherently specific. Therefore, it is crucial to establish a methodology for measuring the effects characteristic of LR and to substantiate, with reliable data, the extent of benefits realized by the selected stakeholders. This will aid in persuading managers to consider implementing this approach. (Serravalle, Pantano, 2023; Sunder et al., 2018).

3. Examining value flows in terms of the distribution chain.

The retailing sector is closely interdependent with the preceding distribution links; therefore, many beneficial changes must be addressed from a broader perspective that extends beyond the commercial organization itself (Escuder et al., 2022; Lukić, 2012).

4. Customer value.

The value perceived by customers in retail services has a distinct profile. In addition to price, various other factors are significant, such as location and personal relationships. This necessitates a comprehensive operationalization for the successful implementation of LR applications (Serravalle, Pantano, 2023; Urban, 2016).

5. Waste in retail.

Wastes that are well-documented and justified for mass production should be identified for retail organizations. It is crucial to understand the factors that contribute to waste, including retailers' strategies, promotional practices, and irresponsible customer behaviour. Customer-related waste warrants particular research attention, in line with

the value indicated above (Serravalle, Pantano, 2023; Escuder et al., 2022; Madhani, 2020; Urban, 2016; Noda, 2015; Lukić, 2012).

6. Continuous improvement at LR.

Continuous improvement, which leads to numerous incremental innovations, requires dedicated employees and is deeply rooted in the specifics of process flows. In the retail sector, employee commitment encounters several challenges, while processes are significantly influenced by the close presence of customers (Serravalle, Pantano, 2023; Madhani, 2020; Sunder et al., 2018).

7. Relevance of new technologies at LR.

New technologies from the digital sphere are significantly transforming commercial activities. It is advisable to utilize these technologies extensively to enhance all processes, including those related to customer service, as well as to introduce new retail models (Wolniak, Stecuła, Aydın, 2024; Serravalle, Pantano, 2023; Lukić, 2012).

8. LR organisational barriers.

There is no doubt that the implementation of LR must address adversities and organizational barriers. Analysing these challenges can significantly enhance and expedite the application and delivery of outcomes through LR (Čiarnienė, Mančas, 2024; Madhani, 2020).

The Toyota Way outlines the management culture of Toyota, based on four fundamental principles collectively known as the 4Ps. These principles serve as a graphical representation of the Lean concept, into which Liker integrated the 14 principles. Fig. 1 illustrates the application of the identified subject areas relevant to exploration within the LR sphere as applied to this framework. Previously, eight LR research gaps were systematically organized according to the Toyota framework. The four key areas of focus are as follows: Philosophy, Process, People and Partners, and Problem Solving.

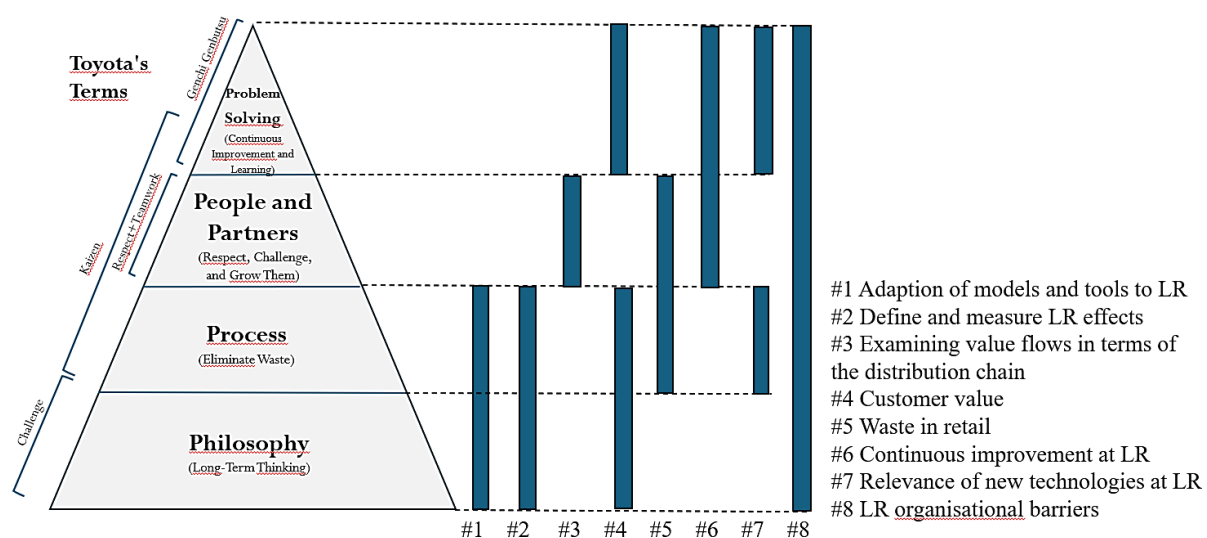


Figure 1. Systematics of research challenges for LR in terms of the 4P of Toyota Way model.

Source: Liker, 2004, p. 27, own elaboration.

As illustrated in Fig. 1, the majority of challenges are associated with the fundamental building blocks of Lean approach: Philosophy and Process. This suggests that focusing on these research areas (#1, #2, #4, #5, #7, #8) will help establish a foundation for addressing issues related to the higher levels of the pyramid. The capacity for long-term thinking is a crucial component of organizational development, enabling the creation of a robust and resilient structure committed to the pursuit of continuous improvement. The elimination of waste not only reduces costs but also allows for more efficient results, thereby facilitating the ongoing implementation of Lean principles and enhancing the appeal of the concept to other organizations.

7. Conclusions

The adoption of Lean methodology in the service sector is a trend that is becoming increasingly evident across a diverse range of economies, including both developing economies and leading ones. When considering the application of Lean in the context of services, it is crucial to recognize the differences in the interpretation of value flow principles that arise from the distinct characteristics of service provision compared to industrial production. This article presents an in-depth analysis of the relevant issues surrounding the development of Lean methodology in retailing. To achieve a comprehensive approach to LR, it is essential to examine retail businesses from a broader perspective, encompassing the distribution chain, long-term strategies, and external partnerships. Existing research indicates that LR is not yet a sufficiently well-explored subject. However, there are studies that highlight key research directions and barriers to implementing Lean in retail. By investigating previously unstudied areas, it is possible to identify and leverage the potential benefits of LR.

Some of the identified barriers to the implementation of LR originate from within the organization itself. The role of the customer in value creation is a crucial factor in the development of service organization strategies, which are increasingly focused on customer satisfaction and sustainable growth. Consequently, unfavourable circumstances for implementing change may arise, such as high staff turnover rates and the need to adapt to changing customer preferences through point-of-sale modifications or pricing policies. A certain dissonance exists between the corporate strategy and the operational level responsible for executing this strategy. Therefore, it is recommended that the methodology for measuring the quality experienced by customers be integrated with the operational improvement methods used in Lean Management. This close connection is an essential component of the process of developing and enhancing the competitiveness of service companies.

In the context of a study exploring the field of city logistics, the concept of waste is defined specifically within this domain (Escuder et al., 2022). These types of waste closely resemble the seven forms of muda, as articulated by Taiichi Ohno in relation to manufacturing processes (Mossman, 2009). When there is an imbalance between the outsourcing of tasks and the availability of resources, various forms of waste are generated in operations. This underscores the necessity for comprehensive research insights into the commercial aspects of waste. A review of the literature reveals that waste in commerce remains largely unexplored. There are only scattered hints and fragmented observations, with no systematic categorization or assessment of the potential scale for specific types of commercial facilities. The concept of waste serves as a fundamental starting point for LR, alongside an understanding of its objectives. Identifying the underlying causes of waste is crucial, as it is a complex issue. This identification is essential for the successful implementation of the Lean approach in retail. Consequently, this suggests a direction for future research: to identify the optimal points and synergies that enable corporate-level decisions and actions to effectively eliminate waste.

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CORPORATE SOCIAL RESPONSIBILITY, WORK-LIFE BALANCE AND WELL-BEING – THE EMPLOYEE PERSPECTIVE

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Purpose: The purpose of the article is to present the results of the research and identify factors that allow to take care of well-being of the personnel employed in the SMEs. According to observations, various personnel management strategies are emerging in enterprises. One of them is work-life balance (combining private life and work), and there is also talk of work-life integration (combining work with private life) or workation (combining work with vacation). The assumption is that employers in the SME sector are just beginning to use this type of solution, allowing them to retain the best employees and increase the attractiveness of the company in the eyes of future candidates. The tools used are chosen intuitively and are not part of personnel management programs. It was also important to show the place of these concepts in the corporate social responsibility strategy of SMEs.

Design/Methodology/Approach: For the purpose of the article, an attempt was made to identify factors to take care of the well-being of employees and to propose a toolkit that can be applied in the practice of SMEs. In order to identify the needs of employees in these areas and the most important elements of programs aimed at staff, a survey was conducted using a diagnostic survey method and the sample was purposively selected. The survey covered employees of micro-, small- and medium-sized companies from the area of the Silesian province. In addition, source data from secondary reports, academic publications and scientific sources was used. The time scope of the study is from August to November 2024.

Findings: The sector of micro-, small- and medium-sized enterprises is now the overwhelming majority in Poland. Employment in these companies is also higher than in large enterprises. SMEs operate in an ever-changing market environment, influence the development of the local economy, create jobs and often engage with local communities, resulting, among others, in an image of socially engaged businesses. Corporate social responsibility programs aimed at employees are one of the important elements of an organization's personnel management strategy. One of the challenges of for the companies socially responsible in the area of caring for employees, is the use of practices consistent with work-life balance (WLB). According to the survey, the SME sector personnel notice and expect such solutions to be applied. By identifying the expectations of their employees, small and medium-sized companies can even better cope with the turbulent environment. The proposed solutions should be similar in terms of functionality compared to large enterprises. In turn, they should be different in terms of tools and subjects. This is often due to the resources (financial, tangible and human resources) available to the surveyed organizations.

Practical Implications: The text identifies the most important measures that can be applied in small and medium-sized enterprises to meet the needs of employees, create attractive jobs and nurture the image of a socially responsible company. In addition, barriers to the introduction of some work-life balance and well-being solutions are presented.

Social Implications: By responding to the needs of today's employees and addressing their self-development, well-being and work-life balance, the proposed solutions can be important components of personnel management programs. It is a challenge for entrepreneurs today to implement long-term programs to create balance, increase motivation, engage in work and make it comfortable and attractive. Employees who are aware of their needs will look for work that they enjoy and do well. Employers, on the other hand, need to be aware of it and treat it as a strategic investment in the success of the company.

Originality/Value: The issues presented in the article have not been widely discussed in the literature with regard to small and medium-sized companies in Poland. Well-being, work-life balance, and attention to employee satisfaction are rather the domain of larger companies.

Keywords: work-life balance, well-being, SMEs, enterprise, personnel, personnel management.

Category of the Paper: Research paper.

1. Introduction

Today's businesses operate in an ever-changing, often turbulent environment. Business conditions, external and internal environment factors, are changing. Internal factors are the ones that determine development of the company, and the company itself has the capacity to directly influence them. One of the key internal factors is people. The human factor is undoubtedly the most important resource of any enterprise. The involvement of employees in the implementation of the company's strategy, the execution of daily tasks, the level of knowledge and creativity, and the willingness to take on new challenges, require business owners and managers to use a number of different tools. The purpose of the article is to present the results of the research and identify tools that allow to take care of well-being of the personnel employed in the SMEs. According to observations, various personnel management strategies are emerging in enterprises. One of them is work-life balance (combining private life and work), and there is also talk of work-life integration (combining work with private life) or workation (combining work with vacation). The assumption is that employers in the SME sector are just beginning to use this type of solution, allowing them to retain the best employees and increase the attractiveness of the company in the eyes of future candidates. The tools used are chosen intuitively and are not part of personnel management programs. It was also important to show the place of these concepts in the corporate social responsibility strategy of SMEs.

2. Corporate Social Responsibility, Work-Life Balance and Well-Being – Literature Review and Discussion

Corporate social responsibility is one of the key research areas of 21st century strategic management. Another factor from the point of view of this study is strategic talent and human capital management (Bieliczyński, 2024, p. 33). The concept of corporate social responsibility (CSR), as the name suggests, focuses on micro-level problems (Brzozowski, 2013, p. 11). In practice, the concept is about companies undertaking various activities in response to the needs from stakeholders. These are activities that often serve the local community, activities that are often image-building and philanthropic. As I. Ścibiorska points out, companies are responsible to the broader environment of the organization: employees, suppliers, intermediaries and other stakeholders, as defined in the Davos manifesto. The personal interest of the owner can no longer be separated from the general good (Ścibiorska, 2008, p. 350). Among the many benefits that a socially responsible enterprise can achieve are better relations with its employees (Błaszowski, 2024, p. 125). There is no single universal definition of the concept of corporate social responsibility. The ISO 26000 standard, published in 2010, defines social responsibility as “an organization's responsibility for the impact of its decisions and activities on the society and environment, through transparent and ethical behavior that contributes to sustainable development, including the health and well-being of the society, takes into account stakeholder expectations, complies with applicable law and is consistent with international standards of behavior, and is implemented throughout the organization and practiced in its operations within its sphere of influence” (Jastrzębska, 2013, p. 38). According to I. Ścibiorska, “the concept of corporate social responsibility is often defined as conducting production and service activity aimed at building lasting, positive relationships with all stakeholders both inside and outside the organization” (Ścibiorska, 2008, p. 351). In terms of internal factors, the following aspects are characterized: workplace safety, human resource management, management of raw materials consumed by the company and the environmental impact of the company's operations, shareholder relations and corporate governance principles. The external factors, i.e. the company's impact on the environment, include: impact on local communities, relations with business partners, suppliers, customers and public institutions, respect for human rights, concern for the environment (Zuzek, 2012, p. 199). With regard to the issues discussed above and the subject matter addressed in this paper, it makes sense to treat the well-being and work-life balance of employees as important elements of corporate social responsibility. In the context of small and medium-sized enterprises, this is mentioned by F.A. Sanusi and S.K. Johl (Sanusi, Johl, 2022, p. 9). Other authors point out that most of the previous studies on well-being had been conducted in larger companies (...). In small companies, the psychological well-being of employees is often worse than that of the staff of large companies (Tabala et al., 2024, p. 1043). Here we can give examples of companies such

as Decathlon (Work-Sport Balance campaign), Santander Bank Polska, Jeronimo Martins, PKO Cargo, Danone, DB Shenker, Leroy Merlin, etc. (Responsible Business in Poland Report, 2023). The modest state of knowledge in human resource management with regard to small businesses is indicated by Szmidt, Król, and Kołodziejczyk-Olczak (Kołodziejczyk-Olczak, 2013, p.117). “Human resource management in small and medium-sized enterprises in Poland has its own characteristics and differs from practices in this area in large companies. (...) Relatively simple methods and tools prevail” (Król, Ludwiczynski, 2007, p. 89).

The concepts of work-life balance and well-being are a very topical area being addressed in the literature and research today. Maintaining a work-life balance allows employees to be able to reconcile professional responsibilities with family life, passions, travel, further education and personal development. This aspect is pointed out by N. Ngaliman, I.W. Catrayasa, K. Khairil (Ngaliman, Catrayasa, Khairil, 2024, p. 49). Work-life balance also contributes to employee loyalty. M. Stor, Ł. Haromszeki and J. Poór point to professional recognition and respect as undoubtedly the most important factors in building employee commitment and loyalty. They also point to work-life balance as another key factor influencing employee loyalty. Flexible work arrangements, prioritizing employees' leisure time send a message about how important employees' well-being is to the employer. Implementing health programs and providing a safe work environment are ways in which organizations can show that they care about the health of their employees. Interest in the welfare of employees directly translates into an increase in the loyalty of employees, who feel protected and valued (Stor, Haromszeki, Poór, 2024, p. 28). Heavy workloads and extended working hours pose challenges to maintaining employees' personal and professional lives. As a result, they quit their jobs and experience stress and sadness (Sharma, S., Sharma, K., Saini, 2024, p. 593). The experience of a work-life imbalance leads to problems in family life, private problems for the employee, as well as problems at work. The situation of not achieving work-life balance leads to absenteeism, increased employee turnover, strikes, workplace accidents, decreased productivity and employee resignation (Sarkbay, 2024, pp. 1430-1431). Thus, one can speak of a two-way conflict between work and family. It is mentioned by R.P. Zhang, P. Bowen, P. Edwards who proposed a model grounded in boundary theory and work-family boundary theory (Zhang, Bowen, Edwards, 2024).

The effect of introducing work-life balance programs is improving the well-being of employees. Well-being is called a positive attitude of experiencing emotions and a cognitive positive evaluation of one's life (Czerw, 2017, p. 20). As mentioned by I. Zerbe and A. Springer, employee well-being can be assessed in two aspects: eudaimonistic and hedonistic. In the eudaimonistic view, it means living a meaningful, valuable, and purposeful life, while in the hedonist view, well-being is defined as experiencing pleasure and as individual satisfaction with the life one has (Zerbe, Springer, 2023, p. 4). E. Kulawska stated that “mental well-being plays an important role in all professional groups, but it is particularly important in the professions that have direct contact with other people” (Kulawska, 2019, p. 130).

Table 1.*Examples of well-being activities in medium-sized enterprises in Poland*

Company name	Company size	Well-being and work-life balance activities
Anpharm Pharmaceutical company	Medium-sized company – 250 employees	family picnic, celebration of service anniversaries, training and skiing trips, support for sports initiatives and competitions for employees and their families, employee volunteerism and farewell events for retirees
Natural Pharmaceuticals	Medium-sized company – 240 employees	flexible working hours, tailored to the individual needs of employees who can work remotely, in the company's headquarters employees can adjust 8 hours of work to their needs in the time range from 7.00 a.m. to 5.00 p.m., meetings are organized from 9.00 a.m. to 3.00 p.m., in the Rzeszów branch they enjoy flexible hours, which are adjusted to their personal lives, for example taking into account university classes or children's school hours
Urtica	Medium-sized company – 300 employees	sports, educational and integration activities for employees, joint initiatives, provide employees with the opportunity to get to know each other better, making their cooperation even more effective
Job Impulse	Medium-sized company – 150 employees	Job team – it is an internal initiative of employees who do sports, like movement and prefer a healthy lifestyle associated in group, the members of which support and motivate each other, share advice and jointly perform in competitions
Fabryka Mebli Balma	Medium-sized company – 200 employees	the company has reduced the strain on the musculoskeletal system of production workers by using electric pallet trucks and tables with adjustable tops

Source: Raport Odpowiedzialny Biznes w Polsce, (2023). Responsible Business Forum, accessed: <https://odpowiedzialnybiznes.pl/publikacje/raport-2023/>

Well-being in an organization is a new phenomenon in Poland and has not yet been fully recognized. It refers primarily to shaping the conditions of the work environment to build the well-being of employees and positively affect their professional development, sense of security or strengthen the bonds between them, and ultimately - the sustainability of the company. Examples of measures used in medium-sized companies in Poland are shown in Table 1.

There are many factors that determine the well-being in an organization. These include the new generation's demands on employers, changing perceptions of quality of life, diseases of affluence, and the employee market (Kulig-Moskwa, Nogieć, 2018, p. 354). K. Muszyńska declared that “more and more employers are looking for solutions with young parents in mind, introducing the principle of work-life balance, taking care of the equality of men and women on the job and the general well-being of employees” (Muszyńska, 2021, p. 202).

3. SME Sector in Poland

Classifications of small and medium-sized enterprises (SMEs) are based on quantitative and qualitative (or mixed) criteria. Quantitative criteria may include the number of employees, the value of the balance sheet total, the value of annual net turnover or the value of fixed assets (Dziemdziała, Krzyżanowska, 2020, p. 90). The small and medium-sized enterprise sector is of great importance to the economy. As Jowita Trzcielińska showed, “in Poland in 2014 there

were 1.84 million non-financial enterprises, 99.8% of which were MMSPs. Their share was 96%, 3% and 1%, respectively. According to 2013 data, these enterprises generated 50.1% of GDP, and the share of each group was 30.8%, 8.8% and 10.6%, respectively. At the end of 2014, the number of employees in MMSPs in Poland was 6.3 million people, 38.2% of whom were employed in micro-, 13.4% in small, and 17.6% in medium-sized enterprises” (Trzecińska, 2020, p. 5). The SME sector continues to grow. According to the data published in the Report on the Condition of the Small and Medium-Sized Enterprise Sector in Poland in 2024: “enterprises operating in Poland currently produce nearly two-thirds of Poland's GDP (67.9%). The largest contribution comes from SMEs, which generate nearly one in every two zlotys of GDP (45.3%)” (Raport o stanie sektora..., 2024).

4. Material and Method

As mentioned above, there is no shortage of analyses and studies in the literature on work-life balance and well-being in large companies. Corporate social responsibility issues are more often related to activities aimed at external stakeholders. According to observations, small and medium-sized enterprises apply some work-life balance solutions to their employees, taking care of the well-being of their staff. These are often based on intuition and applied on an ad-hoc basis. The aim of the study was to identify factors that allow to take care of the well-being of personnel employed in the small and medium-sized enterprise sector and to identify the most important elements of programs addressed at personnel in this type of companies.

Research questions:

1. How do employees of small and medium-sized companies rate the corporate social responsibility of the companies where they are employed? Does this responsibility only apply to the external elements of the company's environment?
2. Do SMEs recognize the need to take care of the well-being of their employees? How do employees evaluate the measures taken?
3. What measures are applied by SMEs to take care of the employee's mental and physical health and work-life balance? What is the level of awareness of employees in this regard? How do employees rate their well-being?

The assumption is that employers in the SME sector are just beginning to use this type of solution, allowing them to retain the best employees and increase the attractiveness of the company in the eyes of future candidates. In addition, it was assumed that SMEs intuitively apply certain work-life balance and well-being tools, without yet seeing the effects of their application on unlocking employees' potential. This may be due to some financial and organizational constraints. In order to identify the needs of employees in these areas and the most important elements of programs aimed at staff, a survey was conducted using a diagnostic

survey method. The research tool was a survey questionnaire. The survey covered employees of micro-, small- and medium-sized companies from the area of the Silesian province. The sampling was purposive and the time scope of the survey covers the period from August to November 2024.

Fifty-eight people participated in the survey, of which 52 questionnaires were accepted for further analysis. The sampling was purposive, and a questionnaire consisting of 10 factual questions and demographic questions was used. The snowball method was used to reach the respondents. Due to the small sample, the results of the survey should be treated as a prelude to further research on the social responsibility of SMEs.

The majority of participants in the survey were women (77%). The largest number of respondents were in the 18-25 and 26-35 age groups (both 38.5% each). Those between the ages of 46 and 55 accounted for only 19.1%, with the least number of people between the ages of 36 and 45 (3.8%). Information about the age of the respondents is very important in this case. Indeed, the largest group was made up of 18-35 year olds. A large proportion of these people are representatives of Generation Z (it is assumed in the literature that Generation Z are those born between 1995 and 2012). Employees of this generation appreciate flexible working hours and benefits such as extra days off. Details of the age of the respondents are shown in Figure 2.

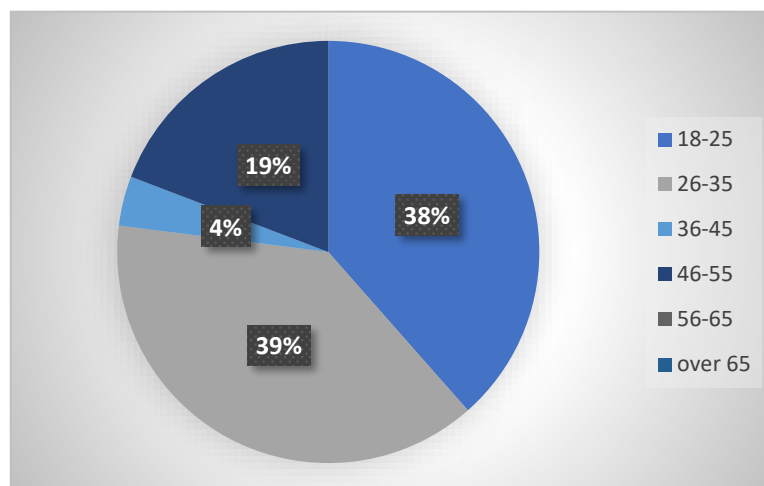


Figure 1. Age of respondents.

Source: own research based on conducted surveys.

Most respondents were residents of large cities (100-500 thousand residents) – 61%, rural residents – 15%, and 8% of residents of very large cities (over 500 thousand residents). Small and medium-sized cities were ticked by 8% of respondents each.

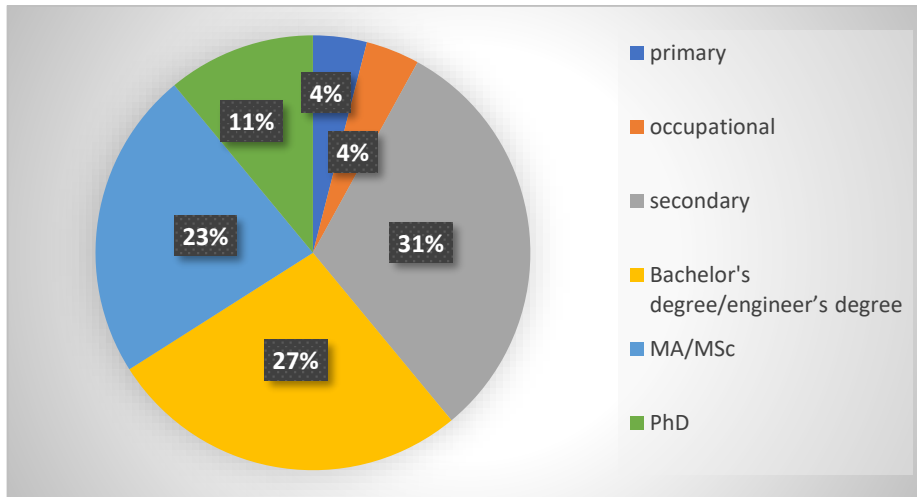


Figure 2. Level of education of respondents.

Source: own research based on conducted surveys.

A question on family structure provided interesting data from the point of view of the topic addressed. The responses obtained showed that singles and couples were most numerous among the respondents – 31% each. There were fewer families with one child (23%) and families with two children (11%). Families with three or more children accounted for 4%. As mentioned above, the survey using the questionnaire method was a pilot study to assess the manifestations of three areas of SME activity from the perspective of their employees. The areas that were analyzed were corporate social responsibility, work-life balance and well-being. It was assumed that work-life balance (WLB) as an element of corporate social responsibility can be the basis for building employee well-being. Introducing well-being into an organization is about managing the well-being of an employee in order to address their needs in a multidimensional way while achieving an organization's business goals. Well-being also means improving the organization's image and many benefits for the employee. Most of those surveyed were employees of private companies (85%). Local government units or other public entities were represented by 15% of respondents. All the respondents work in companies located in the Silesian province.

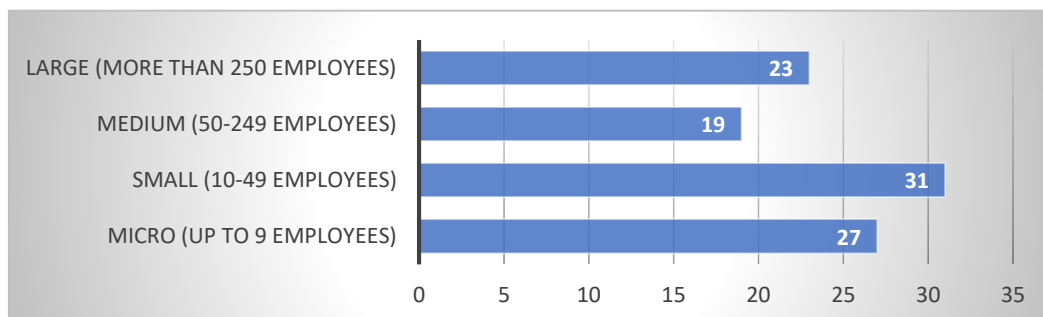


Figure 3. Size of the company where the respondents are employed.

Source: own research based on conducted surveys.

In the next two questions, the respondents indicated activities that they believe demonstrate social responsibility and identified CSR personnel activities that they have noticed in their workplaces. According to the respondents, the following activities are indicative of a company's social responsibility: caring for the well-being of employees (65%), measures to protect the environment (61%), support for employees' work-life balance, and responsible management of raw materials (50% each). Among the most frequently cited CSR personnel management tools that respondents see in their workplaces are workplace safety (81%), subsidized training, postgraduate studies, etc. (54%), a friendly atmosphere that fosters employee creativity and loyalty (46%), and respect for human rights (38%). According to the respondents, the companies where they are employed do apply work-life balance measures (as indicated by 73% of the respondents). Detailed responses on the work-life balance activities applied are shown in Figure 4.

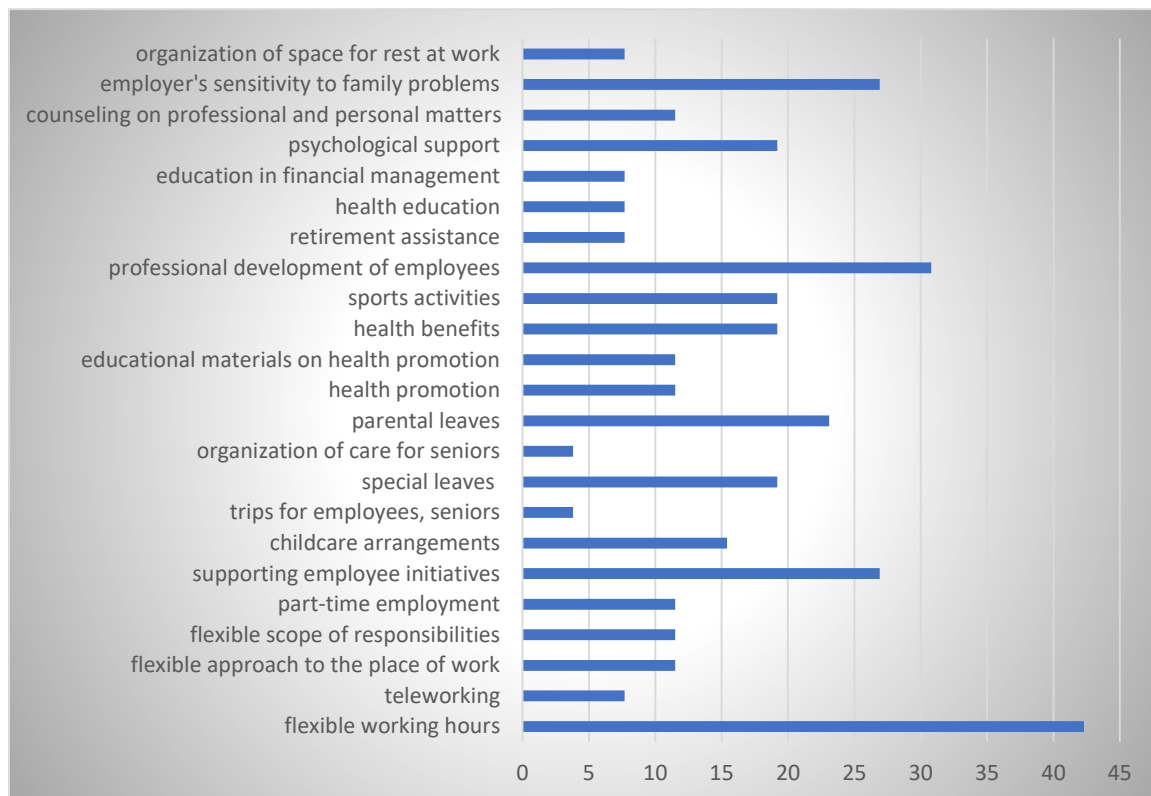


Figure 4. Activities aimed at ensuring employees' work-life balance (WLB) applied by the employer in the respondents' current workplace.

Source: own research based on conducted surveys.

As shown in the chart above, the most common solutions in the surveyed small and medium-sized enterprises are flexible working hours (42.3%), measures for the professional development of employees, training, counseling, financing foreign language courses (30.8%), support for employee initiatives and employer sensitivity to employee family problems (26.9% each). Interestingly, respondents did not indicate such issues as education for young parents, programs/activities to support parents in returning to work after a prolonged absence (to develop and improve professional skills), incentives for fathers to increase their participation

in family life in order to relieve women of the burden of parental responsibilities, the creation of new patterns for fulfilling social roles, and assistance in choosing types and forms of training taking into account the psychophysical characteristics of employees.

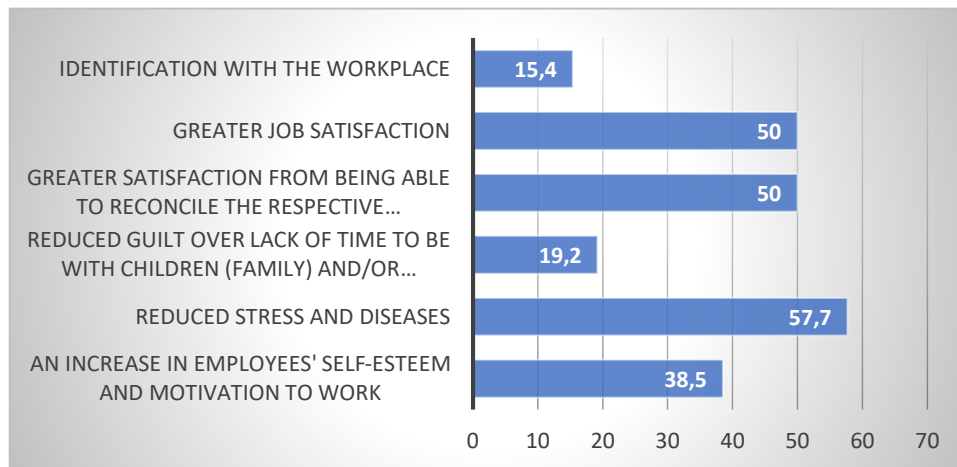


Figure 5. Benefits of employer's introduction of WLB activities according to respondents.

Source: own research based on conducted surveys.

Respondents also indicated the benefits they felt after employers introduced WLB solutions. The most frequently cited health aspects were: reduced stress and illness (57.7%) greater job satisfaction (50%), greater satisfaction with being able to reconcile different parts of life (work, family, personal life) – 50%. Increased self-esteem and motivation to work were also important aspects for respondents. As one can see, the use of work-life balance measures has a positive impact on employees' attitudes, well-being and health. What is surprising, however, is the aspect of identification with the workplace – 15.4%. In the next part of the questionnaire, respondents were given the opportunity to suggest measures they felt employers could introduce (and which are not currently being applied at the company) to take care of the well-being of their employees. The ones most frequently mentioned were introduction of flexible working hours, the possibility to work remotely, the provision of psychological support, the organization of well-being programs, including health benefits, such as passes to the gym or relaxation classes, psychological assistance. There were also suggestions such as a 4-day work week, knowing the planned work schedule several days ahead, hiring additional staff to relieve the burden on others, and a clear separation of work and free time (not contacting employees after working hours). Among additional benefits, respondents pointed to subsidies for training, sports and relaxation activities, and organizing team-building events.

In the last part of the survey, the respondents assessed their well-being, i.e. their subjective feelings resulting from professional fulfillment and low levels of stress at work, and indicated the elements of well-being they have recently felt that improved. The issues indicated by the respondents are shown in Figure 6.

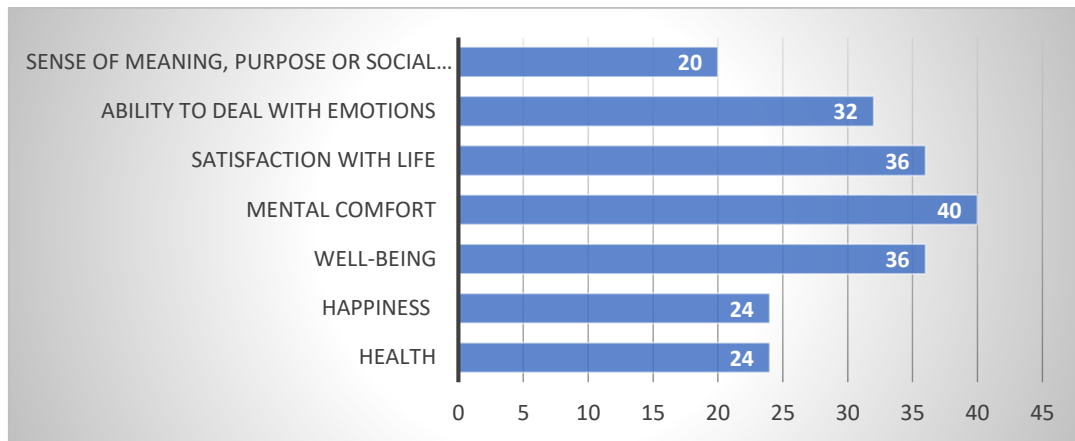


Figure 6. Respondents' well-being assessment – elements they have felt improved recently.

Source: own research based on conducted surveys.

The most important feeling observed by respondents in recent times has been mental comfort, followed by prosperity and life satisfaction. Thus, in the research conducted, it was discovered that the respondents – employees in the SME sector – rate their well-being at a low to medium level, which indicates that employers are not yet applying a wide enough range of WLB measures. In comparison, in a survey of Poles' well-being conducted in 2024 by the Infuture Institute for Benefit System, almost half of Polish women and men rate their well-being as average (Dobrostan Polek i Polaków, 2024, p. 7).

4. Conclusion

Well-being and work-life balance as elements of corporate social responsibility relating to employees became more interesting for researchers during and after the Covid-19 pandemic. It was recognized that at that time the staff (both management and rank-and-file employees) faced a very heavy workload, almost blurring the line between work and private life. Managers showed tremendous mobilization to survive in the market, between applying for government support and being creative in supporting employees and finding new solutions and markets. At the same time, it can be observed that issues related to employees' and managers' pursuit of well-being and work-life balance in the SME sector are not often described in the Polish literature. It is assumed that advanced personnel management strategies using work-life balance and well-being apply only to large companies. Observation of the market, however, shows that small and medium-sized companies are meeting the expectations of employees and are increasingly using at least some of the work-life balance and well-being tools. What's more, these activities are an important part of the personnel management strategy and are an essential element of the social responsibility of these companies. This approach is completely justified.

One of the reasons for addressing CSR, WLB and well-being was to draw attention to the need for work-life balance strategies in small and medium-sized companies. To point out that corporate social responsibility, attention to staff balance and well-being, are not only the domain of large and very large companies. Employee well-being, satisfaction and quality of life can affect the growth and competitiveness of any business. This study can be a prelude to further research, but based on the survey, it is possible to identify activities to build organizational climate or employee loyalty.

To sum up, taking into account the expectations and perspective of staff, small and medium-sized enterprises can base their work-life balance programs on the following activities:

1. Flexible working time, working hours, remote or hybrid work – the selection and applicability depends on the industry in which the company operates.
2. Lifelong learning. Employees expect opportunities for further training, learning new skills, foreign language courses.
3. Upskilling (acquiring new skills) and reskilling – employees, especially representatives of generations Y and Z, want to constantly develop, while quality of life is more important than financial status for representatives of generation Y, and generation Z are creative people who value self-development and independence.
4. Health support, physical activity and preventive health care – creating healthy habits for employees. For example, the MultiSport Program¹ is aimed at companies with at least 10 employees (Benefit System).
5. Work on changes in the understanding of roles in the family (in the survey, respondents did not indicate any activities to support parents in returning to work after a prolonged absence, including young fathers).
6. Measures in the form of incentives for fathers to increase their participation in family life in order to relieve women of the burden of parental responsibilities, creating new models for fulfilling social roles.
7. Integration of the team of employees. Small and medium-sized enterprises are characterized by frequent interactions among employees, managers and customers. These interactions affect well-being, fitness, loyalty and creativity.
8. Well-being assistant with modern technology – also small and medium-sized enterprises can use the available tools, such as well-being platforms. An example of such a platform is MultiLife which provides support for companies that want to take care of the well-being of their employees in 6 areas: consultation with a psychologist, nutritionist, trainer, language learning, development coach and financial education (MultiLife).

¹ The MultiSport Program offers sports cards (for Students, for Seniors, for adults and for children) that allow users to enjoy activities at various sports and recreational facilities. Employers can offer this to their employees as a benefit. An individual customer cannot purchase participation in the MultiSport program without going through their employer.

There is also criticism of the idea of work-life balance, saying that these areas cannot be rigidly separated. Suggestions are being made to use work-life blending, i.e. a gentle intermingling of these spheres. However, it is important to pay attention to the relationship between work and personal and family life. "In this context, new proposals have begun to emerge to define the essence of the balance, such as:

- work-life integrity emphasizing the maintenance of harmony based on the values that are most important to individuals,
- work-life quality,
- work-life rhythm - taking care of the rhythm of your own day and managing your own productivity,
- or the aforementioned work-life blending capturing the essence of the interpenetration of work and private life" (Mroczkowska, Kubacka, 2020, p. 38). SME companies do not have the same resources as large companies. However, they can take ideas and inspiration from the programs of the biggest players in the market.

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IMPORTANCE OF ORGANIC FARMING CERTIFICATION FOR CONSUMERS

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Purpose: The aim of the study is to assess the importance of organic farming certification for consumers and their behaviour on the market for certified organic food products.

Design/methodology/approach: A survey was conducted using a proprietary online and physical questionnaire on a group of 240 respondents from the Pomeranian and Masovian Voivodeships. The results were subjected to statistical analysis using the chi-square test and comparison of structure indicators.

Findings: It was found that the majority of respondents had not encountered the organic farming certificate on food products and do not pay attention to it when shopping. Less than half of respondents buy certified organic food products. Although the majority of respondents believe that food products with the organic farming certificate are of higher quality, the vast majority of respondents are not able to pay a higher price for such products. Gender, age, and level of education are the characteristics that differentiate respondents' answers on organic farming certificates on food products.

Research limitations/implications: The study was accompanied by limitations related to access to respondents and the research area – the study was a pilot. Further research may concern consumers' knowledge of the requirements that an organic certified food product must meet, as well as the difficulties and barriers perceived by the organic food producers.

Social implications: Increased consumer knowledge on and awareness of organic farming certifications of food products can increase the competitiveness of such products, despite the identified barrier to consumption of these products, which is their price. Increasing the consumption of certified organic food can enhance public health and increase the market share of these foods.

Originality/value: The originality of the article results from the assessment carried out on the importance of food products with an organic farming certificate and barriers to the sale of this type of products. The addressees of the article are organic food producers, consumers, environmental organisations, and government agencies.

Keywords: organic farming, Euro-leaf, consumers.

Category of the paper: Research paper.

1. Introduction

In the 21st century, the discussion of issue of destruction and pollution of the environment and food, which is low in quality and heavily chemically modified, and therefore has a negative impact on health, becomes more and more popular. The issue of organic production is very important for the future of humanity and the Earth. Organic farming might take of the environment, food, and health, so that future generations will not have to worry about these problems. In times of poor food quality and insufficient education on the issue, this is an important topic for consumers.

Currently, organic farming is defined as a comprehensive system of food production and appropriate farm management that combines the best practices for the surrounding environment, an appropriate degree of biodiversity, protection of natural resources and the use of high standards related to animal welfare (Regulation (EU) 2018/848). Therefore, the production of organic food performs many functions such as providing an organic commodity on the markets and acting for the benefit of society and the public good, since it has an impact on animal welfare, environmental protection, and development of rural agricultural areas (Łuczka-Bakuła, 2007; Sambor, 2020; Zieliński, 2020).

Currently, organic production in agriculture is regulated in Poland by the European Union regulations, as well as by national laws including attached implementing regulations. The main EU legislation, which from 1 January 2022 regulates organic production and labelling of organic products, is Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 (together with a number of delegated and implementing regulations). This regulation establishes the objectives and principles of all stages of production, preparation, distribution, and control of organic farming products, as well as the use of indications relating to organic production on labels and in advertisements (Regulation (EU) 2018/848; Sambor, 2020; Sazońska, 2022). Meanwhile the Polish basic legal act in this area is the Act of 23 June 2022 on organic farming and production. It specifies the tasks and competence of authorities and organisational units in the field of organic production and matters to the extent not regulated in the provisions of Regulation (EU) 2018/848 (Ustawa o rolnictwie..., 2022).

All food products that the vendors wish to sell as organic within the European Union should bear the "Euro-leaf" logo, the certification body number, and the place of production of the raw materials that are ingredients of a particular product. The logo gives EU organic products a consistent visual identity. It makes it easier for consumers to recognise organic products and helps farmers to market them across the EU (EC, 2024). The EU organic production logo is shown in Figure 1.



Figure 1. EU organic logo.

Source: (EC, 2024).

The organic production logo can only be used on products that have undergone organic production certification by an authorised certification body or control authority. This means that it is obligatory for these products to comply with demanding conditions concerning production, processing, storage, and transport methods. In addition, the products must have at least 95 percent organic ingredients in their composition, and the remaining 5 percent must meet special conditions (Regulation (EU) 2018/848).

In Poland, organic production and certification bodies are supervised by the Main Inspectorate of Agricultural and Food Quality Inspection (MAFQI), which also cooperates closely with the Office of Competition and Consumer Protection, the Veterinary Inspection, and the State Inspectorate for Plant Protection and Seeds Service (Miecznikowska-Jerzak, 2022; Ustawa o rolnictwie..., 2022). In organic farming, the MAFQI and the certification bodies constitute a control and certification system, the functioning of which is a basic guarantee for the consumer that the products on the market have been produced in accordance with the applicable regulations on agriculture (GIJHARS, 2023). Currently, there are thirteen authorised certification bodies in place to verify whether an operator is operating in accordance with the organic production rules contained in Regulation (EU) 2018/848 (IJHARS, 2024).

The organic food market is growing all over the world, but the highest growth rate is observed in Europe. This is due to higher demand for organic food, which can be attributed to growing environmental and health awareness, as well as an increase in the purchasing power of European consumers (Pawlewicz, 2019; Wrzaszcz, 2023). The results of the research showed significant regional differences in both total and per capita retail sales of organic food on the EU market. Retail sales of organic food are higher in countries with higher GDP and higher household consumption per capita. Sales and consumption of organic food are highest in Germany, France, Italy, the United Kingdom, and Switzerland (Pawlewicz, 2019). In Poland, despite noticeable decreases in the number of organic producers and agricultural areas in recent years, a clear increase in its value was noted on the market, namely in 2021 it almost doubled compared to 2015 (Koalicja na rzecz BIO, 2021). However, previous research results indicate that the consumption of organic food and the knowledge of organic signs in Poland is still at a fairly low level (Chudzian, Chatys, 2014; Wilczyńska, 2015; Hermaniuk, 2018; Witek, 2015; Kułyk, Michałowska, 2018). Questions arise as to the current awareness and behaviour of consumers towards products with an organic farming certificate, whether consumers are able

to pay a higher price for food products with an organic farming certificate and whether they see it as synonymous with quality. The aim of the study is to assess the importance of organic farming certification for respondents and their behaviour on the market of certified organic food products depending on gender, age, and education level.

2. Methods

The research was conducted using a survey questionnaire constructed for the study. It contained twelve substantive questions and three questions relating to the criteria characterising the study group. The survey took place in 2024 in the Pomeranian and Mazovian Voivodeships. The survey was conducted using a questionnaire in both online and physical form. 253 questionnaires were returned, out of which 240 were complete, which were analysed. The questionnaire was validated on a group of 12 respondents, and as a result the questions were slightly modified.

The study used proportional selection. The characteristics of the study group are shown in Table 1.

Table 1.
The characteristics of the study group

Feature	Category	N	%
Gender	women	122	50,8%
	men	118	49,2%
Age [years]	18-29	60	25,0%
	30-49	60	25,0%
	50-65	62	25,8%
	65 and above	58	24,2%
Education	primary	10	4,2%
	secondary	108	45,0%
	higher	122	50,8%

Source: own research.

Of the 240 adults whose responses were analysed, 122 were female and 118 were male. There were 60 respondents in the 18-29 and 30-49 age brackets, 62 in the 50-65 age bracket, and 58 in the 65 and above age bracket. In contrast, the survey was dominated by respondents with secondary (108 people) and higher education (122 people). Only 10 respondents with primary education took part in the survey.

The numerical material obtained from the survey was subjected to statistical analysis using the Statistica 13.3 package. A chi-square test of independence was used (Stanisz, 2006). The aim of the test was to verify the hypotheses about the dependence of respondents' responses to the questions on their gender, age, and education level. Due to the low number of respondents with primary education (10 respondents), this category was combined with the "secondary education" category. Moreover, due to the low number of respondents aged 65 and above

purchasing certified organic food products (4 people), this age category was omitted from the testing. The verification was performed at the significance level = 0.05, based on the test probability value "p".

3. Results

The first questions asked about the respondents' exposure to the "Euro-leaf" logo on food products, as well as familiarity with and perception of the logo on food products. The results are shown in Table 1.

Table 1.

Summary of respondents' answers regarding attitudes towards certified organic products – percentage of indications and results of the chi-square test

Feature	Category	1			2			3		
		Yes [%]	No [%]	X ²	Yes [%]	No [%]	X ²	Yes [%]	No [%]	X ²
	total	33,3	66,7	–	47,5	52,5	–	22,5	77,5	–
Gender	women	41,0	59,0	0,011*	49,2	50,8	0,596	33,6	66,4	<0,001*
	men	25,4	74,6		45,8	54,2		11,0	89,0	
Age [years]	18-29	63,3	36,7	<0,001*	60,0	40,0	0,198	10,0	90,0	<0,001*
	30-49	33,3	66,7		53,3	46,7		21,7	78,3	
	50-65	29,0	71,0		48,4	51,6		48,4	51,6	
Education	secondary	28,0	72,0	0,101	33,9	66,1	<0,001*	18,6	81,4	0,265
	higher	38,5	61,5		60,7	39,3		26,2	73,8	

Questions: 1. Have you encountered organic farming certification on food products?, 2. Are you able to recognise the organic farming label?, 3. Do you pay attention to organic farming certification when shopping for food products?

* means that the tested relationship is significant at the level $\alpha = 0.05$ ($p < 0.05$).

Source: own research.

The survey found that the majority of respondents had not encountered the EU organic farming certificate on food products (66.7%). Women encountered it almost twice as often (41%) as men (25.4%). As age increases, the percentage of people who have encountered organic farming certificate on food products decreases (63.3% of respondents under the age of 29, 33.3% of respondents aged 30-49, and 29% of respondents aged 50-65).

Almost every second respondent (47.5%) declares that they are able to correctly identify the organic farming mark. Taking gender and age into account, familiarity with the "Euro-leaf" sign is at a similar level. Respondents with higher education are much more likely to declare familiarity with the "Euro-leaf" (60.7%) than people with lower education (33.9%).

The majority of the surveyed group (77.5%) do not pay attention to the organic farming certificate on food products when shopping. Men are much less likely to pay attention to it (11.0%) than women (33.6%). As age increases, the percentage of respondents who pay attention to organic farming certificates when shopping for food products increases (10% of

respondents under the age of 29, 21.7% of respondents aged 30-49, and 48.4% of respondents aged 50-65). The level of education is not a differentiating feature here.

Respondents were then asked how often they buy certified organic food products (Table 2). One in two consumers (50%) does not buy certified organic food products at all. A higher percentage of women than men buy (with varying frequency) certified organic food products (total: 64% women, 35.6% men). As age increases, the percentage of people who buy these products often and occasionally increases (cumulatively: 10% of respondents under the age of 29, 25% of respondents aged 30-49, and 51.6% of respondents aged 50-65), and the percentage of people who do not buy them at all decreases (55% of respondents under the age of 29, 45% of respondents aged 30-49, and about 10% of respondents aged 50-65). These results are in line with respondents' declarations about seeing the "Euro-leaf" label on products. A higher percentage of respondents with higher education buy (with varying frequency) certified organic food products (around 60%; while for respondents with lower education it's around 40%).

Table 2.

The results of the analysis of responses to the question regarding the frequency of purchase of food products with organic farming certification – percentage of indications and results of the chi-square test

Feature	Category	Often [%]	Sometimes [%]	Rarely [%]	Not at all [%]	X ²
	total	4,2	18,3	27,5	50,0	–
Gender	women	8,2	25,4	30,3	36,1	0,007*
	men	0,0	11,0	24,6	64,4	
Age [years]	18-29	0,0	10,0	35,0	55,0	<0,001*
	30-49	3,3	21,7	30,0	45,0	
	50-65	12,9	38,7	38,7	9,7	
Education	secondary	0,9	15,3	22,9	61,0	<0,001*
	higher	7,4	21,3	32,0	39,3	

* means that the tested relationship is significant at the level $\alpha = 0,05$ ($p < 0,05$).

Source: own research.

Respondents were also asked what type of certified organic food products they buy. The most frequently selected product category was eggs (70.8%). Other types of products frequently mentioned by respondents were fruit and vegetables (62.9%), milk and dairy products (53.3%), cereal products (48.3%), and fruit and vegetable products (40.4%). In contrast, respondents are less likely to buy certified teas and coffees (24.2%), meat and fish (20.8%), fats (16.3%), and spirits (12.9%).

Respondents were then asked to what extent organic farming certification determines their decision to purchase a food product (Table 3). No respondent identified organic farming certification as a very important factor that influences their decision to buy a food product. For more than half of the consumers surveyed (55.8%), the organic farming certificate is not a determinant for the purchase of a product. In contrast, gender, age, and education are the characteristics that differentiate the percentage of people for whom organic certification determines the purchase of the product. In total, around 65% of women declare that this

certificate is relevant to varying degrees, while only around 22% of men indicated these response categories. In addition, a total of around 37% of respondents aged up to 29, 43.3% of respondents aged 30-49, and as many as around 90% of respondents over 50 declare that the certificate is important to them to varying degrees. Taking into account the level of education, the organic farming certification is of varying importance for a total of about 52.5% of respondents with higher education, and only for about 35.5% of respondents with lower education.

Table 3.

The results of the analysis of responses to the question on the extent to which organic farming certification determines the respondents' decision to purchase a food product – percentage of indications and results of the chi-square test

Feature	Category	Not important at all [%]	Not very important [%]	Important [%]	X ²
	total	55,8	30,0	14,2	–
Gender	women	34,4	45,9	19,7	<0,001*
	men	78,0	13,6	8,5	
Age [years]	18-29	63,3	30,0	6,7	<0,001*
	30-49	56,7	30,0	13,3	
	50-65	11,3	53,2	35,5	
Education	secondary	64,4	28,0	7,6	0,008*
	higher	47,5	32,0	20,5	

* means that the tested relationship is significant at the level $\alpha = 0,05$ ($p < 0,05$).

Source: own research.

A question was also asked about the possibility of paying a higher price for food products with an organic farming certificate (Table 4).

Table 4.

Results of the analysis of responses to the question regarding the possibility of paying a higher price for certified organic food products – percentage of indications and results of the chi-square test

Feature	Category	Yes [%]	No [%]	X ²
	total	25,0	75,0	–
Gender	women	32,8	67,2	0,022*
	men	17,0	83,1	
Age [years]	18-29	13,3	86,7	<0,001*
	30-49	20,0	80,0	
	50-65	64,5	35,5	
Education	secondary	17,8	82,2	0,034*
	higher	32,0	68,0	

* means that the tested relationship is significant at the level $\alpha = 0,05$ ($p < 0,05$).

Source: own research.

Three out of four respondents (75%) said they are not able to pay a higher price for food products with organic farming certification. Women accept a higher price for these to a greater extent than men (about 33% of women, 17% of men). Similarly, respondents with higher education are more accepting of paying a higher price (32% positive responses, compared to 17.8% of respondents with lower education). Furthermore, as age increases, the proportion of

people who accept a higher price for certified organic food products increases (13.3% of respondents under 29 years, 20% of respondents aged 30-49 years, and about 64.5% of respondents aged 50-65 years).

Respondents were asked whether, in their opinion, food products certified as organic were safer for the body than products without such certification (Table 5).

Table 5.

Results of the analysis of responses to the question on respondents' opinion on the safety of food products in certified organic farming – percentage of indications and results of the chi-square test

Feature	Category	Definitely yes [%]	They are the same level of safe [%]	X ²
	total	30,8	69,2	–
Gender	women	42,6	57,4	<0,001*
	men	18,6	81,4	
Age [years]	18-29	20,0	80,0	<0,001*
	30-49	21,7	78,3	
	50-65	62,9	37,1	
Education	secondary	23,7	76,3	0,038*
	higher	37,7	62,3	

* means that the tested relationship is significant at the level $\alpha = 0,05$ ($p < 0,05$).

Source: own research.

None of the respondents agreed with the statement that certified organic products are less safe than those without certification. The majority of the group surveyed (69.2%) believes that organic food products are as safe for the human body as products without such certification. Women believe to a higher degree than men that food products certified as organic are significantly safer (42.6% of women, 18.6% of men). Similarly, those aged 50-65 feel the same way, to a greater extent than the other respondents (62.9% of indications; while for the younger respondents it was 20-21.7% of indications). Respondents with higher education are also more likely to consider food products certified as organic to be significantly safer (approximately 37.7% of indications, compared to 23.7% of respondents with lower education).

In addition, respondents expressed an opinion on whether the organic farming certificate is the same for them as ensuring high quality of the food product (Table 6). More than half of the surveyed group (54.2%) agreed with the statement that organic farming certification is the same as ensuring a high quality food product. Women agree with this opinion to a greater extent than men (total: about 80% women, about 48% men). Similarly, those aged 50-65 agree with it to a greater extent than other respondents (total: 80% of indications, around 45% of indications for younger respondents). Respondents with higher education are much more likely to believe that an organic farming certificate confirms the high quality of a food product than those with a lower education (around 90% of indications, compared to 36.4% of respondents with lower education).

Table 6.

Results of the analysis of responses to the question on respondents' opinion on whether organic farming certification is the same as ensuring a high quality food product – percentage of indications and results of the chi-square test

Feature	Category	I fully agree [%]	I mostly agree [%]	It is hard to say [%]	X ²
	total	9,2	54,2	34,2	–
Gender	women	13,1	65,6	16,4	<0,001*
	men	5,1	42,4	52,5	
Age [years]	18-29	6,7	40,0	50,0	0,002*
	30-49	10,0	33,3	56,7	
	50-65	19,4	61,3	12,9	
Education	secondary	5,9	30,5	58,5	<0,001*
	higher	12,3	77,1	10,7	

* means that the tested relationship is significant at the level $\alpha = 0,05$ ($p < 0,05$).

Due to the low number of indications, two categories were omitted: I rather disagree ($n = 6$) and I strongly disagree ($n = 0$).

Source: own research.

Respondents also expressed an opinion on whether products with organic farming certification have greater sensory appeal than products without such certification (Table 7).

Table 7.

Results of the analysis of responses to the question on respondents' opinion on whether products certified as organic have greater sensory appeal than products without such certification – percentage of indications and results of the chi-square test

Feature	Category	I fully agree [%]	I mostly agree [%]	It is hard to say [%]	X ²
	total	6,7	15,8	71,7	–
Gender	women	6,6	21,3	60,7	0,025*
	men	6,8	10,2	83,1	
Age [years]	18-29	3,3	6,7	80,0	0,007*
	30-49	6,7	20,0	73,3	
	50-65	16,1	19,4	51,6	
Education	secondary	4,2	8,5	78,8	0,041*
	higher	9,0	23,0	64,8	

* means that the tested relationship is significant at the level $\alpha = 0,05$ ($p < 0,05$).

Due to the low number of indications, two categories were omitted: I rather disagree ($n = 10$) and I strongly disagree ($n = 4$).

Source: own research.

An overwhelming number of respondents surveyed (71.7%) were unable to say whether products with organic farming certification had greater sensory appeal than products without such certification. Women agree to a higher degree than men about the greater sensory appeal of certified organic products (total: 27.9% women, 17% men). Those aged 50-65 agree with this opinion to the biggest extent, and those below 29 - to the least extent (in total: over 50 - over 35% of indications, 30-49 - around 27% of indications, the youngest - 10% of indications). For respondents with higher education, products with organic farming certification are characterised by greater sensory appeal to a greater extent than for people with secondary education (in total: about 32% of indications; for respondents with lower education – 13%).

In addition, respondents were asked what is or could be the reason for choosing organic products. For the majority of the group surveyed, the most important reason for choosing such products is the health aspect (88.3%). Environmental factors (41.3%) and the desire to support the organic farming sector (31.7%) are also important. The factors that have the least impact on the respondents' decision to choose a certified organic food product are the current fashion (3.8%) and economic aspects (2.1%). None of the characteristics differentiate respondents' statements on this topic.

Finally, the respondents were asked where they get their knowledge of organic farming from. The most popular source of information on organic farming among the entire study group is television (65.4%) and the least popular is scientific sources (8.3%). In addition, respondents get their knowledge from friends (49.2%), the press and the Internet (40% each), as well as from school or university and the radio (15.4% each). It should be noted that the main characteristics differentiating respondents' answers were age and education level. The group that stands out in terms of acquiring knowledge from acquaintances are those aged 30-49 (more than 83% of respondents, as compared to less than 40% of other categories). Age is also a characteristic that differentiates the percentage of people who derive their knowledge of organic farming from the Internet, television, press, and school or university. In turn, the level of education is a characteristic that differentiates the percentage of respondents who derive their knowledge from television and the press. More respondents with higher education say they get their knowledge from the press (51%, compared to only 29% of respondents with lower education). In contrast, respondents with lower education are more likely to use TV as a source of information (75%, as compared to only 51% of respondents with higher education).

4. Discussion

The results obtained regarding respondents' attitudes towards the organic farming certificate and the products labelled with it are in line with previous research results on this topic. The study shows that only 33.3% of the respondents have come across the organic farming certificate, 47.5% declare that they are able to correctly recognise the organic farming label, but the majority of the surveyed group (77.5%) do not pay attention to this certificate when shopping for food products. Earlier findings by Nestorowicz (2017) confirm that only 24.7% of respondents said they had seen an EU organic food label before. Of the group of people who had seen the "Euro-leaf" logo before, one in five respondents could not explain its meaning, and a further 23% of people explained its meaning incorrectly. The results of a study by Cichocka and Oleniuch (2017) also confirmed the low level of familiarity with quality labels. Only 19.3% of respondents stated that they had seen the "Euro-leaf" logo on the product. In contrast, the results of Wilczyńska's (2015) study among young consumers indicated that

38% of them identified the organic food label, and that women had better knowledge of the labels than men. The better familiarity of younger people with the EU organic farming logo compared to the entire survey sample is also confirmed by the results of Bryła's (2018) study. Nevertheless, based on the results of Błazik and Śmieja's (2019) survey, it can be concluded that the organic farming logo is the most recognisable organic food label among other organic product labels (27% of respondents).

The survey shows that half of the respondents (50%) do not buy certified organic food products at all. An upward trend was observed, with Wilczyńska's (2015) findings indicating that as many as over 77% of respondents did not buy certified food. The findings of Błazik and Śmieja (2019) also confirm that organic products are not often chosen by respondents. Of the organic products, the consumers questioned most often chose fresh fruit (40% of respondents) and vegetables (around 39% of respondents). Dairy products, breads, juices, and eggs were also very popular. The conducted research shows that the most frequently chosen category of products were eggs (70.8%), while fruit and vegetables were also frequently chosen products (62.9%).

According to the survey, up to 75% of respondents are not able to pay a higher price for certified organic food products. As the results of the study by Kułyk and Michałowska (2018) indicate, the main barrier to the development of organic products is, among other things, the high price. This is also confirmed by the results of a study by Barłowska, Wolanciuk and Idec (2017) – the most significant factor limiting the purchase of organic food was the high price, since as many as 75% of consumers surveyed could not afford to buy "eco-food" more often. The BIO Coalition's 2021 report shows that although the organic food market has been growing rapidly over the past few years, with the value of the organic food market in 2021 reaching PLN 1.36 billion, this amount nevertheless represents only 0.5% of the value of the entire food market in Poland. Annually, each Pole spends an average of PLN 36 on organic food. Compared to the EU average of PLN 342, this indicator seems very low (Koalicja na rzecz BIO, 2021; Pieczyrak, 2024). The results of individual studies (Willer, Schaack, Lernoud, 2019; Trávníček, Willer, Schaack 2021; Wrzaszcz, 2022, 2023; Nowak, Kobiałka, 2024) confirm the small share of the organic food market in Poland.

The conducted research shows that for the majority of respondents, the most important reason for certified organic food products is the health aspect (88.3%). Environmental factors (41.3%) and the desire to support the organic farming sector (31.7%) are also important. This is confirmed by the results of a study by Barłowska, Wolanciuk and Idec (2017), according to which the most common reason for purchasing organic food was concern for one's own health, as well as that of family members. Consumers surveyed cited higher health values, a more beneficial impact on the environment, and helping farmers as reasons for purchasing organic food.

5. Summary

On the basis of the research results obtained and the discussion held, the following conclusions were drawn:

1. The majority of respondents have not encountered the organic farming certificate on food products and do not pay attention to it when shopping.
2. Half of the respondents do not buy certified organic food products at all.
3. Although the majority of respondents believe that food products with the organic farming certificate are of higher quality, the vast majority of respondents are not able to pay a higher price for such products.
4. Gender is a differentiating characteristic in respondents' answers about organic farming certificates on food products. Women are much more likely than men to pay attention to certified organic food products and to buy them. Moreover, more women declare that this certification is an important factor for them when buying a product, and decide to pay a higher price for a food product with such certification. In addition, women are more likely than men to equate certified organic food products with greater safety and higher quality.
5. Age is a differentiating characteristic in respondents' answers about organic farming certification of food products. Admittedly, as age increases, the proportion of people who had encountered the organic farming certificate on food products decreases, while among these respondents the proportion who pay attention to organic farming certificates when shopping and buy food products with the "Euro-leaf" logo increases, as well as accepting a higher price for such products.
6. The level of education is a differentiating characteristic of respondents' answers about organic farming certificates on food products. Those with higher education are much more likely to declare knowledge of the "Euro-leaf" and to buy products labelled with it than those with lower education. More people with higher education declare that organic farming certification is an important factor influencing the purchase of a food product. In addition, those with higher education are more accepting of a higher price for certified organic food products, as well as identifying such products with greater safety and higher quality, than those with lower education.

Consumers' familiarity with the labels that appear on food products, including the organic farming certificate, plays an important role. If consumers are not familiar with the labels used on packaging, it will be difficult for them to recognise which labels are credible, and which are merely persuasive, and this in turn will lead to a situation where they either do not take such labels into consideration at all or make their decisions on the basis of erroneous considerations - labels that are not backed up by certification, reliable independent audits, etc. (Nestorowicz, 2017).

The results obtained allow recommendations to be made for intensified action to raise consumer awareness of the organic farming certificate and, more broadly, of the labels found on products relating to organic food. This can include actions taken by a variety of interested parties, ranging from organic food producers themselves, through organic food producer organisations and ecological organisations, to the state government and government agencies. Increasing consumer awareness can increase sales of certified organic food products, despite the identified barrier to consumption of these products, which is price. Increasing the consumption of certified organic food can enhance public health and the development of this market.

The survey was accompanied by limitations mainly related to access to respondents, low numbers of respondents, and a narrowed survey area. The study carried out was a pilot study, therefore this justifies the need for further research, which will be carried out on a larger scale and will address consumer awareness of the details of the certification processes and the requirements that a food product with organic farming certification must meet. The direction of further research can also address the actions taken by organic food producers and the difficulties and barriers they perceive.

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DETERMINANTS OF GENERATING IMPACT ON THE ENVIRONMENT AS A PUBLIC VALUE OF SCIENTIFIC PROJECTS – EXPERIENCES WITHIN THE UNIVERSITY OF LODZ

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Purpose: The paper aims to discover how the stakeholders of research processes carried out within universities perceive the possibility of generating the impact of scientific projects on the economy, society and the environment.

Design/methodology/approach: For the purpose of the paper, several steps were executed. First, the desk method was implied. On the basis of the literature operating of the university in a wider context was presented, as well as economic theories on the relationship between human activity and the environment, also the concept of public value and Responsible Research and Innovation (RRI) concept were discussed. The empirical part was the study in the form of focus group organized to obtain information on the perception of the potential impact generated by scientific projects.

Findings: The study proved that such an impact is exerted and that appropriate activities disseminating the results of research work have a chance to achieve sustainable positive economic, social or environmental changes. It was possible to identify the factors which affect the efficiency of such processes.

Research limitations/implications: The focus group was carried on a relatively small sample and the participants were already involved in socially/economically/environmentally accountable activity. Nevertheless, it was possible to acquire the main ideas on how the scientific and innovation processes developed within the university can generate public value by positively influencing economic, social and environmental surroundings.

Practical implications: The paper provides insight into possible changes in the processes of universities' generating impact on their environment.

Social implications: Society is a part of the environment of universities, therefore society would benefit if this impact were optimized. The paper brings findings in this area.

Originality/value: The paper combines the theory of the economy with Responsible Research and Innovation and the public value concept in the field of generating impact on the environment by higher education institutions.

Keywords: impact, Responsible Research and Innovation (RRI), R&D, university, public value, quadruple helix.

Category of the paper: Research paper.

1. Introduction

Over time, the university's function has changed. Modern universities are involved in the social and economic spheres in addition to teaching and performing science. In order to promote sustainable development and the conservation or restoration of natural resources, they also take the environment into account.

The theory of economics has gained sufficient explanations on how R&D or innovation processes can influence the surroundings. A useful approach to evaluate R&D initiatives is a public value concept which was first introduced by Mark Moore (1995). Responsible research and innovation (RRI) concept, promoted recently by both scientists as well as policymakers refers to a research and development process integrating research into a broader social context (Owen, 2013; von Schomberg, 2013). The paper presents findings of focus study carried in the form of focus group in the University of Lodz to better understand how the R&D and innovation stakeholders perceive the public impact of scientific and innovation processes.

2. Method

For the purpose of the paper, several steps were executed. First, the desk method was implied. On the basis of the literature, university operating in the wider context was presented, as well as economic theories on the relationship between human activity and the environment, also the concept of public value and Responsible Research and Innovation (RRI) concept were discussed. The empirical part was the study in the form of focus group organized to obtain information on the perception of potential impact generated by scientific projects. The focus group proved that such an impact is present and that appropriate activities disseminating the results of research work have a chance to achieve long lasting positive economic, social or environmental changes.

3. The mission(s) of the university and its impact on the external environment in the theory of economics

Universities have a long history of generating and disseminating knowledge through education and scientific publications. Furthermore, relationships with the corporate world were typically not institutionalized in the conventionally defined higher education institution (HEI) (Matusiak, 2010). From the perspective of the modern economy, universities' traditional role is

insufficient. According to Howard (2005), a university can participate in the following types of knowledge transfer, sharing, and technology commercialization:

- Diffusion of knowledge. By facilitating the widely accepted adaptation of scientific discoveries to industry through communication, education, training, and the development of norms and standards for production and distribution, universities and research institutes produce expertise that is both commercially and socially beneficial.
- Knowledge creation. Universities and research institutions create socially and business-relevant knowledge by selling or licensing research results. Knowledge becomes a commodity for sale – intellectual property is directly used on the market. This is the standard model of commercialization.
- Creating knowledge relations. Universities and research institutions create economically useful knowledge by providing services indirectly through the use of intellectual property. Platforms for the exchange of expertise, know-how and so-called "hidden" knowledge are being created. The emphasis is on cooperation, joint ventures and partnerships.
- Engagement-based knowledge transfer. University communities and their surroundings are viewed as secondary producers of useful information. In order to create collaborative projects with different socioeconomic system stakeholders, the goal is to transcend the conventionally perceived limits of the university's operations.

There can be identified eight dimensions of this third role of the university (Laredo, 2007):

1. Human resources with the focus on transfer of embodied knowledge in Ph.D. students and graduates.
2. Intellectual property with the focus on codified knowledge produced by the university and its management (patents, copyright).
3. Spin-offs with the focus on knowledge transfer through entrepreneurship.
4. Contracts with industry - knowledge co-production and circulation to industry. This is taken as the main marker of the attractiveness of universities for existing economic actors.
5. Contracts with public bodies with the focus on the 'public service' dimension of research activities.
6. Participation in policy making focusing on involvement in the shaping and/or implementation of policies (at different levels).
7. Involvement in social and cultural life reflected in involvement of the university in 'societal' (mostly 'city') life.
8. Public understanding of science focusing on interaction with society.

All of these activities are based on the operations of HEIs that get public funding, thus it makes sense to understand how they affect society, the economy, and the environment both now and in the future. The economic theory explains this kind of HEI influence.

The activities of persons or public bodies have an impact on the external environment. The research impact is “the demonstrable contribution that excellent research makes to society and the economy” (The Economic and Social Research Council, ESRC) and includes academic effects, which are the proven contributions of excellent social and economic research to changing the understanding and progress of scientific methods, theories and applications across disciplines, and economic and societal effects, which are the proven contributions of excellent social and economic research to society and the economy and their benefits to individuals, organisations or nations. Impact is a change in the results of an organization. The impact can be positive or negative, intentional or not, direct or indirect. The latter features of the impact are a consequence of the nature of the economic mechanisms and can be illustrated by the value chain of the impact, in which inputs understood as financial, human and material resources are converted into activities (actions through various inputs) which are converted into products (transformations, also products, capital goods and services) and outputs are converted into results (usually or achieved short-term or medium-term effects) and ultimately converted into impact understood as positive or negative, primary or secondary, direct or indirect, intended or unintended. The theory of the economy (externalities, spillovers, multipliers) explains the mechanisms of the social, economic and spatial (including environmental) impacts of university activity. The impact of any social (including economic) activity of a human being can be described by external theory (Hołuj, 2021). Externalities arise from the production or consumption of goods or services, resulting in costs or benefits for a third party unrelated to them, i.e. they occur and affect an entity that is not directly related to the production or consumption of a particular good or service. External factors can be positive or negative.

„Externalities are always accompanied by spillovers. {...} In general, spillover effects occur when a phenomenon spreads (usually it is knowledge) in various spatial systems or structures in an uncontrolled, unconscious, unintentional, and freeway. The spillover effect may concern experience, prediction skills, good practices, or local customs. Spillover effects can occur on several different levels and in different configurations. They can be individual, private, mixed, social, or economic spillover effects, generated by individuals or businesses” (Hołuj, 2021).

The impact that university activities can have on the regional economic, social and spatial systems can also be described from the perspective of multiplier effect. “A regional economic multiplier is defined as the total economic effect that occurs in a region by unit of the direct economic change that caused the effect” (Stevens, Lahr, 1988). In other words, the multiplier effect indicates that the implementation of new expenditures (e.g. exports, public expenditures, or investments) can lead to new expenditures and investments, as part of the new expenditures themselves will be used to generate income for other entities (enterprises, individuals, local governments). The latter will also spend part of their income and it will again create income for others. For example, “every time a local economy generates a new job by attracting a new business, additional jobs might also be created, mainly through increased demand for local

goods and services” (Moretti, 2010). Moreover, "the input of science and technology innovation factors leads to the multiplier effect of economic development" (Cheng Hui, Wang Bei, 2019).

4. Public Value and Responsible Research and Innovation (RRI)

When evaluating the efficacy of public institutions, the idea of public value is a powerful one. The creation of this value occurs when a society that simultaneously invests in the operations of public organizations and, like the corporate sector, is essentially their "shareholders" achieves the status of a fulfillment of needs that are expressed and accepted collectively through the activities of these public organizations (Wiśniewska, 2018). This concept was introduced in 1995 by Moore (Moore, 1995) and was developed in the following years (Mahdon, 2006; Blaug et al., 2006; Stoker, 2006; Bozeman, 2007; Botterman et al., 2008; O'Flynn, Alford, 2009, Kelly et al., 2002).

In the private sector, public value is comparable to shareholder value (Coats, Passmore, 2008). Public managers can more precisely define their operations by making it the organization's primary purpose. This includes determining the value of the services offered to residents and how to best utilize them. In order to secure increased trust in public institutions and satisfy citizens' rising expectations, this enables public managers to interact with service users and other stakeholders to enhance the quality of decision-making. Three questions, according to Coats and Passmore, determine whether public managers adopt public value as a determinant of their actions (Coats, Passmore, 2008):

1. What is my organization used for?
2. To whom is he accountable?
3. How do you know we're doing well?

Public managers cannot provide the solutions to these problems alone; rather, they must collaborate with the "shareholders" of the public organization and, by extension, of society. Getting "authorization" is essential for the public to take certain acts. To ascertain what value is and whether it can be attained by certain behaviors and not others, a standard procedure is required.

When societal expenditures (financial resources as well as the sacrifice of some liberties and regulations in the name of the common good) result in outcomes that outweigh the costs to public opinion, and when the government is directed by society to take a particular action, then public action will be valuable. The concept's authors contend that political election outcomes are insufficient. Constant communication with stakeholders is necessary, as is their ongoing endorsement of public authorities' actions.

Businesses can and should be included in the concept of public value for a number of reasons, including (a) being significant stakeholders, (b) providing public goods on behalf of the public sector, and (c) being organizations that generate public value through their operations, particularly when businesses are founded on knowledge generated and funded by public funds. Additionally, business operations may provide value to the public (Meynhardt, Gomez, Schweizer, 2014; Moore, 2003; Talbot, 2011). The concept of value is not alien to the literature of the business sector. The following concepts are used: total and marginal utility, stakeholder value, economic value, added value, shareholder value, and corporate social responsibility (CSR) perspective.

According to Meynhardt, Gomez, and Schweizer (2014), businesses' effects on society are just one of many facets of their operations. They consider this effect to be an integral component of their operations, influencing consumer encounters as well as internal company culture. According to them, exchanges in which business plays a major role lead to a "viable" society. These authors suggest a method that measures how businesses affect public values in order to quantify their social contribution. The University of St. Gallen is where the Public Value Scorecard (PVSC) was created. Based on the psychological theory of needs, PVSC is marketed as an enhancement of the balanced scorecard. In this context, "public value" refers to the values that define the individual-"society" interaction and establish its quality (Meynhardt, 2012). Five dimensions are used to make the assessment (Meynhardt et al., 2014):

1. Usefulness.
2. Profitability.
3. Political acceptance.
4. Positive experience.
5. Decency.

In each of the above mentioned dimensions, the potential chances and risks are evaluated.

As a result, PVSC enables the evaluation of a company's operations from the perspectives of politics and morality in addition to utility. According to Meynhardt (2012), practitioners would not accept the absence of a financial factor.

One must remember that HEIs creating spin-offs and spin-outs contribute to the business sector and thus it seems relevant to evaluate their activities through public perspective.

The idea of Responsible Research and Innovation (RRI) is in line with the notion of public value, but it is only relevant to the process of research and innovation. Responsible Research and Innovation is a concept that has gained particular significance in the European Union (EU) in the last ten years. It integrates research into a broader social context (Owen et al., 2013; von Schomberg, 2013). In order to examine how science and technology may best contribute to the construction of a desirable society for future generations as well as the resolution of today's issues, the RRI encourages open multilateral cooperation between scientists, citizens, policy makers, corporations, and third-sector groups. "Responsible innovation evokes a collective duty of care, first to rethink what we want from innovation and then how we can

make its pathways responsive in the face of uncertainty” (Owen et al., 2020). Von Schomberg (2013) defines RRI as "a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products, in order to allow a proper embedding of scientific and technological advances in our society” (von Schomberg, 2013). RRI approach is in line with the quintuple helix concept incorporating in the cooperation not only business, academia, public bodies and public (the quadruple helix model), but also the natural environment (Carayanni et al., 2015; Alfonso et al., 2012). As RRI tries to answer most important contemporary problems, seven ‘Grand Challenges’ as one of the three main pillars of the Horizon 2020 program serve as a background of the research and innovations efforts with accordance to RRI requirements (https://ec.europa.eu/commission/presscorner/detail/en/MEMO_13_1085). These “Challenges” are:

1. Health, demographic change and wellbeing.
2. Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy.
3. Secure, clean and efficient energy.
4. Smart, green and integrated transport.
5. Climate action, environment, resource efficiency and raw materials.
6. Inclusive, innovative and reflective societies.
7. Secure & innovative societies.

Creating a society whose R&I procedures and outcomes are dedicated to attaining sustainable, morally acceptable, and socially desirable outcomes is the goal of RRI. All individuals and organizations that are impacted by and dedicated to research and innovation bear responsibility for our future, according to the RRI framework. Predicting the outcomes of research and innovation processes in the future is the goal of the RRI. Results are the outcome and/or present in the description of the process requirements rather than being decided independently. As a result, it is important to consider how RRI's processes and outcomes are integrated. Four clusters can be used to characterize the RRI process (Table 1).

Table 1.

Four clusters of RRI process requirements

Cluster	Description
Diversity and inclusion	For normative democratic reasons, diverse and integrated RRI procedures must widen and diversify sources of expertise, disciplines, and views, as well as involve a wide range of stakeholders in the early development of science and technology. In this sense, a range of activities ought to result from inclusive practices. Different practices, on the other hand, are more likely to involve everyone.
Openness and transparency	Accountability, liability, and thus responsibility are contingent upon openness and transparency. Building public confidence in politics and science requires this. More transparency does not, however, inevitably translate into more trust; in order for stakeholders to understand information, it must be tailored to their needs.

Cont. table 1.

Anticipation and reflexivity	Anticipation entails imagining the future and comprehending how current dynamics of research and innovation methods influence it. As a result, future difficulties can be addressed. Reflection is also necessary in order to respond wisely and to remain receptive to changes in direction. Learning about the problem definitions, commitments, practices, and institutional and individual attitudes, presumptions, and routines is part of this reflection.
Responsiveness and adaptive change	Being responsive entails adapting to new information, viewpoints, norms, and attitudes. Adaptive change is contingent upon responsiveness. In order to adapt to shifting conditions, fresh perspectives, stakeholders, and public values, RRI necessitates the capacity to modify or mold current procedures, organizational structures, and systems.

Source: Kupper, Klaassen, Rijnen, Vermeulen, Broerse, 2015.

5. Public value of scientific projects – experiences within the University of Lodz

As part of the activities of the University of Lodz in RiEcoLab project, a participatory approach of various stakeholders (internal and external) was applied to the process of integrating the concept of RRI into higher education. RiEcoLab stands for Responsible Innovation-led Entrepreneurial University Transformation Centres (Ecosystem Integration Labs). The project was developed under Horizon 2020 and was supported by EIT (European Institute of Innovation & Technology) within HEI Initiative: Innovation Capacity Building for Higher Education. The main aim and an overall joint vision of the RiEcoLab project (<https://riecolab.eu>) is to develop a novel way R&D is being performed in universities to ensure immediate commercialization (spinoffs) and involvement of a large number of internal stakeholders (academic and non-academic staff, students).

For the purpose of gathering information on how HEIs can influence socio-economic and environmental systems, the focus group was organized.

The aim of the focus group was, among others, to answer the question of how to identify the impact of R&D in various areas.

The scientific team applying for the focus group was presumed to have research interests that depended on the clever specializations of the Lodzkie region. Smart specializations reflect the publicly important research areas from a regional point of view. After an open recruitment process, researchers from eight scientific initiatives that aligned with the Lodzkie region's smart specialization participated in the focus group:

- 1 project in compliance with “IT and personalized design”,
- 2 project in compliance with sustainable agriculture and agri-food industry,
- 5 projects in compliance with “innovative medical industry, pharmaceuticals and cosmetics”.

The recruitment was also addressed to internal and external stakeholders of University of Lodz. Networking and pre-existing connections with the institution, professors, partners, and stakeholders were the primary means of recruitment. The following stakeholder groups participated in the study:

1. Academia.
2. NGO.
3. Industry.
4. Public sector.
5. Internal.

A total of 40 participants took part in the study. During the study the attendants worked in groups consisting in 6-7 people. They were provided with sheets of paper and worked on the following issues:

1. Impact of research and innovation (R&I) projects on environment.
2. Impact of R&I projects on economy.
3. Impact of R&I projects on society.
4. Impact of R&I projects on public policies.
5. Impact of R&I projects on quality of life.

The above-mentioned questions were not closed lists and motivated participants to brainstorm, lively discussions, ideas and experiences. Four moderators assisted participants in generating ideas and clarifying or collecting them. The ideas were marked on the small adhesive stickers. This enabled a broader discussion and presented the results of the brainstorming in groups.

6. Results

The focus group demonstrated that scientific research has an influence and that adequate dissemination of research findings has the potential to produce long-lasting positive social or environmental impacts. Changes in enhancing the social inclusion of individuals with disabilities, enhancing social integration, promoting healthy eating habits to improve population health, developing strategies for territorial unit development that take scientific perspective and accomplishments into account, and many more are examples.

In particular, the focus group revealed that:

1. In terms of impact on environment – there is a significant and constant need of networking and system monitoring for research, investment and impact areas. The possible impact can be achieved in the fields like:
 - preserving or improving biodiversity,
 - response to climate change, inhibition,

- decrease in energy costs,
 - clean environment,
 - reduction or elimination of nuisance – air pollution, soil, noise reduction, light pollution).
2. In terms of impact on economy- there is a necessity of a) efficient network of b2b and b2c needs, but also b) the education of deficit labour groups, c) SMEs orientation, d) constant contact with venture capital providers, e) identification of the needs of the economy at the initial stage of implementation of scientific projects. The possible impact can be achieved in the fields like:
 - decrease in employee absenteeism,
 - economic recovery,
 - multiplier effects (Creation of new companies, new jobs, increase in investment, GDP).
 4. In terms of impact on society the focus group underlined the fact, that impact can be understood as ‘usefulness’. For such effect, there is a necessity of a) information and knowledge network, b) communication, c) targeting on ‘usual issues’, d) trends monitoring, e) information exchange among stakeholders f) social capital building and very important: g) improving public awareness of the importance of research and trust in science.
 5. In terms of impact on public policies – HEIs should use benchmarking to improve efficiency, keep relations with self-government as well as with other stakeholders, build trust for science and importance of knowledge resulting from science and building awareness of the variability of the environment and thus the need to adapt public policies to changing conditions. The possible impact can be achieved in the fields like:
 - decrease in public costs,
 - more effective local and regional development strategies,
 - sustainable spatial planning.
 6. In terms of impact on quality of life - scientific research and investment should be oriented on the basis of quality of life studies. The possible impact can be achieved in the fields like:
 - reducing social exclusion,
 - lifespan,
 - improving social inclusion,
 - building social capital.

Additionally, the focus group generated a consensus regarding the necessity of identifying the anticipated social and environmental impact at the research planning stage. However, this calls for some awareness-raising or occasionally formal and legislative adjustments, which may be followed by a more extensive discussion among R+D process stakeholders on

universities' environmental responsibilities. Though they need to be systematized and included into the strategic and operational framework of scientific units, there are currently trends in the scientific community toward this way of thinking. As previously mentioned, steps must also be taken to systematically monitor social and environmental demands through the use of networking mechanisms and the involvement of several internal and external stakeholders.

7. Discussion

There are several flaws in the research that is being provided. The sample size used for the study was relatively small. Furthermore, because the researchers represented projects that adhered to regional specializations, the participants were already engaged in socially, economically, and environmentally responsible activities. Additionally, the stakeholders were contacted via channels connected to organizations that already had some sort of relationship with academia. It is crucial to conduct broader study on a sample representative of the entire quadruple helix community, including scientists who are not interested in "responsible science", even though it was possible to capture the essential concepts regarding the impact of research and innovation processes carried out in academia. Future research should concentrate on the following potential issues:

1. What are the most efficient routes of networking in a quadruple helix context?
2. How to monitor the wider impact of HEIs and how make such activities comparable in an inter-HEI context?
3. How to efficiently involve business in research project orientation to better fulfill the needs of this sector?
4. How to improve social awareness of the importance of research and trust in science?
5. How to foster the cooperation between academia and the public sector to better answer public challenges through the results of scientific projects?

8. Summary

The third mission of university should not only be a slogan but a deeply understood idea which is executed in university's practical activities, for example in R&D and innovation processes. The theory of economics explains the mechanisms of how such practices can influence the surroundings of academia. The concept of public value allows for a broader look at the activities of universities. It is an approach that, enriched with the concept of Responsible Research and Innovation (RRI), brings a new perspective on the impact of HEIs on economy,

society and environment. The study carried out for the purpose of this paper brought some more insight in the field.

The focus group demonstrated that scientific research has an impact on the economy, society, and environment and that proper activities are required to disseminate the findings of research. This would make it possible to make long-lasting improvements to the environment or society. A widespread grasp of the necessity of indicating the desired social and environmental impact already at the study planning stage was also produced by the focus group. However, this calls for some awareness-raising, sometimes formal and legal, which can then be accomplished by a more extensive discussion amongst R+D process participants regarding the university's environmental responsibilities. The scientific community is already seeing trends in this direction, but they need to be organized and incorporated into the operational and strategic framework of the scientific institutions. As previously said, it is necessary to take steps to systematically monitor social and environmental demands through networking mechanisms and the involvement of different internal and external stakeholders.

Considering the limitations and shortcomings of the study, deeper research in the field of external, publicly valuable impact of academia should be carried out.

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For more information about a project, please refer to the following website: <https://riecolab.eu>

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SUCCESS FACTORS OF ENTREPRENEURIAL WOMEN IN THE BEAUTY INDUSTRY – CASE STUDY

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Purpose: The aim of the article is to identify the success factors of women with an entrepreneurial attitude, running a business in the Beauty industry.

Design/methodology/approach: The study used the method of analysis and criticism of literature and a case study. The author also cited the results of interviews with the owners of three micro-enterprises providing various services in the Beauty industry, in the Mazovian province.

Findings: The results of the analyses were presented in the form of case studies, which show the motives for the activities of enterprises and achieving success in the specific conditions of a given company. Based on them, it can be stated that the success factors result from: the entrepreneur/owner, the company itself and the company's environment, and professional success, which they associate with personal success, which is understood as the ability to make independent decisions, earnings in the first year of operation, a sense of peace and time for the family, the ability to fulfill passions and personal mission.

Practical implications: In the described enterprises, the factors of success of entrepreneurial women were identified, which can encourage women to establish and run a company in the Beauty industry.

Originality/value: The presented research and the resulting observations and conclusions contribute to the diverse context of research on the problem under consideration, and fill a specific research gap in the form of showing the factors of success of entrepreneurial women in the specific conditions of a given company in the Beauty industry. The conducted research can expand the literature on women's entrepreneurship.

Keywords: women's entrepreneurship, success factors, Beauty industry.

Category of the paper: Research article, case study.

1. Introduction

The first studies and research on women's entrepreneurship appeared at the turn of the 70s and 80s, while recent years have shown a clear increase in interest in this subject. The main trends in research on women's entrepreneurship (Lubacha-Sember, 2016) are barriers to their

entrepreneurship, motivation to start their own business, support for entrepreneurship, but also a comparative characteristic of women's and men's entrepreneurship (Rembiasz, Siemieniak, 2021). In research on the phenomenon of entrepreneurship, the dominating view is that they require an interdisciplinary approach: economic, psychological and social (Gano, Łuczka, 2017). The aim of the article is to identify the factors of success of women who run a business in the Beauty industry. The research problem formulated in the form of questions is as follows: what factors influence the success of women running a business in the Beauty industry, what are the components of this success, do they combine professional success with life success, and what prompted them to start a business in the discussed industry? To answer these questions, the author conducted interviews with the owners of three micro-enterprises providing various services in the Beauty industry in the Masovian Voivodeship.

2. Success of entrepreneurial women

In business management, the aim of the efforts undertaken is the desire to achieve success, i.e. success, prosperity, successful effect of one's own or joint actions (Zakrzewska-Bielawska, 2007). Success is understood as a successful result of some undertaking, achievement of the intended goal, gaining fame, wealth, high position (Dictionary of the Polish language). It is also understood as establishing a business, overcoming barriers related to entering the market, obtaining financial resources, equipping the company, increasing regular customers in subsequent years of operation, obtaining customer satisfaction. Success also means increasing profits from business activity and expanding the area of operation. Success is measured slightly differently by employees, who do it through the prism of the level of remuneration, quality of life and certainty of employment (Zakrzewska-Bielawska, 2007). Success in life, in turn, is most often associated with a successful family life, a combination of a good family and financial situation with good health and job satisfaction, happiness and fulfillment of dreams. In the literature, one can also find a statement that the success of a company depends not so much on the market, but on its internal situation. The foundations for lasting success are not created by management techniques and tools, but by the attitude, including entrepreneurship, values, mindset and approach of top management (Kwiecień, 2018).

One of the first to describe the phenomenon of entrepreneurship was R. Cantillon, who called it the ability to perceive opportunities and use the opportunity created by the market to achieve profit in order to continue effective action (Siemieniak, 2010). The concept of entrepreneurship is understood as an action that aims to create and implement new connections between production factors and shows the connections between entrepreneurship and human personality traits, such as creativity, activity in action, resourcefulness or ingenuity. In the literature, these traits are attributed to people who are the driving force of economic life,

i.e. people with entrepreneurial traits. After all, entrepreneurship is "the ability to perceive new opportunities and search for opportunities to achieve profit that others have not yet noticed" (Kurczewska, 2013, p. 26).

As Sabina Klimek states in her work on women's entrepreneurship in Poland, many types of entrepreneurship can be distinguished, because entrepreneurship in its essence is very diverse and with the progress of technology, its new varieties appear (Klimek, 2020, p. 19). In the cited study, entrepreneurship was classified according to:

- the nature of the activity, in which international, innovative, ecological, intellectual and academic entrepreneurship can be distinguished,
- the person of the entrepreneur, female entrepreneurship, family entrepreneurship, seniors, immigrants,
- the type of behavior, i.e. team entrepreneurship, entrepreneurship as a lifestyle,
- the level of company development: start-up entrepreneurship, entrepreneurship in companies with strong growth.

Due to the problem raised in the article, attention should be paid to the classification of types of entrepreneurship according to the person of the entrepreneur, namely female entrepreneurship. This is a problem that is increasingly being paid attention to by researchers dealing with women's entrepreneurship and their role in the economy.

The increase in the number of professionally active women has been one of the dominant social trends in Europe for the last 30 years and continues to this day (Broniszewska, Ślusarczyk, 2017). The changes taking place on the labor market have been and continue to be a kind of impulse for the growth of women's entrepreneurship in the 21st century. The literature suggests that women are more adaptable than men and can cope better with stress. For many women, starting their own business is much easier than obtaining a managerial position in the company where they work. Working "on your own" allows women to more easily reconcile family and professional responsibilities (Ślusarczyk, Broniszewska, 2014, p. 222).

In recent years, the number of women starting their own businesses has been increasing, which is why it is necessary to strive to understand the essence of female entrepreneurship (Rembiasz, Siemieniak, 2021). This fact is confirmed not only by statistical data, but also by the growing interest of researchers in the topic (Zavodny-Pospisil, Zavodna, 2022, p. 53).

In Poland, women run businesses more often than in other countries. Poland is the second country in the EU in terms of the percentage of women running their own business – in our country it is 8%, it is higher only in Greece (10%). In turn, the average in the EU is around 6% (Figure 1).

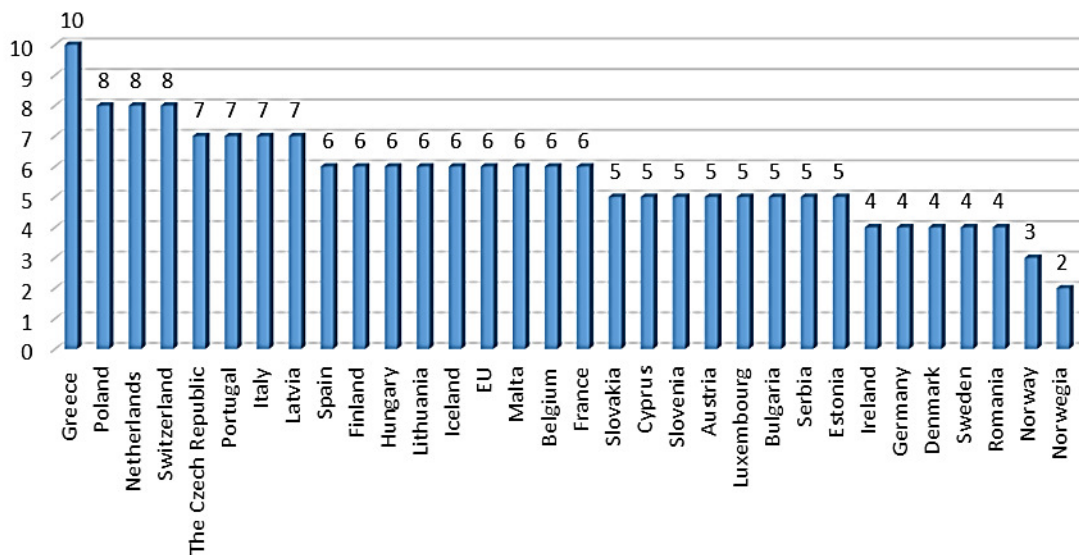


Figure 1. Percentage of women aged 15-64 running their own business in 2021.

Source: Polish Economic Institute, 2023, p. 18.

According to the GEM Report (2022), in 2021, entrepreneurial attitudes among Polish women and men changed compared to 2020 and again approached those observed before the pandemic, and compared to 2020, more women than men saw business opportunities in their environment. Polish women were much more likely than the average European to positively assess the conditions for starting a business in their environment, and were more convinced of their entrepreneurial competences than men (Tyrańska et al., 2023). More than half of all companies managed by women are microenterprises (55%). By opening them, they are realizing their goals and dreams. In which industries do women most often operate? Polish women own as many as $\frac{2}{3}$ of companies in the service industry. According to the KRS analysis conducted by the Dun & Bradstreet credit information agency on behalf of the Sukces Pisany Szminką Foundation, in the first quarter of 2022, the largest percentage of businesses owned by women (76%) was registered in the "social assistance without accommodation" section, and women are also owners of more than half of companies classified as "production of basic pharmaceutical substances and medicines and other pharmaceutical substances" (55%) (PARP, 2022). The third sector in terms of the number of companies owned by women is "other individual service activity", including hairdressing and beauty salons, solariums, massage and slimming salons, tattoo and piercing salons". Women constitute 63.5% of all business owners in the Beauty industry, which is called the women's industry. The results of the analyses by the Author and EFL (EFL Report, 2024) show that knowledge and business management skills are a very big challenge for people starting their own business. Neither Polish women nor Poles are "diligent students of entrepreneurship" and did not describe their knowledge as very high. However, women were much more likely than men to start their own companies without business preparation or with low knowledge and skills (28% vs. 21%), which was presented in the article. Gaining business knowledge in the discussed industry is very important for women, as shown by the number of training courses, workshops and conferences they participate in while running a company.

On February 28, 2024, the industry sanctioned its definition and identified the model areas of the Beauty industry, which is defined by M. Łenczyński as: "all fields dealing with beauty and well-being" (Beautyrazem)¹, i.e.: hairdressing, cosmetics, including treatments with technology, aesthetic cosmetology and aesthetic medicine, eyelash styling, eyebrows and eye framing, make-up, make-up with wigs and the work of a make-up artist and stylist, solariums, light therapy and spray tanning, ear piercing, piercing, including piercing performed by piercers, tattooing and permanent make-up, manicure, pedicure, nail styling and podiatry, hairdressing and trichology, cosmetic and relaxation massage, biological regeneration and SPA, body shaping, hair removal with any technique, including laser, sale of after-care products, and education in the form of courses and training and other forms, in all of the above Beauty areas. This is a rather specific industry, in which companies are mostly run by women, and women also constitute the majority of the staff. The specificity of this industry also lies in the fact that clients, when choosing a Beauty salon, are mostly guided by customer reviews published on the Internet (65.4%), recommendations and opinions of friends (59.6%). The driving force of success in the Beauty industry is recommendations. The reasons for such behaviors are fear of poor quality of service, lack of trust and anonymity of the beautician/cosmetologist (Stanisławska, 2017, pp. 14-17).

In the last decade, society's interest in improving its own image has increased significantly, and health awareness in society is increasing. From a social and economic perspective, the aspect of healthy life expectancy is very important. This is the expected average number of years that people in a given society have to live without major damage to their health and disability. In the last 15 years, this indicator for women in Poland has been around 62-64 years. This is a number similar to the average in the European Union. It is also worth noting that in Poland, women's healthy life expectancy is on average 2-3 percentage points higher than men's - similarly to some other EU countries, although in most of them such a disproportion is not visible (Polish Economic Institute, 2023, p. 38).

There is also a visible increase in interest in the services of companies in the Beauty industry, as well as skin care and makeup products. Especially ecological and natural cosmetics, which reflects the growing interest in a healthy and conscious lifestyle. In addition, product innovations, such as personalized cosmetics and products based on advanced research and technology, attract new consumers (fashionbiznes). This is supported by the current trend related to a healthy lifestyle, attractive appearance and well-being (Wiśniewska, 2020, p. 7). Society is increasingly aware of the threats caused by stress, a sedentary lifestyle, lack of physical activity and rush, but also a lack of care for physical condition and appearance, which provides wide opportunities for the development of companies in the Beauty industry.

¹ The Beauty Razem Foundation is a professional social organization of the Beauty industry of 100,000 Beauty experts, beauticians, cosmetologists, stylists, make-up artists, hairdressers and representatives of dozens of related specialties. The president is Michał Łenczyński.

An additional factor strengthening the position of the Polish cosmetics industry is the generational change and the entry of young consumers into the market, who spend more on cosmetics. In 2023, the average Pole spent an estimated just over 125 euros on cosmetics - we read in the PKO BP report "Cosmetic industry - current situation and forecasts until 2028" in 2022, the average resident of our country spent 117 euros on these products. In 2028, this amount is forecast to increase to 165 euros. The largest share in the market (48.2%) is held by personal care cosmetics (PKO branża kosmetyczna, 2024).

3. Case studies

The case studies were developed based on interviews with the owners of three micro-enterprises providing various services in the Beauty industry, in the Mazovian province.

One of the main reasons for analyzing the selected cases was to identify the key factors that influenced the success of the owners, i.e.: establishing the company, its development, generating profits, the ability to repay loans. Each of these women, before starting their own business, had different experiences, worked in a different industry, and yet decided to establish a company in the Beauty industry, which functions well and brings personal satisfaction and financial profit.

Company A. Beauty salon, (cosmetology and training), legal form: sole proprietorship, run by a 46-year-old married woman with two children. Higher education - master's and postgraduate, on the market for over 20 years. Activity according to PKD: hairdressing and other beauty treatments, and other extracurricular forms of education, not classified elsewhere. She runs the company alone, for several years she has not employed employees. In addition to her business activity, she has a loan. Before opening her own company at the age of 24, the owner was employed full-time for 3 years, in a profession learned in the Beauty industry. The experience gained was very helpful when opening the business.

The owner takes part in training sessions at least once a month, which are conducted by leading companies on the Beauty market, on new products, running a business and how to perform treatments, running social media, a holistic approach to skin care, and interpreting research results. The costs she incurs are an average of one thousand per training session.

According to her, the success factors of running a business in the Beauty industry are primarily knowledge of the industry, previous and acquired professional experience, running a business without debt, having children, introducing new solutions, growing demand for services, fashion for a healthy appearance, changing the mentality of women - healthy egoism, good location of the company, equipment of the salon, building relationships with employees, but also "reliability, training in the Beauty industry, holistic approach to the human body and its skin, empathy for people, permanent development in cosmetology, mission, bringing reliable

knowledge to future beauticians and cosmetologists, persistence and determination". The professional success that she achieved, she does not combine with personal success at every stage of life. "There are different stages in every person's life, you can achieve professional success by struggling with turmoil of a personal nature".

Company B. Body shaping studio (body shaping, facial and body treatments), legal form: sole proprietorship, run by a 43-year-old married woman with one child. Master's degree, on the market for 1 year. Activity according to PKD: hairdressing and other beauty treatments, her husband supports her in running the company. She employs one employee on the basis of an employment contract. In addition to her business activity, she has a loan. Before she started her business at the age of 42, the owner was employed full-time in her learned profession as an accountant in a pharmaceutical company for over 15 years. The experience gained was helpful when she started her own business, but she does not use it at present.

The owner takes part in industry training sessions at least twice a month, which are conducted by the franchisor as part of the franchise agreement, concerning marketing, sales training, and on getting to know the customer's personality and using new equipment. In her work, she uses the products of companies that conduct training.

Success factors of running a business in the Beauty industry are primarily knowledge of the industry, family support, introduction of new solutions, cooperation with other companies, trusted employees, growing demand for services, fashion for a healthy look, support of friends (using its services), investment in equipment, new services, good location, equipment of the salon and building relationships with clients, but also: "determination, family support, customer loyalty". She combines professional success with personal, satisfaction from independence and earnings in the first year of business. Possibility of investing from the generated profit. Achieving peace and time for the family.

Company C. Podiatry studio, (foot and hand care), legal form: limited liability company, run by a 39-year-old married woman with one child. Master's degree, on the market for 7 years. Activity according to PKD: hairdressing and other cosmetic treatments, her husband supports her in running the company. In addition to her business activity, she has a loan. Before she started her business at the age of 31, the owner was employed full-time for 13 years, in a profession learned as an office worker in the police and municipal guard. The experience gained was helpful when she started her own business.

The owner takes part in hand nail styling training at least five times a year, on the subject of wound treatment, the role of a podiatrist in the world of medicine and industry training, the cost of which ranges from 2 to 6 thousand. In her work, she uses products from companies that conduct training.

In her opinion, the factors of success in running a business in the Beauty industry are primarily running a business without debt, having children, increasing the wealth of society, good location, building relationships with customers, continuous development of the company and rapid introduction of new products, and: "having financial resources to start, determination

and determination, self-confidence, improving qualifications, support from family". She combines professional success with personal success, job satisfaction, support from her spouse, the opportunity to pursue one's own passion and mission related to it, in the form of volunteering several times a month".

3.1. Summary of case studies

Table 1.

Characteristics of the women studied

Item	A	B	C
Age of the owners	46	43	39
Age of the owners at the time of establishing the company	24	42	32
Family status	husband, two children	husband, one child	husband, one child
Education	higher, master's and postgraduate degrees	higher, master's degree	higher, master's and postgraduate degrees
Experience in the industry at the time of founding the company	yes, school, full-time employment in the Beauty industry	none	none
Previous experience	3 years of full-time employment in the Beauty industry	15 years of full-time employment as an accountant	13 years of full-time employment as an office worker in the municipal guard and police

Source: Based on own research.

Table 2.

Conditions of running a business

Company	A	B	C
Equipment	very good	innovative	very good
Location	good	good	very good
State of competition	small	big	no competition
Credit/leasing available	yes	paid off	yes

Source: Based on own research.

Table 3.

Comparative Characteristics

Company	A	B	C
Motivation to start your own business	- desire to go it alone, - need for independence, - pursuing one's own passion	- lack of promotion opportunities, - desire to start your own business, - need for independence, - upcoming opportunity, - tired of working full-time, - pursuing your own passion	- desire to act on your own, - need for independence, - pursuing your own passion
Reasons for your success	- empathy for people, - permanent development in cosmetology, - mission, - providing reliable knowledge for future beauticians and cosmetologists, - persistence and determination	- determination, - family support, - customer loyalty	- determination, - self-confidence, - improving qualifications, - family support

Cont. table 3.

The way of doing marketing	- website, - instagram, - facebook, - word of mouth marketing	- website, - instagram, - facebook, - franchise, - word of mouth marketing	- website, - instagram, - facebook, - cooperation with influencers, - word of mouth marketing
Characteristics of Entrepreneurial Women	- diligence, - courage, - self-discipline, - persistence, - initiative, - patience, - ease of establishing contacts, - continuous acquisition of industry skills	- diligence, - courage, - patience, - ease of establishing contacts, - continuous acquisition of industry skills	- diligence, - self-discipline, - patience, - ease in establishing contacts, - continuous acquisition of industry skills

Source: Based on own research.

Industry education when starting a business (Table1) is not always a factor in success, just like creativity, initiative and courage or a strong desire to succeed. However, diligence, persistence, self-discipline, ease in establishing contacts and communication skills, as well as patience and continuous improvement of skills and expansion of industry knowledge (Table 3) are very important factors that distinguish successful women in the discussed industry, and these are trainings, workshops and industry conferences.

The equipment of the salon (Table 2) is of great importance, as well as the high quality of services provided and communication skills, because the specificity of the Beauty industry shows that over 65% of clients using services in Beauty salons take into account the recommendations of friends, family, and are also influenced by opinions found on the Internet. The reason is simple but very important, and it is characteristic of the Beauty industry. A client going for a treatment that improves appearance and well-being must have an inner conviction that they will achieve the desired effect in a given time. It is extremely rare for us to decide on a facial treatment without feeling that we are putting ourselves in good hands, which is why so much depends on the skills and experience of the person performing the treatment, the owner, but also trusted, well-trained employees, as well as recommendations and orders, which is particularly important in the Beauty industry.

4. Conclusions

The results of analyses and research conducted by the author, which aimed to demonstrate the motives for establishing and running businesses in specific conditions of a given company, show that success factors result from:

- the entrepreneur/owner: the age of the owner (borderline of generation X and Y), experience in the industry and continuous acquisition and improvement of industry skills, personal mission, improving qualifications, character/personality traits (industriousness, self-discipline, ease of establishing contacts, high quality of services provided, communication skills), motivation to establish a business, having children and a stable family situation;
- from the company itself: introduction of new solutions, trusted employees-specialists, availability of dates for services provided, having a pool of regular customers, investment in equipment, continuous development, place of business, equipment of the office, introduction of new services, good location;
- from the company's environment: support from family and friends, good financing conditions (leasing, credit), cooperation with influencers who recommend using the services of a given person, and companies offering benefit systems and sports and recreation subscriptions (Multisport, Medicover Sport, PZU Sport), growing demand for services, the motivating role of competition, the fashion for a healthy appearance, increasing wealth of society, changing the mentality of women – healthy egoism.

Professional success, which entrepreneurial women running a business in the Beauty industry associate with personal success, is understood as: the ability to make independent decisions, earnings in the first year of business, a sense of peace and time for the family. They also define it as the ability to fulfill a dream, to pursue one's own passion and a personal mission to help, e.g. in the form of volunteering or training competent staff of beauty and cosmetology salons. An important factor in achieving success was establishing cooperation with companies providing benefit systems, which in the case of company B had a significant impact on retaining customers during the holiday and vacation period. It is worth noting that all the owners notice a change in the mentality of their clients from generations X and Y, namely healthy egoism determining systematic visits to Beauty salons in order to take care of the appearance and condition of the skin and body, which is closely related to well-being.

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INNOVATIVENESS OF ENTERPRISES IN THE EUROPEAN UNION IN THE CONTEXT OF THE APPROACH TO INNOVATION PROCESSES

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Purpose: This article is a continuation of a series of publications on enterprise innovations and the benefits they bring. It serves as a foundation for further research among companies, the results of which will be presented in a subsequent publication. The primary goal was to identify the basic innovation profiles of European enterprises and the use of the main sources of information on innovation by companies, which may be important in the context of further identification of the models of innovation processes used.

Design/methodology/approach: The study is based on a review of the literature on innovation models and the reasons for their implementation and uses statistical data on the innovativeness of enterprises in the European Union countries provided by Eurostat. The research results on the profiles of innovative enterprises in the European Union were analysed, with particular emphasis on Polish companies due to the planned further research.

Findings: The study made it possible to determine the differences occurring in the European countries covered by Eurostat research in terms of the innovation profiles of enterprises and revealed relatively low innovation activity among Polish companies. It was also found that enterprises use various sources of information in their innovation processes. Differences in the approach of companies from different European countries were also identified in this area. It is particularly apparent that innovative entities from Poland relatively rarely use external sources of information for their innovation activities.

Originality/value: The results highlight different approaches to innovation in the surveyed countries and will enable better planning of further research aimed at determining the impact of numerous factors on the innovation activity of Polish enterprises, with particular emphasis on subsidies from EU and national public funds.

Keywords: innovativeness of enterprises, innovation profiles of enterprises, innovative activity of an enterprise.

Category of the paper: analytical research paper.

1. Introduction

The development of innovations and their impact on the level of competitiveness of enterprises and economies is significant, as evidenced by the results of numerous studies and the positions of academics. The European Union has been trying for decades to stimulate innovation processes in the private and public sectors, and its innovation policy is constantly evolving (Gajewski, 2017). Research confirms the correlation between economic development and innovation, although its connection with the development of entrepreneurship is less clear-cut. The complexity of the EU innovation policy management processes, the imperfection of financing instruments and too many decision-makers involved in the innovation-stimulating processes lead to results that are below EU expectations (Crudu, 2019). According to the European Innovation Scoreboard 2024 report, South Korea remains the most innovative country surveyed. The other three competitors – Canada, the United States and Australia – still have an advantage over the European Union. Noteworthy, however, is that since 2021, the EU's average innovation performance has been higher than that of Japan. Nonetheless, it is necessary to further strengthen the innovative capacity of individual countries. This means that further improvement of innovation policy is required, and for this purpose research should be conducted to identify key factors that have a positive impact on the innovative attitudes of enterprises.

The aim of the research conducted for the purposes of this article is to gather the knowledge necessary for further planning of the research process for the next publication in the series. It was important to determine the basic innovation profiles of European enterprises and the basic sources of information used by companies in the context of the applied innovation process models, which will be examined further.

When it comes to innovation, one of the key issues to consider is how decisions are made to invest in it. It is also important to focus on the determining factors in order to understand why enterprises undertake or abandon innovative activities. Additionally, it is crucial to identify the sources of information that innovators use in the process of creating innovations.

The obtained results will constitute the basis for detailed preparation of further research procedures for the next part of this publication series.

2. Models of innovation processes

When it comes to the determinants of decisions on implementing innovations, it can be crucial to identify the model of innovation processes that dominates in enterprises. The first to be described was the model of innovation “pushed” by science (supply-side), which was

characteristic of economic activity in the mid-20th century. This is one of the linear models that assumed a dominant role of science and basic research, which in turn drove applied research, eventually leading to the introduction of innovations to the market. In this approach, customers had little influence on creating the directions of innovation development; the role of the market was to receive new products and accept them or not. By the mid-1960s, the role of customer needs began to be emphasised in innovation processes. It was noted that a considerable proportion of successful innovations resulted from companies responding to identified market needs. This led to the description of another linear model of market-pull (demand-driven) innovation, in which entrepreneurs often introduced small, incremental innovations that were a response to rapidly changing market needs (Repetowski, 2008).

Roy Rothwell wrote about five generations of innovation process models, among which the described supply and demand models are classified as the first and second phases.

In the 1970s, the interactive model (known as the coupling model) became widespread, which combined the two linear models described above. While still sequential, it represented a move away from a linear approach to a parallel one, which was expected to be more efficient (Rothwell, 1994).

Gabor Keresztes and Marcell György Endresz also discuss the simultaneous-coupling model, in which innovations arise from the simultaneous combination of knowledge from three functions: marketing, production and research and development. Its characteristic feature is that the point at which the innovation process will begin is not known in advance. They mention this model before the interactive model (Keresztes, Endresz, 2020).

The fourth generation includes parallel models focusing on internal enterprise integration and building relationships with key suppliers and active customers through various relationships and alliances. The fifth phase, however, is based on continuous innovation using networks, which has been common since the late 1980s. These models leverage the possibilities for intensive information exchange thanks to developing information and communication technologies (Rothwell, 1994).

Paul Trott presents a somewhat different chronological perspective on the development of innovation process models due to their characteristics, identifying a total of eight phases. The final phase, according to him, is based on open innovation (Trott, 2017). This has emerged in response to the growing risk to innovation because of shortening product life cycles, increasing global competition, very rapid technological progress and the rising costs of implementing innovations. Companies aim to mitigate this risk by using open innovation and deepening collaboration within networks (Kozioł-Nadolna, Świadek, 2010).

3. Innovation profiles of enterprises in the European Union

The innovativeness of the European Union economy is one of the fundamental conditions for maintaining and increasing its competitiveness on international markets. For years, the community has been making efforts to effectively compete with the USA and Japan, which have historically been the leaders in innovation rankings. Other global economies also recognise the importance of innovation in creating the foundations for building competitive advantage. Notably, countries like South Korea or the USA spend a higher percentage of GDP on research and development than the European Union. One recent initiative is the development of the European Innovation Plan, which aims to help Europe become a leader in high-tech innovation, which requires significant financial investment (Polluveer, 2024).

To support the development of the EU's innovation policy, Eurostat is introducing new reporting tools to facilitate the study of business innovation. The Community Innovation Survey (CIS) provides data on the innovation activities of enterprises, but the mere number of implemented innovative solutions does not significantly contribute to assessing the effectiveness of innovation activities. Moreover, it is difficult to provide information on the success of individual solutions in each country due to practical limitations. As a result, a tool was created to determine the innovation profiles of enterprises based on data related to their capacity for innovation, actions taken and business innovation outcomes. As a result, seven profiles were developed, distinguishing between companies that engage in innovative activities and those that do not. Profiling takes into account basic information about the innovative behaviour of enterprises, first identifying whether an entity conducts any innovative activities. A distinction is then made between innovators who implement innovations and those who do not. Next, the innovation capabilities of enterprises are considered, and whether they develop them either independently or in cooperation with other entities. The fourth level assesses whether enterprises have developed significant innovation capabilities that result in the implementation of product or process innovations, which allows them to be distinguished from those that, lacking such capabilities, are forced to acquire fresh solutions (Eurostat, 2023).

The enterprise innovation profiles are as follows:

Profile I: Product innovators introducing new products to the market – entities that have developed and implemented products that are new to the market, i.e. those that were not previously offered by competitors.

Profile II: Product innovators without market novelties – entities introducing a product innovation that is identical or remarkably similar to products already offered by competitors.

Profile III: Business process innovators – implementing innovations in a business process that has been developed by the enterprise.

Profile IV: Innovators without significant innovation capabilities of their own – enterprises that, when introducing product or process innovations, do not develop them themselves, but purchase them from others.

Profile V: Entities that are not innovators, which have worked on innovations but have not implemented them – that is, those that have conducted innovation activities in the last three years but have not implemented them because they have not completed them or have abandoned them during that time.

Profile VI: Non-innovators that have attempted to innovate – enterprises that have only considered innovating but have not had any ongoing or discontinued innovation activity in the last three years.

Profile VII: Non-innovative entities that have not attempted to innovate – enterprises that have no tendency to engage in innovation activities.

They provide better information to analysts and policy-makers than one-dimensional standard indicators. “Innovation profiles” is a new tool that will capture better the complete picture of innovation in European enterprises.

This approach is intended to provide answers to the questions: What do companies do to be innovative? What limitations do they face? What promotes innovation? What can be done to create favourable conditions for the development of innovation in enterprises and thus increase the competitiveness of the economy?

The approach of European Union enterprises to innovation in the light of Eurostat data.

To identify approaches to implementing innovation processes, the innovation profiles of enterprises were primarily examined. The findings from Eurostat’s research indicate that enterprises capable of independently developing and implementing innovations are more likely to be found in the category of medium and large enterprises. Companies purchasing innovative solutions are small, but the average number of employees is the upper limit of this category of companies and is 49 people. Companies that do not undertake any innovative activities are most often small enterprises employing fewer than 40 people. The results obtained in the 2020 Eurostat study based on data from selected European Union countries confirm the thesis that the size of an enterprise may affect its innovation potential.

The analysis of data related to the innovation profiles of companies in the European Union countries covered by the study indicates that there is a strong positive correlation between GDP per capita and the percentage of innovative companies that independently introduce product innovations that are new to the market because they have not been offered before by competitors (Profile I). The Pearson correlation coefficient in this case is 0.67. The relationship between the percentage of companies with a profile I and the level of GDP is shown in Figure 1.

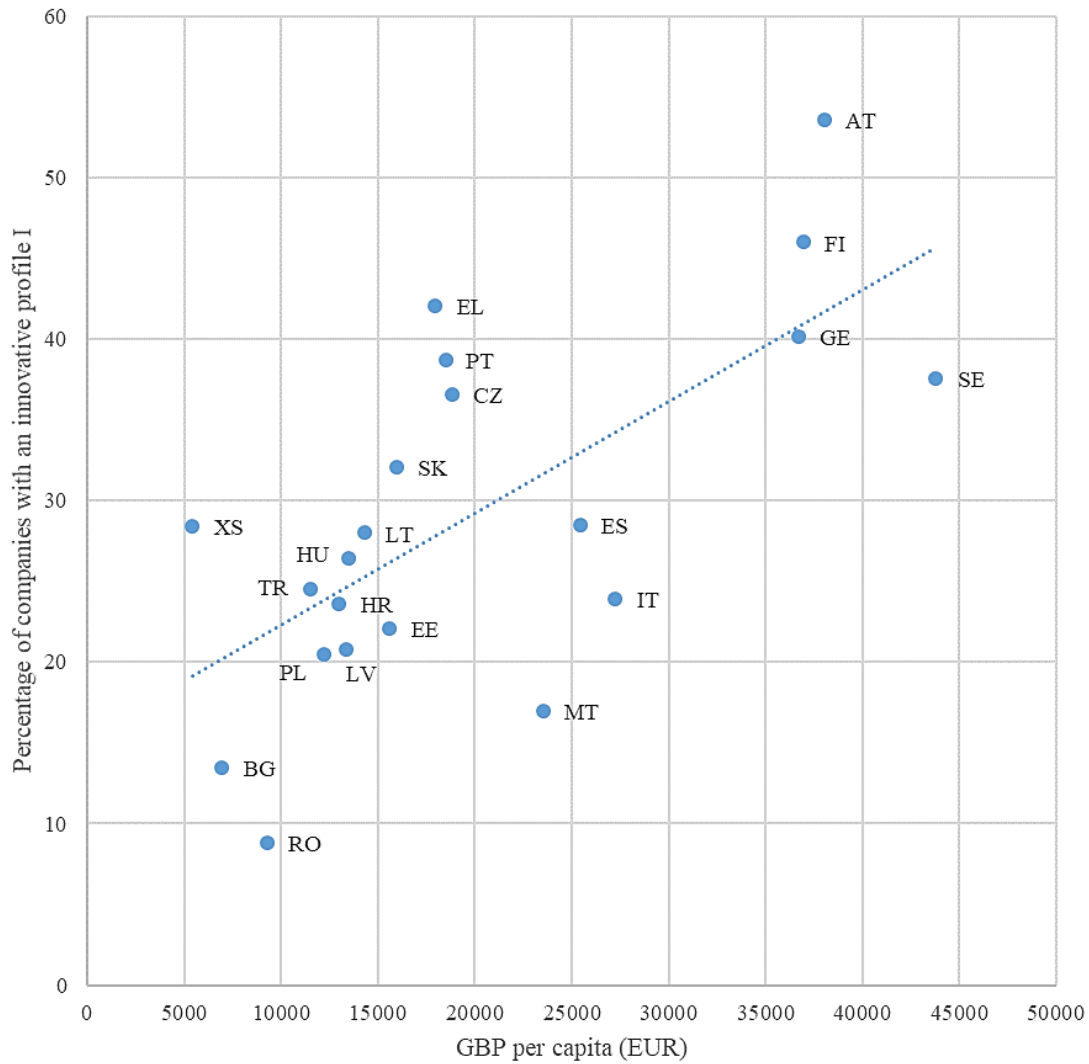


Figure 1. Correlation of the percentage of profile I companies with GDP.

Source: Own elaboration based on Eurostat data.

No significant correlation was found for profiles II to IV. A weak correlation (Pearson coefficient 0.37) occurs between GDP and the percentage of companies with innovation profile V. A moderate negative correlation, but with a higher coefficient (-0.44), occurs in the case of companies with profiles VI and VII. This means that as GDP grows, the percentage of enterprises with the lowest innovation activity or those that do not demonstrate it should decrease.

The relationship between the aggregated percentage of companies with a profile VI and profile VII and the level of GDP is shown in Figure 2.

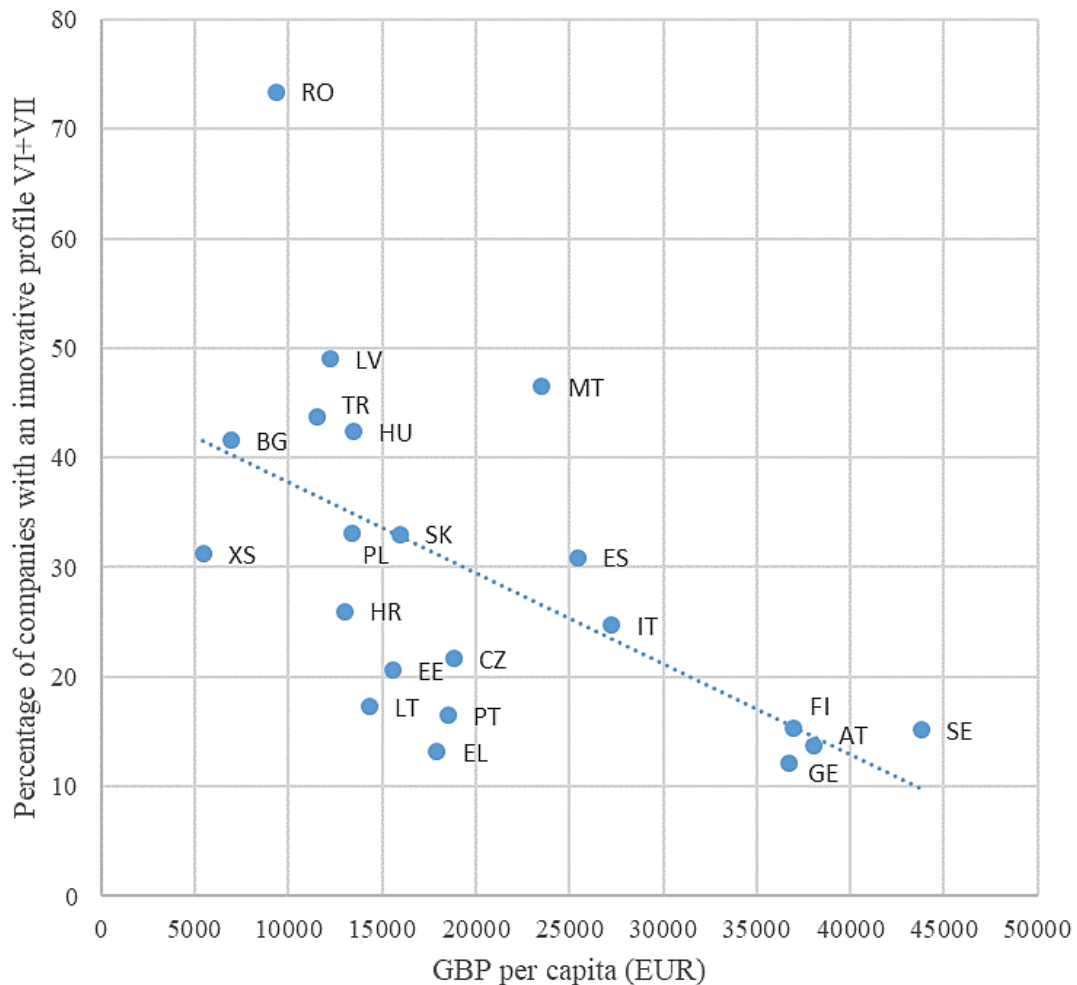


Figure 2. Correlation of the percentage of profile VI and VII companies with GDP.

Source: Own elaboration based on Eurostat data.

Compared to enterprises from other countries covered by the study, the innovativeness of Polish enterprises is unfavourable. The percentage of enterprises that do not undertake any innovative activity is significantly higher only in Romania (almost 55%). The situation is also slightly worse in Bulgaria (33.5% of non-innovative companies, but with almost twice lower GDP per capita). A specific situation also occurs in the case of Malta, where 31% of companies represent profile VII and 15.5% have profile VI. Malta is therefore characterised by a low share of enterprises implementing product innovations. A strong negative correlation can be obtained by adding up the percentage of enterprises with innovation profiles VI and VII. The correlation coefficient in this case is -0.58.

In terms of the percentage of entities that do not implement any innovations, regardless of whether they only considered innovation activity or did not even undertake it, the situation in Poland is better. Innovation activity in Romania, as well as Bulgaria, Turkey, Latvia, Hungary and Malta is significantly lower, while Slovakia and Spain have similar indicators.

Details of the profiles can be found in the Table 1.

Table 1.
Innovation profiles of enterprises

Country	GBP per capita 2019 (EUR)	Innovative profile (percentage of companies)						
		I	II	III	IV	V	VI	VII
Bulgaria (BG)	6960	13,5	11,3	24,6	6,5	2,5	8,1	33,5
Czechia (CZ)	18820	36,6	20,0	17,7	3,4	0,7	8,4	13,3
Germany (GE)	36720	40,2	24,6	15,5	4,3	3,3	8,6	3,5
Estonia (EE)	15570	22,1	21,6	33,4	0,3	1,9	4,2	16,4
Greece (EL)	17 930	42,1	24,1	16,1	3,2	1,3	5,9	7,3
Spain (ES)	25 420	28,5	22,0	8,1	5,9	4,6	16,1	14,8
Croatia (HR)	12 980	23,6	26,6	15,8	7,2	0,8	11,2	14,8
Italy (IT)	27 260	23,9	21,8	21,9	2,6	5,2	3,7	21,0
Latvia (LV)	12 230	20,5	6,9	18,6	3,8	1,2	27,6	21,4
Lithuania (LT)	14 300	28,0	19,2	24,3	8,8	2,4	4,6	12,7
Hungary (HU)	13 490	26,4	12,9	7,4	6,9	4,0	32,4	10,0
Malta (MT)	23 520	17,0	14,0	18,2	2,8	1,4	15,5	31,0
Austria (AT)	38 040	53,6	10,3	16,3	3,4	2,6	3,1	10,6
Poland (PL)	13 370	20,8	16,8	21,1	3,7	4,5	3,8	29,3
Portugal (PT)	18 500	38,7	17,5	15,6	5,0	6,7	11,0	5,5
Romania (RO)	9 310	8,8	7,1	6,9	1,5	2,3	18,5	54,9
Slovakia (SK)	15 940	32,1	7,7	14,7	5,8	6,8	21,1	11,9
Finland (FI)	36 970	46,0	16,4	11,8	2,4	8,1	0,0	15,3
Sweden (SE)	43 790	37,6	17,8	19,7	5,3	4,4	4,2	11,0
Serbia (XS)	5 440	28,4	18,7	9,7	11,6	0,3	10,6	20,6
Türkiye (TR)	11 500	24,5	12,7	13,0	0,9	5,1	21,6	22,2

Source: Eurostat.

In terms of sources of information on innovation, the European enterprises surveyed are less likely to use private sector clients and even less likely to seek information from public sector clients. Polish companies are characterised by some of the lowest indicators. They are most likely to use group companies as a source of information about innovations. In this respect, companies from Estonia are interesting, as they most willingly use information from suppliers and customers from the public sector, and from Italy, where suppliers have the greatest influence and companies from the corporate group the least.

The distribution of responses from the surveyed enterprises may indicate that there may be non-linear models of innovation processes, which may be suggested by various sources of information on innovation indicated as important, but this requires verification during further surveys among entrepreneurs.

4. Summary and conclusions

Innovations are an important pillar in the development of the European Union's economy, which tries to encourage enterprises to develop them. At the same time, it is improving the tools for collecting data that allow for assessing the effectiveness of innovation policy. However, these tools are still not perfect, and the results of research conducted by Eurostat need to be

supplemented to find answers to the question of how various instruments, especially financial ones, stimulate innovation activity.

The correlation between GDP per capita and the percentage of enterprises implementing independently developed product innovations and those that do not conduct innovation activities or are only considering them indicates a strong connection between these values. Of course, it is possible to discuss whether the level of economic development promotes innovation or the other way around. It is most likely that there is bidirectional stimulation in these areas. The cases of European countries with higher business innovation activity than indicated by GDP suggest that it is possible to stimulate it through appropriately designed innovation policy instruments, which need to be continuously researched and developed.

A factor that certainly promotes the development of innovation is the size of the enterprise, but in all European Union countries the economy is dominated by medium-sized and small entities, so we should look for other stimulants to enhance innovation.

The available data do not clearly indicate whether the applied models of innovation processes or the willingness to use particular sources of information on innovations influence the overall level of innovation in enterprises. This is particularly visible in the case of Estonia, where enterprises are less willing to use various sources of information on innovations apart from public sector clients, which is the source they use most often among entities from all countries covered by the survey. Meanwhile, Estonia has been steadily progressing in its position in the European Innovation Scoreboard reports, and in the latest one it is rated as a strong innovator, recording a significant increase in its innovation score, changing its position by as much as two groups from 2021. Meanwhile, Poland remains in the group of emerging innovators, despite the progress that is being observed. This confirms the need to seek new opportunities to increase innovation. This is very difficult, because there are no conclusive research results to develop an effective support system. It is necessary to use new tools, such as the described innovation profiles, and to continuously carry out research on the attitudes of enterprises towards innovation and on the internal and external determinants that can stimulate their innovation activity.

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USING ARTIFICIAL INTELLIGENCE FOR CUSTOMER ENGAGEMENT IN SOCIAL MEDIA

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Purpose: The article aims to provide current insights into the use of artificial intelligence (AI) in enhancing customer engagement on social media and to propose directions for future research. It addresses a research gap by demonstrating how AI supports customer engagement processes and the potential benefits for businesses.

Design/methodology/approach: The research objectives were met through a systematic literature review of articles from the Scopus and EBSCO databases. This review analyzed keywords related to AI, customer engagement, and social media, enabling a comprehensive understanding of current research and the identification of existing gaps.

Findings: The literature review reveals that artificial intelligence (AI) plays a critical role in customer engagement on social media by enabling content personalization, chatbot interactions, audience segmentation, and marketing campaign optimization. AI tools allow for the creation of personalized messages and advertisements tailored to individual customer preferences, which enhances engagement and fosters brand loyalty. Furthermore, AI supports real-time data analysis, enabling companies to continuously refine their marketing strategies, thereby improving campaign effectiveness and increasing return on investment.

Research limitations/implications: The study's limitations stem from a lack of research focused on the European market, including Poland, and a limited number of studies examining AI's direct impact on customer engagement in social media. The author recommends further research across diverse regional and industry contexts to address these gaps.

Practical implications: The use of AI can significantly streamline marketing processes, enhance campaign efficiency, and boost customer loyalty and engagement. By leveraging AI, companies can tailor content to align with customer preferences, resulting in improved business outcomes.

Originality/value: The article provides a fresh perspective on using AI for customer engagement in social media, highlighting existing research gaps and proposing directions for future studies.

Keywords: artificial intelligence, customer engagement, social media.

Introduction

The use of artificial intelligence in customer engagement-oriented marketing brings multiple benefits to companies, helping them build stronger and more effective customer relationships through personalized capabilities. Analyzing data on customer behavior enables companies to tailor offers, messages, and recommendations to individual needs. Algorithms process information based on previous interactions with the brand, leading to increased customer engagement (Kumar, Rajan, 2019). By leveraging AI in marketing, companies report significant time savings for their teams through the automation of processes such as chat support, email dispatch, and marketing campaign management. This allows businesses to focus on strategic planning (Murphy, 2021).

The use of artificial intelligence also enables precise customer analysis, allowing businesses to tailor their offerings and reach audiences more effectively (Chaffey, Ellis-Chadwick, 2019). Personalization, relevant recommendations, and real-time responses to customer inquiries significantly enhance engagement. Satisfied customers are more likely to return for purchases and maintain relationships with the brand (Zhou, Duan, 2020). Algorithms can analyze the tone of customer feedback, such as comments on Facebook, enabling companies to better understand the prevailing sentiments among their audience (Rust, Huang, 2021). Creating personalized posts and ads that cater to individual preferences also boosts audience engagement (Fitzgerald, 2020). An essential benefit of AI application is improved security through the analysis of false information and detection of undesirable behaviors and communications on social media (Kietzmann, 2019).

Recognizing the potential of artificial intelligence in customer engagement, a systematic literature review was conducted to examine whether businesses are indeed leveraging AI to engage customers on social media. This article fills a research gap by presenting an analysis of the relationships between artificial intelligence, customer engagement, and social media.

Literature Review: Customer Engagement, Social Media, Artificial Intelligence

The term "customer engagement" was introduced into marketing literature in 2001 as a concept describing the active participation of the customer in the value creation process (Żyminkowska, 2019). However, there are significant definitional discrepancies within the literature. Customer engagement is considered from two perspectives: a multidimensional approach, encompassing both the attitudes and behaviors of the customer, and a unidimensional – behavioral approach, which focuses solely on customer behaviors. Within the behavioral

approach, two perspectives are distinguished. The first includes all customer behaviors excluding purchases, while the second includes both behaviors and purchases (Żyminkowska, 2019).

In the multidimensional interpretation, customer engagement is defined as a "voluntary investment of specific customer resources in brand interaction, driven by motivation". This investment includes intangible resources, such as knowledge, material resources, and cognitive, emotional, behavioral, and social skills (Hollebeek, Srivastava, Chen, 2016). In the unidimensional interpretation that includes purchase, customer engagement is viewed as customer behavior toward a brand or company, resulting from motivational factors, including the purchase itself.

Customer engagement encompasses the client's interactions with the company in a comprehensive view (Kumar et al., 2010). In contrast, in the unidimensional behavioral perspective, which excludes purchase, customer engagement refers to customer actions toward the brand or company beyond transactions, such as blogging, writing reviews, or sharing opinions (Verhoef et al., 2010).

Customer Engagement (CE) is defined as behaviors directed toward a company or brand that go beyond the purchase itself, driven by customer motivation (Wang, Hall, 2023). CE is considered a key marketing imperative, essential for building a positive brand image (Yang et al., 2023; Gupta, Pandey, 2021). The literature also highlights the growing role of artificial intelligence in personalizing CE, which strengthens the relationship between the customer and the brand (Yang et al., 2023).

CE is seen as a process of actively engaging the customer in value creation, assuming that the customer is not merely a recipient but a co-creator of brand value. Customer engagement encompasses not only transactional interactions but also a value co-creation process, which requires relationship management and an understanding of customer motivations (Żyminkowska, 2019).

In the literature, Customer Engagement (CE) is addressed in both broad and narrow perspectives. In the broad perspective, CE is defined as "the intensity of customer participation in the organization's offerings and activities and their connection with these offerings and activities, initiated by both the customer and the organization" (Żyminkowska, 2019). In the narrow perspective, CE is understood as Customer Engagement Behavior (CEB), encompassing various forms of customer behavior focused on the brand or company that are not directly related to purchase but arise from motivational factors (van Doorn et al., 2010).

Within the narrow perspective, two main types of behavior can be distinguished:

1. Behaviors related to communication between customers, and
2. Behaviors related to co-creation of products and innovations by the customer and the company (Żyminkowska, 2018).

In the digital domain, marketing communication has expanded with strategies that leverage the internet and social media to connect with customers and build lasting relationships (Varghese, Jenin, 2019; Kewat et al., 2023).

Social media are defined as a group of applications that utilize Web 2.0 technology, enabling users to exchange content (Dorenda-Zaborowicz, 2012). Platforms like Meta, Instagram, Twitter, and LinkedIn support businesses in connecting with customers, sharing information, and fostering engagement (Bilgihana, Ricci, 2023).

Social media are among the most popular online spaces for information exchange between users. As early as 2013, Schultz and Peltier explored their potential for customer engagement (Schultz, Peltier, 2013). The 2014 Global C-Suite Study Insights report revealed that, at that time, few companies used social media to connect with customers (IBM, 2014). Polish research from the Digital 2022 report by Infomax Group shows that over 27 million Poles actively use social media, spending an average of 1 hour and 49 minutes daily. The most popular platforms are Facebook (88.1%) and Instagram (59.6%), with content about family and friends being most frequently followed (nearly 50%), while brand-related information interests over 20% of users (Digital, 2022).

In 2023, the number of active social media users in Poland rose to 27.5 million, with daily time spent on platforms extending to 2 hours and 2 minutes. Instagram surpassed Facebook, reaching 61.5% of users, while Facebook held 34.6%. Interest in brands and their content increased by 6.8% compared to the previous year, reaching 26.8% (Digital, 2023). These changes reflect the ongoing development of social media and growing user engagement. The decline in Facebook activity may be linked to the emergence of new platforms and Instagram's rising popularity. The findings highlight that social media continues to be a dynamic channel, enabling brands to maintain constant contact with customers.

With the development of social media, customers have gained the ability to quickly and easily express opinions and interact with brands. They can share their feedback and experiences, while companies, by utilizing social media, receive direct customer feedback (Bansal et al., 2019).

The dynamic growth of online platforms has contributed to the increasing popularity of social media as a channel for customer engagement. Customer engagement in social media can be defined as a set of measurable actions that customers take in response to published content, such as likes, comments, shares, or reactions like hearts (Barger, Peltier, 2016). Social media are interactive and co-creative, allowing companies to engage users more effectively (Barger, Labrecque, 2013). Research confirms that well-planned strategies can significantly boost customer engagement on social media (Felix et al., 2017).

The COVID-19 pandemic accelerated the development of artificial intelligence, also increasing the demand for customer engagement (So et al., 2019; Hentzen et al., 2022; Hollebeek et al., 2022). Artificial intelligence, as a branch of computer science, encompasses the creation of systems and algorithms that mimic human thinking. Its purpose is to perform

tasks without human intervention, tasks that would typically require human intelligence (Russell, Norvig, 2021). AI is also defined as software that mimics human cognition through the automation and analysis of large datasets (Prentice et al., 2020) or as a technology or machine (Perez-Vega et al., 2020).

Artificial intelligence undoubtedly improves the effectiveness of marketing activities, for example, through precise audience segmentation in social media (Culotta et al., 2015). It also serves as a tool subtly encouraging customers to make purchases (Dimitrieska et al., 2018).

Artificial intelligence has become an integral part of marketing communication, revolutionizing the way companies interact with customers (Hafiz, 2024). AI is identified as a key area of research that will dominate trend exploration after 2024 (Nguyen, 2024). Its significant potential for achieving market advantage is widely recognized, enabling companies to leverage this technology for competitive gains.

The dynamic development of AI in marketing has increased interest in research on its impact on various areas of this field (Mahabub, 2023). AI-based marketing is a strategy aimed at maximizing the use of technology to enhance customer experiences (Jain, Aggarwal, 2020). AI allows marketers to personalize content, which is particularly useful in communication on platforms such as Facebook (Dimitrieska et al., 2018).

Analysis indicates that innovative technologies significantly increase customer engagement (Bilgihana, Ricci, 2023). In the context of digital transformation, it is crucial to utilize AI's capabilities for engaging customers, as this enables companies to achieve success, especially in online business (Kumar et al., 2024).

Interactivity is a unique feature of social media that influences consumer experiences (Mollen, Wilson, 2010). It determines the level of customer engagement in interactions with virtual content (Ho et al., 2022). Social media users share their experiences, review products and brands, and express their opinions (Hollebeek, Chen, 2014). Customer engagement on social media is measured by the number of likes, comments, shares, and clicks (Trunfio, Ross, 2021).

Methodology

To verify whether artificial intelligence is used in customer engagement processes on social media, a systematic literature review was conducted in this field. A systematic literature review allows for the development of a clear and repeatable procedure that leverages the current state of knowledge (Siddaway et al., 2019). This study followed the literature review procedure outlined by Czakon (2015).

The aim of the study was to examine the current state of knowledge regarding the use of artificial intelligence in customer engagement and to identify potential research gaps. Two databases, Scopus and Ebsco, were selected for analysis due to their reputation for reliability and wide usage in the academic community. The choice of these two databases enabled a more comprehensive exploration of the topic. Scopus includes results from over 20,000 peer-reviewed journals (Verma et al., 2021). Following the review procedure, the following research questions were formulated:

1. Is artificial intelligence used for customer engagement on social media?
2. What AI tools are applied for engaging customers on social media?
3. What benefits do companies gain from using AI tools for customer engagement on social media? (if they use them).
4. Do companies have a need to use AI tools for customer engagement on social media in the future?

To address the research questions, the author selected the keywords: "artificial intelligence", "customer engagement", and "social media". Given the topic of the article, these terms were combined into pairs of concepts: "artificial intelligence" and "customer engagement", as well as "artificial intelligence" and "social media". The inclusion criteria involved searching within the title, abstract, and keywords, specifying publication type as peer-reviewed articles, limiting language to English, and focusing on the subject area of Business/Economics/Management. The initial search yielded 197 articles, which were then filtered and assessed according to the established procedure. After removing three duplicates, 17 relevant articles were obtained. Additionally, 32 articles were identified as inspiring, while 145 results were deemed outside the scope of the article's subject. The outcomes of this procedure are presented in Table 1.

Table 1.
SLR Procedure

A priori selection process	Results
Source of collected works: SCOPUS	50
Source of collected works: EBSCO	140
Total	197
A posteriori selection process	Results
Articles marked as selected	17
Articles marked as inspiring	32
Articles marked as useless - outside the topic	145
Articles marked as useless - duplicate works	3
Final database of articles	17

Source: Own elaboration.

Results

The literature emphasizes a growing need for research on the impact of artificial intelligence (AI) on customer engagement to enhance this interaction (Bapat, Hollebeek, 2023). Analysis of customer activity and engagement online reveals that these actions also influence companies' social media strategies (Campbell et al., 2020; Li, 2019). Companies use AI to generate marketing content ideas, which strengthens their campaigns (Kose, Sert, 2017).

In social media, AI supports A/B testing (e.g., on platforms like Meta), audience segmentation, and streamlines marketing department processes (Peyravi et al., 2020). Another advantage of AI is its ability to personalize offerings, allowing it to predict future customer behaviors and preferences (Epk, Thilagavathy, 2021). AI is also used in chatbots—online communication tools that enhance customer engagement (Arsenijevic, Jovic, 2019; Tussyadiah et al., 2017). AI-powered ad optimization enables better targeting of engaged audiences, translating to a higher return on investment. AI algorithms quickly analyze campaign effectiveness, aiding marketing decision-making (Juska, 2021).

With technological advancements and personalized, interaction-based communication, companies achieve higher results in customer engagement (Vlacic et al., 2021; Chen et al., 2021; Mogaji et al., 2021). Companies are increasingly eager to leverage AI's potential, appreciating its numerous benefits, such as improved customer engagement rates and satisfaction. Personalized content, enabled by AI, enhances customer loyalty toward the brand and supports effective audience segmentation (Cheng, Jiang, 2021). AI also allows for the rapid optimization of marketing campaigns through advanced analytics (Nurgul, 2024). An additional advantage of AI-based systems is the minimization of human errors (Logg, 2019).

AI opens new opportunities for more effective customer engagement (Wen et al., 2022). One of the key applications of AI in marketing communication is message personalization. By analyzing data on customer behaviors and engagement history, AI algorithms can tailor messages to individual users while maintaining a universal appeal. Higher personalization levels improve customer engagement by enhancing their experiences, translating into better marketing campaign results (Sandy et al., 2021; Pearson, 2019).

With increasing competition and the dynamic growth of the hospitality industry, there is a need for effective marketing strategies based on new technologies, including AI (Bilgihana, Ricci, 2023). Hospitality companies in the USA utilize AI to engage guests on social media, where chatbots facilitate customer interaction. Through quick responses and problem-solving capabilities, chatbots boost engagement and convenience for users. For example, Facebook Messenger supports communication, reservations, and personalized recommendations through chatbots, addressing customer needs in real time. Hotels are going further by creating virtual assistants, such as "Edward" at Edwardian Hotels London, which assists with booking and check-in processes, enhancing customer satisfaction (Zhu et al., 2023).

Among AI tools in the hospitality industry, ChatGPT is utilized to generate personalized content and marketing communications, including emails, blog posts, and ads (Bilgihana, Ricci, 2023). An AI-driven strategy provides customers with personalized experiences, which is crucial for maintaining competitiveness (Samara et al., 2020). Another popular tool, DALL-E, works alongside ChatGPT to help hotels create distinctive social media posts, enhancing audience interaction and increasing bookings. AI also facilitates daily customer communication by responding to online reviews and publishing engaging blog entries.

AI supports the creation of ad campaigns with catchy headlines, boosting user reactions. Content personalization through AI significantly enhances customer satisfaction, leading to repeat bookings and revenue growth. The benefits of AI are evident not only in social media advertising but also in traditional marketing content that engages users and attracts new guests (Bilgihana, Ricci, 2023). Thus, AI contributes to both customer engagement and profitability by increasing bookings and retaining existing customers.

In summary, an effective marketing strategy in the hospitality industry requires combining traditional methods with innovations to achieve a competitive advantage (Bilgihana, Ricci, 2023). However, clear answers are still lacking on the optimal use of social media to engage customers and how social media might reshape approaches to building customer relationships (Al-Slehat, 2023; Kitsios et al., 2021; Shah et al., 2021).

The use of AI tools and capabilities has become essential for companies aiming to maintain competitiveness. Artificial intelligence presents an opportunity that businesses should actively leverage. However, it is crucial to understand the synergy between AI's technological capabilities and their alignment with organizational resources. Integrating employees with new technologies is also essential—employees need to master the conveniences provided by AI (Mahabub, 2023). The benefits of implementing AI are evident, as managers can more effectively manage social media and personalize customer experiences (Sterne, 2017).

Research conducted among marketing experts in Indian companies indicates that businesses implement AI due to competitive pressure. The primary benefits cited by respondents include streamlined marketing processes, increased return on investment, and, most importantly, improved customer service and satisfaction. However, respondents also highlighted challenges, such as the lack of appropriate technical capabilities within marketing teams. Managers utilize AI to create chatbots and enhance analytical capabilities, contributing to a better understanding of business dynamics. AI integration in customer service has led to increased customer satisfaction due to faster response times and higher efficiency. AI also enables companies to expand their reach in social media activities (Mahabub, 2023).

In the airline sector, AI supports remarketing efforts aimed at re-engaging customers. A study involving 500,000 customers used personalized headlines with names, resulting in a 15% increase in conversion rates on the website (Guerrubi et al., 2023).

Nurgul H. from the University of Graz recently conducted research on the role of artificial intelligence in social media. Through AI capabilities, companies can analyze customer behaviors in detail, enabling levels of personalization and engagement previously unattainable. Every customer interaction with a brand, including those on social media, generates valuable data. AI systems allow access to insights that would be challenging to detect with the naked eye (Nurgul, 2024). AI mechanisms can predict which products may interest a customer based on past data, such as in advertising. Enhanced communication relevance and improved customer experiences boost engagement and loyalty metrics (Cheng, Jiang, 2021; Prez Vega et al., 2021).

AI supports real-time interactions through chatbots, enabling companies to provide instant support and 24/7 engagement. Customers receive recommendations, answers to inquiries, and transaction assistance without delays, which significantly elevates service quality (Khrais, 2020; Song et al., 2022; Van Esch et al., 2021). By analyzing posts and opinions on social media, AI helps companies understand what customers think of their brand or product, facilitating the implementation and adjustment of communication strategies (Mustak et al., 2021).

The power of AI is immense—it enables companies to deliver relevant content to audiences effectively. It can also recommend visual content likely to attract specific audience segments, suggesting color schemes or themes aligned with brand preferences. Through AI functionalities, content personalization, and tailored strategies, customer engagement deepens, strengthening bonds between the brand and its audience (Nurgul, 2024). Chatbots, a key AI tool, go beyond standard customer service to foster brand engagement, enhancing loyalty (Cheng, Jiang, 2021; Ho, 2021).

The implementation of artificial intelligence in social media has significantly impacted audience engagement, content personalization, and the measurement of marketing activities (Agniohotri, 2021; Benabdelouahed, Dakouan, 2020; Sadiku et al., 2021). AI algorithms can determine optimal publication times for different audience segments and better align content with their preferences by predicting trends. As a result, these tailored contents reach a broader audience more effectively, engaging them through insights derived from behavioral and preference analyses (Van Esch, Stewart Black, 2021; Capitana et al., 2020).

Artificial intelligence has also found application in influencer marketing. AI tools analyze social media data to identify key influencers, evaluating engagement rates, demographics, and content relevance, enabling precise influencer selection for targeted audiences (Alboqami, 2023; Gerlich et al., 2023; Simay et al., 2022). By leveraging AI in social media, companies can achieve higher user engagement—making AI adoption a necessity in today's digital landscape (Nurgul, 2024).

A similar trend is seen in India's banking sector. The growing customer base has led to fewer in-branch visits, prompting banks to invest in chatbots that enhance customer experience and enable convenient communication (Euart, Ferreria, 2020). Theoretical studies also indicate

that AI can assist in attracting new customers, understanding their needs, and aligning with their expectations, with chatbots playing a significant role in this process (Sinhy, 2022). Chatbots not only support customers in their current needs but also facilitate payments, send reminders, and help manage funds (Sinhy, 2022).

Despite the numerous benefits of implementing AI, such as streamlined decision-making, event identification, increased rationality, and more effective project management (Behera et al., 2024), challenges remain. High implementation costs, skill gaps among personnel, and data privacy issues are notable obstacles (Sinhy, 2022).

In the food service sector, artificial intelligence can significantly enhance customer satisfaction and influence purchasing decisions (Prentice et al., 2020). By meeting customer expectations, AI can improve user experiences, potentially increasing interest in products and brand engagement (Luo et al., 2019). However, to date, detailed research on the relationship between AI-based service quality and customer engagement in the food service industry has not been conducted (Supawat, Chompoonut, 2024).

Customer engagement has a notable impact on increasing interest in a company's products and services, which in turn boosts brand loyalty (Chen et al., 2020; Bergel et al., 2010). Previous studies by So et al. (2016) showed that customer engagement is crucial for building loyalty. Research conducted by Supawat and Chompoonut (2024) in Thai restaurants demonstrated that AI-driven services strongly influence customer engagement and loyalty. However, these studies did not cover social media, indicating a need for further analysis in this area.

The literature review reveals that the integration of social media with artificial intelligence has enabled more effective ad personalization (Li, 2019; Singh et al., 2023). Customer engagement levels are assessed based on data analyzed using artificial intelligence, and the use of chatbots can achieve outcomes comparable to human interaction—sometimes up to four times more effective in building engagement (Luo et al., 2019; Proserpio et al., 2020). Studies by Cheng and Jiang (2021) have shown that AI-managed chatbots significantly improve customer engagement.

Rana et al. (2022) and Awan et al. (2021) developed frameworks for increasing customer engagement through brand education. In recent years, companies such as Netflix have focused on strengthening bonds and loyalty among customers (Surana-Sanchez, Aramendia-Muneta, 2024). In the medical sector, chatbots enhance patient experiences by scheduling appointments, sending medication reminders, and providing information, all of which contribute to higher patient engagement (Di Vaio et al., 2020; Targ et al., 2022).

Surana-Sanchez and Aramendia-Muneta (2024) recommend further research into the relationship between social media and customer engagement, including an analysis of factors that influence the effectiveness of social media in building engagement.

Discussion

The analysis conducted through a systematic literature review provided answers to all four research questions posed by the author. Companies recognize the potential of artificial intelligence and actively leverage its capabilities, particularly in enhancing customer engagement. In social media, AI is widely applied, especially in the hotel sector in the United States. In response to increasing competition and rapid technological development, businesses are adapting to new market demands.

The article highlights that artificial intelligence finds applications across various sectors. In banking, chatbots help reduce customer visits to branches and increase satisfaction by automating processes. In the food service industry, AI influences purchasing decisions and enhances customer experiences, thus boosting engagement. In the healthcare sector, AI aids in medication reminders and appointment scheduling, which improves the quality of care and patient satisfaction. In the hotel industry, applications like "Edward" and chatbots used by airlines enable fast and personalized customer service, leading to higher customer satisfaction and conversion rates.

Chatbots not only engage customers but also support them in making purchasing decisions, reinforce brand image, and simplify customer service. Tools like ChatGPT, based on AI capabilities, generate engaging content tailored to specific target groups, and when combined with DALL-E, help create attractive graphics and advertisements for social media.

In other industries, such as airlines and banking, AI supports the personalization of advertising campaigns and customer service, which leads to higher conversion rates and customer satisfaction. For example, personalized headlines increased conversion rates by 15% in the airline sector. In healthcare, AI assists patients by providing reminders for appointments and medications, improving their experience and engagement.

The review results indicate the growing role of AI in building customer relationships and enhancing their experiences across various sectors, which has become a key component of modern marketing strategies. The main benefits that businesses gain from using AI tools include increased customer engagement, which leads to higher sales, an increase in returning customers, and an improved return on investment. With AI, companies can analyze campaign data in real time, enabling faster and more accurate adjustments to marketing strategies. AI-based content personalization positively affects customer engagement, directly translating into increased sales. Additionally, AI tools allow precise scheduling of content publication for specific audience segments, optimizing campaign reach and effectiveness.

Artificial intelligence also supports the development of influencer marketing by facilitating the selection of influencers who are most aligned with a brand's advertising goals. Businesses recognize the necessity of incorporating AI-driven solutions as an integral part of modern marketing strategies.

Although not all studies directly address social media, companies recognize the need to follow new trends. However, the literature lacks research on the direct impact of AI activities on social media, highlighting the need for continued studies in this area, especially within the European market, including Poland. It is justified to conduct research focused on the benefits of engaging customers through AI in social media across various industries. It is crucial to determine whether these benefits are equally visible in all sectors and if the results are comparable. In Poland, further studies are needed to understand the current level of AI development and implementation, particularly in the context of social media. Additionally, there is a lack of analyses on potential negative effects of customer engagement using AI, as well as a comprehensive review of available tools that influence customer engagement.

It is also worth examining the risks associated with AI implementation that go beyond costs and training, such as ethical concerns and the risk of excessive automation in interactions. Research conducted among Indian marketing specialists shows positive effects of AI implementation in marketing strategies, though they do not cover social media. Based on this, further research that includes social media is recommended to better understand the potential and challenges of this technology. Despite enthusiasm for new technologies, it is essential to maintain proper oversight and a critical approach to their use.

Challenges and limitations include high implementation costs, lack of skilled personnel, and data security requirements. To ensure optimal AI effectiveness, continuous monitoring and employee education on effective AI management are necessary.

In summary, artificial intelligence is now an indispensable part of effective marketing strategies, enabling personalized and engaging communication. However, due to the rapid development of this technology, further research is recommended on its impact across different sectors and regional contexts, especially in Europe and Poland.

Managerial implications

The use of artificial intelligence tools, such as chatbots, ChatGPT, and AI-driven graphic programs, enhances customer engagement. Managers should leverage artificial intelligence (AI) to create personalized content that boosts customer engagement and loyalty. They should also stay abreast of trends, invest in employee training, and implement new solutions available in the market. Effectively utilizing ChatGPT functions enables companies to create engaging content, positively influencing brand image and customer loyalty. The measurable benefits motivate companies to embrace new challenges and develop marketing strategies that blend traditional methods with modern tools. Chatbots not only increase customer engagement but also contribute to higher sales.

To gain a competitive edge, companies must keep up with new technologies and experiment with solutions across various sectors.

AI allows for deep segmentation and personalization of content, enabling companies to tailor their marketing campaigns precisely to individual customer preferences. Managers should harness these capabilities to optimize ad reach and enhance campaign effectiveness. Personalization leads to increased customer satisfaction and repeat purchases, which directly impact revenue.

In sectors such as hospitality, banking, gastronomy, and healthcare, AI-powered chatbots can significantly enhance service quality by providing 24/7 availability. They facilitate instant responses to customer inquiries and assist in transactions, positively impacting customer experiences. Managers should consider investing in AI to automate interactions and reduce service costs, ultimately boosting customer satisfaction and loyalty.

AI supports real-time campaign effectiveness analysis, enabling swift adjustments to marketing strategies. Through AI algorithms, companies can identify optimal posting times, increasing the reach of their content. Managers should leverage this data to refine campaigns, leading to a higher return on investment.

AI aids in identifying the most suitable influencers, increasing the effectiveness of marketing activities. Managers should use AI algorithms to select influencers whose content resonates best with the target audience, enhancing audience engagement and improving campaign outcomes.

Implementing AI requires a skilled workforce; therefore, companies must invest in training to fully harness AI tools. Equipping employees with the right skills allows for the maximization of AI potential, enhancing marketing and customer service effectiveness. Managers in Europe, including Poland, should pay attention to cultural differences and customer expectations regarding personalization and automation. AI implementation should be tailored to local conditions to improve customer acceptance of the technology.

Managers should collaborate with firms specializing in AI technology implementation. Combining their experience with AI's potential can foster organizational growth and strengthen competitive advantage. Given the rapid development of AI, companies should regularly update their systems and strategies to stay competitive. Adopting innovative AI-driven solutions is crucial for boosting customer engagement and enhancing a company's financial performance. In summary, artificial intelligence is now an indispensable part of effective marketing strategies, enabling personalized and engaging communication. However, due to the rapid development of this technology, further research is recommended on its impact across different sectors and regional contexts, especially in Europe and Poland.

Limitations

The systematic literature review was based on studies conducted outside the European market. Conclusions were drawn from available research without replication across a broader range of enterprises. Despite the growing use of artificial intelligence in digital marketing, especially on social media, there is a limited body of research thoroughly examining its impact on customer engagement and loyalty. Studies on AI application in various sectors have primarily focused on developed markets, such as the USA. In the European context, particularly in Poland, there is insufficient research on AI implementation and its effects on marketing strategies. Current research focuses on select industries like hospitality, banking, and airlines, which limits the generalizability of findings to other sectors. Further studies are needed to encompass a wider variety of industries and address the specific needs of different sectors. Existing research mainly highlights the benefits of AI utilization, with limited focus on potential negative effects, such as customer fatigue from excessive personalization or over-monitoring of user preferences, which could lead to a loss of trust in the brand.

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DRIVERS OF THE CONSUMPTION OF PLANT-BASED FOOD. INSIGHTS FROM THE PERSPECTIVE OF THE THEORY OF CONSUMPTION VALUES

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Purpose: Sustainable consumption and organic, healthier food are gaining increasing public attention. The discussion builds a more conscious and responsible society. With these matters on the table, corporations feel consumer pressure to reduce the food industry's environmental footprint. The article aims to analyse the determinants of the purchase intent of plant-based food. It poses five research questions.

Design/methodology/approach: The objective was achieved through a literature review concerning the values that affect the purchase intent of plant-based food and through empirical research. The research involved a survey of 208 respondents from Poland. The data were analysed through structural equation modelling with PLS-SEM in R-Studio. We validated the scales for measuring consumption values of plant-based food and built a model to explain the purchase intent.

Findings: According to the model, the primary driver of the intent is emotional value. Other statistically significant factors are epistemic and conditional values.

Practical implications: The results can be useful to future investors in the plant-based food market and those already present in this sector.

Originality/value: The novelty of the research lies in the identification of the values driving the purchase intent of plant-based food that consumers find the most important.

Keywords: sustainability, sustainable development, sustainable consumption, plant-based food, theory of consumption values, PLS-SEM.

Category of the paper: Research paper.

Introduction

The article investigates the values that drive consumers when purchasing plant-based food and the impact these values have on the purchase intent of plant-based food (PBF). Plant-based food is one of the fastest-growing markets in Poland and internationally (Adamczyk et al., 2022; Laassal, Kallas, 2019; Yang, Dharmasena, 2020; Schiano et al., 2020). The plant-based diet is

discussed in the media in numerous contexts: as a type of sustainable consumption, a lifestyle trend, a healthier substitute for a meat-based diet, or an expression of care for the life and welfare of livestock. The increasing interest in sustainable development significantly drives the demand for low carbon footprint products, fuelling the growth and popularity of the PBF industry as an alternative to meat products (Schiano et al., 2020; Peano et al., 2019; Verain et al., 2012). Therefore, it is so important to improve our understanding of the sector.

Many researchers investigated the demand side of PBF (Adamczyk et al., 2022; Laassal, Kallas, 2019), (Yang, Dharmasena, 2020; Schiano et al., 2020; Peano et al., 2019; Verain et al., 2012; Laila et al., 2021; Ribeiro et al., 2019; Schiano et al., 2022; McCarthy et al., 2017). Their research shows that consumers are driven to choose PBF by its nutritional value, health impact, price, and environmental considerations connected with sustainable development. We intend to verify their results in the context of the theory of consumption values to identify those attributes that play pivotal roles in consumer choices in the Polish market. To the best of our knowledge, no research employing the theory of consumption values has been conducted in Poland to date. Indeed, insights into the PBF market the theory can offer could be useful to many stakeholders, including PBF manufacturers, organisations advocating climate change adaptation, and consumers. Hence, we set to answer the following research questions:

RQ 1. What observable variables measure constructs of the theory of consumption values for PBF?

RQ 2. Do these constructs exhibit acceptable validity and reliability levels?

RQ 3. Which of the constructs significantly affect the purchase intent of PBF?

RQ 4. Do sociodemographic variables affect the purchase intent of PBF?

RQ 5. Do sociodemographic variables affect the consumption values of PBF?

The first question was addressed through a literature review focused on the theory of consumption values. We investigated functional value, social value, emotional value, epistemic value, and conditional value. We sought to answer research questions two through five with a survey of only consumers who actively purchased PBF in Poland from time to time. The survey sample is 208 people. The collected data were analysed using 1) structural equation modelling with PLS-SEM and 2) the Kruskal-Wallis tests and Conover's post-hoc tests.

The article is structured into five sections: 1) literature background for the empirical research, 2) methodology of the empirical research, 3) research results, 4) discussion, and 5) summary.

1. Literature review

1.1. Food consumption from the perspective of sustainable development

The notion of sustainable development covers a multitude of social, economic, and environmental aspects. It has become particularly popular in recent decades thanks to improved environmental and social awareness. Many organisations, governments, and enterprises attach growing weight to compliance with sustainable development principles. Its importance was further boosted by the growing concerns regarding environmental issues, such as climate change, loss of biodiversity, and degradation of ecosystems. Sustainable development is believed to respond to these challenges as a tool for fostering harmony between people and the planet. The idea has become integral to many development strategies, public policies, and business plans all over the world. The idea behind sustainable development has been aptly defined in the 1987 Report of the World Commission on Environment and Development: *Our Common Future* as development that ‘meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987).

Environmental protection is among the critical pillars of sustainable development policy. One of the top environmental challenges today is food, especially reducing food waste, improving food quality and availability, and mitigating the environmental impact of food production. Statistics on food systems reveal the significance of food for environmental protection. Food systems are responsible for about 60% of the global biodiversity loss on land and the overfishing of 33% of the commercial fish population (Westhoek et al., 2016). What is more, according to FAO, IFAD, UNICEF, WFP, and WHO publications from 2018-2019, one-third of global food is wasted between the point of production and point of consumption, while about 11% of the global population suffers from malnutrition and 39% is overweight or obese (WHO, 2024). According to the United Nations Convention on Biological Diversity (COP, 2010), the vision of ‘living in harmony with nature’ by 2050 requires us to address the issues of food production and consumption (COP, 2010). It states that the protection of biological diversity and sustainable consumption should be included in policies, strategies, and practices of key public and private organisations that affect biological diversity or rely on it, both locally and globally.

When addressing the issue of sustainable consumption of food, one has to consider the dietary behaviour of individual consumers and their interest in the environmental consequences of their diets. Today, the importance of a plant-based diet and limiting animal product intake to reduce the adverse environmental impact of food production is often emphasised. Greenhouse gas emissions from agriculture amounted to 22% of the total global emissions already in 2007, a result comparable to industrial emissions and higher than transport emissions. It is mostly animal production, including animal transport and feed production, that causes nearly 80% of the agricultural emissions (McMichael et al., 2007). Therefore, dietary decisions may be more

consequential for the environment than commuting or household energy decisions. Moreover, the livestock sector is the primary consumer of such natural resources as land and water, covering about 35% of the total farming area and about 20% of blue water for feed production today. Furthermore, the livestock sector is estimated to consume the equivalent of 11,900 km³ of fresh water a year or about 10% of the estimated global annual water flow (111,000 km³). Moreover, according to estimates for 2010, 2290 km³ of green water and 370 km³ of blue water were used in feed production on fields (FAO, 2019). Green water footprint is the volume of water found in plants or upper layers of soil. It also includes water evaporating from plants (evapotranspiration). Blue water footprint measures the consumption of fresh surface or underground water. (Świat wody, 2020) In 2015, researchers calculated the environmental cost of producing 1 kg of protein in various plant and animal products. The results showed that producing 1 kg of beef protein required 18 times more land, 10 times more water, 9 times more fuel, 12 times more fertiliser, and 10 times more pesticides than producing the same amount of red bean protein (Sabaté et al., 2015). In light of the above and considering the protection of natural resources, increased consumption of meat, especially red meat and animal products, should be avoided because its production involves overexploitation of natural resources, which flies in the face of sustainable development.

A 2017-2018 study shows that changes in consumer dietary behaviour may entail health and environmental benefits that cannot be achieved solely through production process improvements (Clark, Tilman, 2017).

Table 1.

Environmental impact of food

Food type	Environmental impact
Plant-based food	Minimal impact
Eggs, dairy products, poultry, fishing excluding trawling ¹ , and aquaculture without water recirculation ²	Medium impact
Ruminant meat	Very high impact (a hundred times more than PBF)

Source: original work based on (Clark, Tilman, 2017).

1.2. Plant-based food market in Poland

There are many factors behind the purchase intent of PBF. The first point of interest, however, is the sector and its consumers. Various communities followed plant-based diets already in Antiquity. Pythagoras, an appreciated Ancient Greek philosopher, promoted the benefits of the vegetarian diet in his teaching, believing animal slaughter immoral. Therefore,

¹ **Trawling** involves pulling a large, heavily weighted net on the sea floor and catching all bottom-dwelling organisms. (WWF, 2019).

² **Aquaculture without recirculation** means keeping fish in an enclosed environment on land or on a vessel where no water needs to be recirculated and no permanent energy source is necessary to stabilise the aquaculture environment. | Commission Regulation (EC) No 710/2009 of 5 August 2009 amending Regulation (EC) No 889/2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007, as regards laying down detailed rules on organic aquaculture animal and seaweed production.

his followers' diet, the Pythagorean Diet, was mainly based on bread, honey, and vegetables. Religions also affected the spread of plant-based diets by influencing the values of believers to a large extent. Jainism and Buddhism stand firm by the *ahimsa* principle, which means non-violence towards all living beings. Therefore, many believers practice vegetarianism or even veganism. Various cultures and periods saw many different types of plant-based diets. They are sometimes driven by beliefs, ethics, or health considerations (Clem, Barthel, 2021). Although new drivers of decisions to reduce animal product consumption are revealed from time to time, many of those discussed above remain relevant.

The sector of PBF as a substitute for animal products is certainly new and growing. Manufacturers invent new production methods, marketing strategies, substitute ideas, and packaging designs to outcompete each other. The sustainable development policy is also important to the plant-based diet trend. Consumers often indicate sustainability as a reason to reduce their animal product intake. The sales of PBF and plant-based substitutes of dairy products grew in Poland by 46.9% in the last three years alone. Increasingly more people buy PBF. The last five years saw a real revolution in this regard, according to GFK Institute data. In 2018, only 11.5% of households in Poland consumed PBF. In 2023, the number reached 31.7% (GFK 2023). Moreover, meat product sales declined by 7.5% in volume over the last three years, while plant substitutes grew by 30% for dairy products and over 60% for meat products. This means that not only did established PBF consumers buy more of these products, but new ones joined them while meat consumption declined. Furthermore, the plant-based meat substitute market in Poland was worth PLN 729 million [USD 188 million] in 2022, and GFI expects it to grow (GFI 2023).

The key to building effective marketing strategies for the sector is understanding the values and behaviour of PBF consumers. First, let us define plant-based food because the notion is very extensive. Therefore, for research purposes, we define PBF as substitutes for milk, cheese, meat, yoghurt, sweets, and eggs of plant origin. Examples of these products are shown in Table 2.

Table 2.
Plant-based food

Animal product	Plant-based alternative
cow's milk	oat milk, coconut milk, soy milk, almond milk, hazelnut milk
cheese	tofu, cheese substitutes from yeast flakes, nuts, cereals, and other plant- and mushroom-based products that imitate cheese consistency or flavour
butter	plant-oil-based butters, vegetable spreads, olive oil, coconut oil, tahini
eggs	mixes (such as vEGGs), aquafaba
meat	seitan, tofu, soy granules, tempeh, pre-mixed substitutes based on legumes, fungi, other vegetables, and cereals
sweets	sweets without milk powder, eggs, honey, or cream
yoghurt	coconut and soy yoghurt, plant- and seed-based mousse

Source: original research.

1.3. Development of hypotheses based on the theory of consumption values

The theoretical foundation for the empirical research is Jagdish N. Sheth, Bruce I. Newman, and Barbara L. Gross's theory of consumption values (Sheth, Newman, Gross, 1991). It identifies five primary values that affect the purchase intent. Identification of the values that drive consumers helps find the underlying motivation to purchase specific products and pinpoint customer preferences regarding the brand, the type of products they find interesting, and the impact of the manufacturer's climate policy on consumer decisions. The values are 1) functional value, 2) social value, 3) emotional value, 4) epistemic value, and 5) conditional value.

Functional value is mostly based on usability features such as quality, price, health properties, and the production process's environmental footprint. Functional value is one of the primary consumer drivers. The issues of quality, price, or environmental responsibility are very often discussed considering food purchase. Price determines the act of purchase and its volume. It also significantly impacts the buyer in the context of PBF. Plant-based alternatives are usually more expensive than traditional animal-based products. This is mainly because they target a relatively small market, which entails limited availability (Bryant, 2019). This leads to consumers looking for ways and stores where they can buy the same product cheaper or create their own substitutes for products of animal origin. On the other hand, the sector looks promising. As the public grows more interested in such products, their prices can be expected to drop in the coming years, leading to a new wave of consumers. Another component value of functionality is quality. Already in 1980, M.E. Porter considered it an important determinant of purchase. Quality components of food are nutritional value, certificates, health qualities, level of processing, taste, and texture. Plant-based food has much to offer regarding quality as a healthier alternative. Evidence from prospective cohort studies indicates that a high intake of mainly PBF, such as fruit and vegetables, nuts, and whole-grain products, is correlated with a lower risk of cardiovascular diseases. The protective effect of these foods can probably be linked to many advantageous nutrients, including mono- and polyunsaturated fatty acids, Omega-3 fatty acids, antioxidant vitamins, minerals, phytochemicals, fibre, and plant protein (Patel et al., 2017). In contrast, a ten-year study (2010–2020) demonstrated that consuming fatty meat increases the risk of cardiovascular diseases and neoplasms (González et al., 2020). Functional value covers environmental impact as well. According to a PayPal survey, 70% of Poles try to buy products that are environmentally friendly or come from environmentally friendly sources (SCF, 2022). But what does 'environmentally friendly food' mean? The characteristic primarily covers the production process's environmental footprint, distance and type of transport (often disregarded and yet of profound importance), and packaging. The good news regarding product packaging is the strong preference for green packaging among Polish consumers. According to half of the respondents in a survey by Farma Świętokrzyska, the need for reduced use of food packaging made of plastic film and other

environmentally hostile materials is an important transition in the food market (Farma Świątokrzyska, 2021). This survey is yet another proof of the importance of functionality when making PBF purchase decisions. Therefore, we pose the following research hypothesis:

H 3.1: The functional value of PBF significantly positively drives the intent to purchase these products.

Social value linked to PBF can be defined as the impact of the purchase on the response of the people around the consumer. Social value is consistent with the assumption of humans as social creatures, a belief dating back to Aristotle in Ancient Greece. Human beings are moulded by their surroundings, including cultural, familial, and demographic aspects, from birth. Throughout life, people learn many models through norms, upbringing, and surrounding culture while pursuing acceptance in line with Maslow's hierarchy of needs. One's food philosophy is often linked to being part of a social group following the same diet. The reason for this can be a similar worldview and sensitivity to the fate of lesser creatures. Social value also reflects how their friends and family perceive consumer decisions to purchase PBF. Researchers noted that negative reactions in the family make dietary changes much more difficult. In the context of relationships between plant-based diet consumers and omnivores, 'the dinner table can bring back warm and positive memories, but it can also foster division and become a battlefield of family dramas' (Simons et al., 2021). Studies on plant-based diets show that perceptions of meat eaters and non-meat eaters differ significantly. A vegetarian or vegan can be viewed as more virtuous but also less masculine. Moreover, studies on differences between sexes in the context of plant-based diets show that women demonstrate a higher level of empathy towards animals, consistent with the social role of caregivers assigned mainly to women. This may account for why men tend to be less willing to accept vegetarian/vegan diets or limit meat intake (Simons et al., 2021). Social value is strongly linked to the culture and traditions the consumer lives by. Western urban societies exhibit a positive trend towards larger volumes of purchased PBF. In contrast, in more traditionally minded environments, rural and small-town areas, PBF is less prevalent (Melo Pizzardo, 2020; Mocarska, 2021). Both social acceptance and availability of these products outside highly urbanised sites are lower. Therefore, we pose the following research hypothesis:

H 3.2: The social value of PBF significantly positively drives the intent to purchase these products.

Emotional value describes the impact of the purchase on the buyer's mood. It is particularly relevant in the case of PBF because the decision to follow a plant-based diet is often driven by moral considerations and feelings towards animals and the environment. A growing number of publications investigate the empathy of vegans and people reducing meat intake. They show that emotional value is highly relevant to the purchase of PBF. When asked about their reasons for following this philosophy, non-meat eaters often mention animal welfare, water savings, reduced GHG emissions, and health (Mocarska, 2021). Buyer satisfaction is another emotional aspect of purchasing PBF. When making a righteous decision, a person on a plant-based diet

feels better about themselves and is free of the guilt some of them experience when eating animal products (Erlandsson, Jungstrand, Västfjäll, 2016). People following specific diets are not the only ones who experience feelings when buying PBF. When faced with the ethical aspects of meat production, even regular consumers voice concerns about the well-being of farm animals and criticise traditional meat production systems (Hartmann, Siegrist, 2020). Reactions of the group stem from care and empathy towards animals that are killed for their pleasure. A 2022 study by Ha-Won Jang and Meehee Cho confirms a relationship between the dual concern theory and intent to purchase plant-based alternatives, revealing that both the expected positive outcome and empathic concern drove the intent to buy plant-based substitutes. It confirmed that Korean consumers' empathy and emotions significantly affect the purchase of plant-based products (Jang, Cho, 2022). Although the study was conducted in a remote country, both Korean and Polish traditional cuisines abound in meat dishes. Therefore, the cultural dimension of food can be considered similar in both cases. Considering the above, we propose the following research hypothesis:

H 3.3: The emotional value of PBF significantly positively drives the intent to purchase these products.

Epistemic value concerns the urge to collect information and expand knowledge on a specific topic. It involves curiousness and interest in a specific problem. In the case of food products, it is embodied in checking the list of ingredients and researching the manufacturer. Consumers of PBF can be considered very thorough in this regard. The most restrictive sub-group are vegans (Mocarska, 2021). Still, they are not the only ones continuously expanding their knowledge about plant-based diets and their products. The general public also grows more interested in plant-based diets. According to Google Trends, such keywords as 'plant-based', 'vegan', or 'plant-based protein' are gaining in popularity all over the world. In Poland, it is reflected through an increase in searches for such keywords as '*weganizm*' [veganism], '*wegetarianizm*' [vegetarianism], or '*substytut mięsa*' [meat substitute]. In addition to product insights, consumers often seek more details about the manufacturers. Beyond any doubt, providing positive information about one's product is a beneficial manufacturer tactic. Modern society strives for information, so by making accessible information about featured products, the manufacturer improves brand trust among prospective consumers. Hence, the popularity of such strategies as CSR and ESG has increased in recent years. Companies establish departments dedicated to building and implementing their internal sustainable development policies. It is not merely a marketing act but a value they want to stand for. Organisations with superior corporate social responsibility reputations usually have better key performance indicators than their competitors (Orlitzky, Schmidt, Rynes, 2003). These results may be due to increased consumer interest, driving demand. In light of these insights, we propose the following research hypothesis:

H 3.4: The epistemic value of PBF significantly positively drives the intent to purchase these products.

Conditional value is the perceived utility of a product acquired under specific conditions. Important variables of conditional value are time, different financial or market perspectives, or projection of a vision promoting a decision. This value encompasses such drivers as the time when the product is popular, the time when a specific diet makes sense in terms of health, and similar variable circumstances (Ramayah, Abidur Rahman, Ching Ling, 2018). It is often easier to identify the actual leading factor shaping consumption values in research. As regards plant-based diets, these factors often boil down to verification of the manufacturer and how they manage the business: its proposals, environmental and employee policies, product portfolio, and special offers. The conditional value of PBF often covers the price of substitutes and trust in the manufacturer's policy. A manufacturer who does not stop at offering PBF but makes an additional effort to continuously advocate similar values is perceived as more trustworthy. Vegans pose extraordinarily many conditions regarding product ingredients even though their choice is particularly limited by the dietary principles they follow. Sometimes, manufacturers dishonestly advertise their products as vegan even though they use honey, milk powder, or insect-derived colouring. And vice versa, although a product is vegan, they fail to label it as such, making it harder for vegans to identify and buy a suitable product. Manufacturers should pay particular attention to this value to properly respond to PBF consumers' needs. Based on the information above, we pose the following research hypothesis:

H 3.5: The conditional value of PBF significantly positively drives the intent to purchase these products.

Sociodemographic variables include numerous dimensions that can split a group regarding the intent or values. The most important aspects for PBF consumers are dominated by food philosophy, age, education, residence, and duration of the diet. Considering the above, we propose the following hypotheses:

H 4.1: Sociodemographic variables affect the purchase intent of PBF.

H 5.1: Sociodemographic variables affect the consumption values of PBF.

1.4. Research model

We developed the research models visualised in Figures 1 and 2 to answer the third, fourth and fifth research questions.

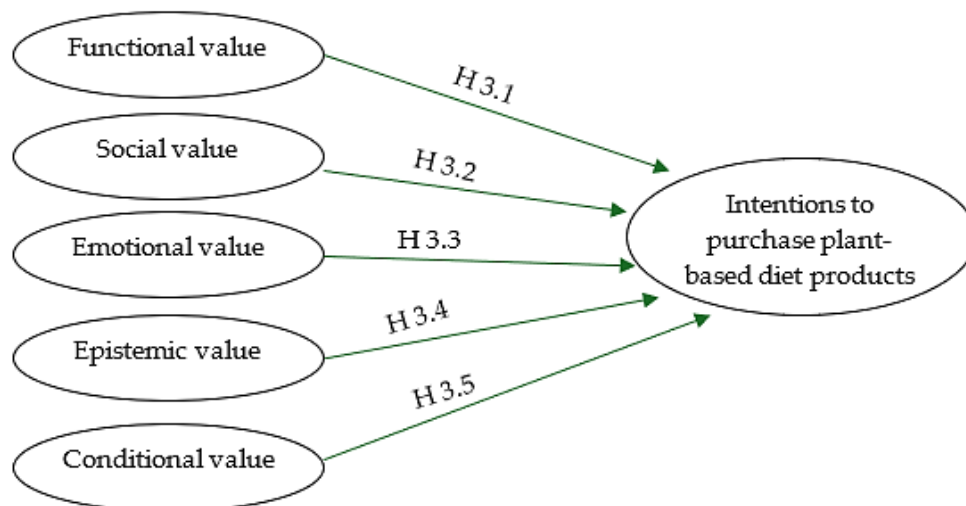


Figure 1. Research model addressing the third research question.

Source: original research.

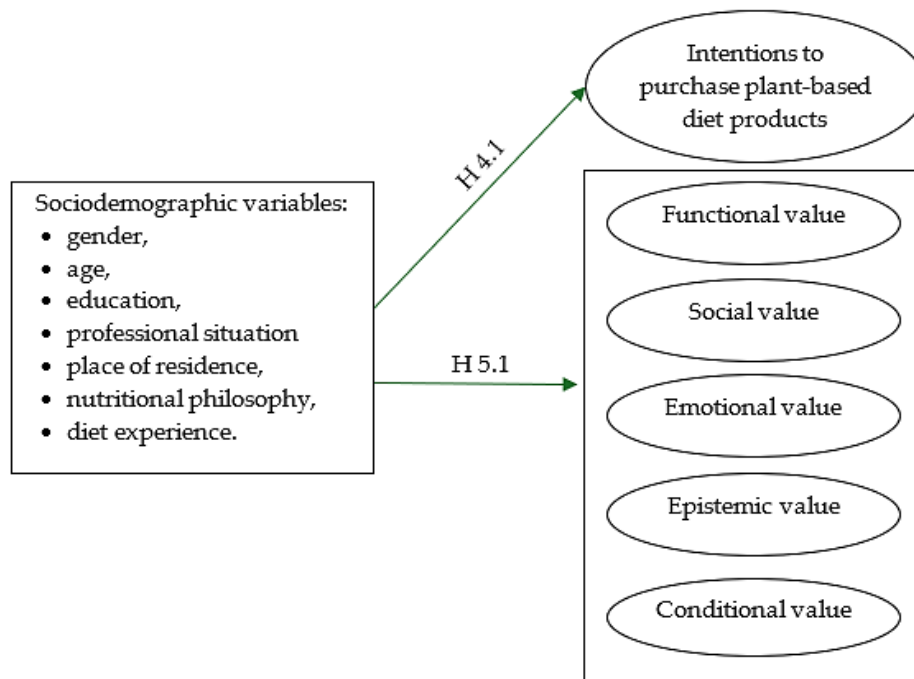


Figure 2. Research model addressing the fourth and fifth research questions.

Source: original research.

2. Materials and Methods

2.1. Data collection and data analysis

We followed the research procedure shown in Figure 3 to resolve the research problem. First, we reviewed the literature to build the research model and questionnaire we then

employed in the survey. The questionnaire contained 42 self-assessment questions: seven demographic questions and 35 questions concerning the variables. The survey was administered from December 2023 to January 2024 on 208 respondents.

The collected data were then analysed in R-Studio. The primary analytical method was structural equation modelling with PLS-SEM (Hair et al., 2019; Hair, 2014; Hair, Ringle, Sarstedt, 2011). The impact of the demographic data on the constructs and intent was investigated with the Kruskal-Wallis test. It extends the Mann-Whitney U test. It is a nonparametric equivalent of one-way ANOVA. It detects differences in distribution positions. It assumes no prior arrangement of k populations from which the samples were drawn. The Kruskal-Wallis test compares sums of ranks instead of means or variances. Therefore, the value of the median in all groups is relevant to reporting its results, not means.

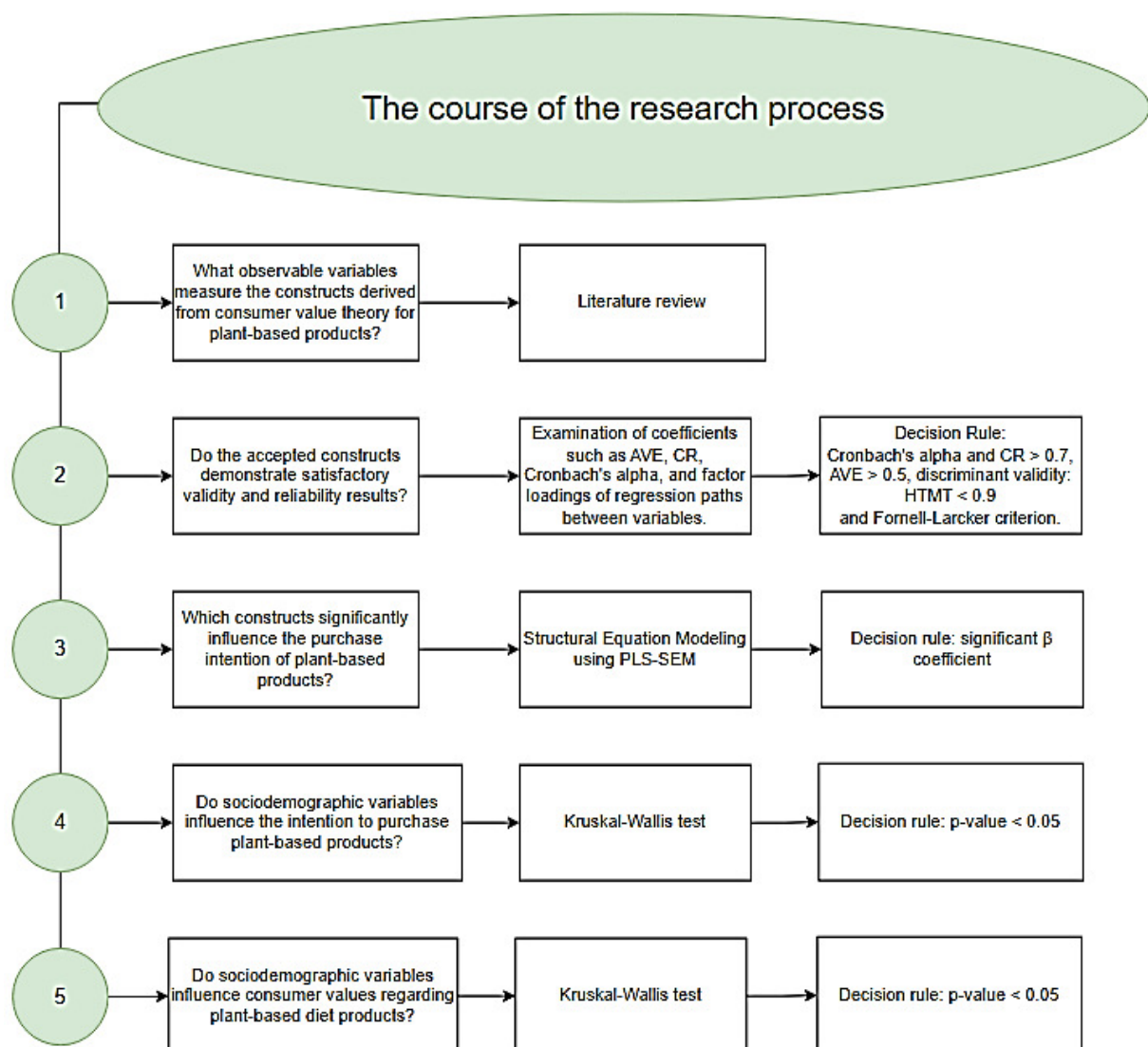


Figure 3. Research process diagram.

Source: original research.

2.2. Questionnaire structure

The measuring tool for the study is a questionnaire. The survey was anonymous to ensure complete confidentiality of the answers. All components measuring the investigated variables (Table 3) were assessed on a five-point Likert scale ranging from ‘Completely disagree (1)’ to ‘Completely agree (5)’. Apart from the standard demographic questions, the profiling part asked about food philosophy and diet duration to further classify the consumers during the analytical step.

Table 3.
Questionnaire used in the research

Construct	Item	Statement
Functional value	F1	Plant-based food maintains high quality.
	F2	The production of plant-based food consumes less water than the production of meat products.
	F3	Plant-based food has better packaging than products of animal origin (less plastics, recyclable packaging).
	F4	Plant-based food is priced adequately.
	F5	Plant-based food entails a lower risk of cardiovascular diseases than meat-based products.
	F6	Plant-based food usually has a high Nutri-Score rating (A or B).
	F7	The production of plant-based food is more environmentally friendly than that of animal-based food.
Social value	S1	Buying plant-based food does not make me feel socially excluded.
	S2	Buying plant-based food improves my image.
	S3	Buying plant-based food impresses my friends and family.
	S4	The public approves buying plant-based food.
	S5	My social circle comprehends buying plant-based food.
	S6	Buying plant-based food makes me feel like part of a group that follows the same diet.
Emotional value	E1	Buying plant-based food makes me feel I am doing something good.
	E2	Buying plant-based food makes me feel I am doing what is morally right.
	E3	Buying plant-based food makes me feel a better person.
	E4	Buying plant-based food makes me feel I am saving animal lives.
	E5	Buying plant-based food makes me feel I am saving the planet.
	E6	I feel my decision to buy plant-based food matters for environmental protection.
Epistemic value	EP1	Before I buy plant-based food, I check the ingredients and nutritional value of the product.
	EP2	Before I buy plant-based food, I compare it to other similar products of the same kind.
	EP3	I am willing to acquire information about new plant-based food or its upgrades.
	EP4	I am willing to look for new information about plant-based food.
	EP5	Before I buy plant-based food, I research how it is produced.
	EP6	Before I buy plant-based food, I research how it is obtained.
Conditional value	C1	I would buy more plant-based food if the price were lower.
	C2	I would buy more plant-based food if it was discounted more often.
	C3	I would buy more plant-based food if I knew its manufacturers had mature climate policies.
	C4	I would buy more plant-based food if I knew it was produced in compliance with organic production principles.
	C5	I would buy more plant-based food if I were sure it was vegan. (Some manufacturers promote products with casein, Omega 3 acids, EPA, and DHA of animal origin as plant-based, for example).

	C6	I would buy more plant-based food if the manufacturers no longer marketed animal-based products.
Intent to purchase plant-based foods	I1	I buy more and more plant-based food.
	I2	I often consider buying more plant-based food.
	I3	I would like to try new plant-based food.
	I4	I regularly buy plant-based food.

Source: original research.

2.3. Research sample

The survey covered 208 respondents. They were conveniently sampled: we specifically asked people who bought plant-based food to participate and only their responses were analysed. They were filtered with screening questions about food philosophy. The data were collected on social media and Internet forums for the target groups. The sample profile is shown in Figure 4.

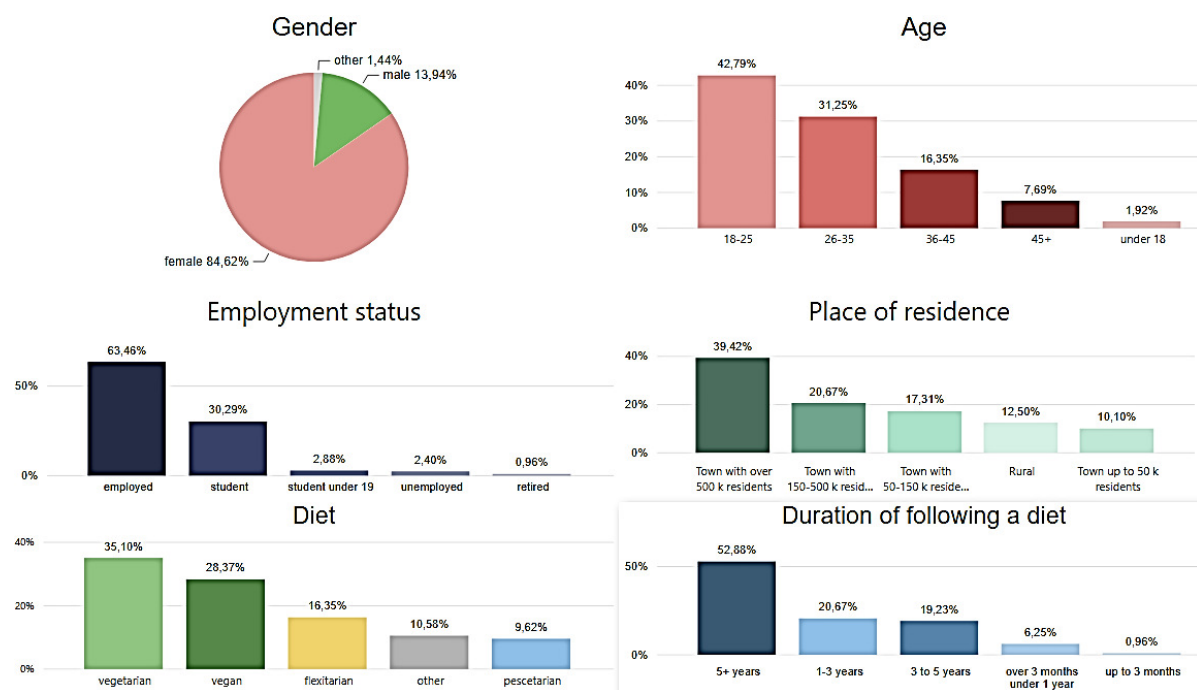


Figure 4. Profile of the sample.

Source: original research.

The sample is relatively young and dominated by women, mostly from cities and usually with a university degree. The largest group were vegetarian, and most respondents had followed the diet for over five years. Apparently, the profile of the sample indeed reflects the popular associations. The prevalent image of people who buy PBF brings to mind usually younger women from a city (Adamczyk et al., 2023). Our sample consists primarily of economically active people with easy access to PBF. As regards food philosophy, the most numerous group were vegetarians (who do not eat meat or any products manufactured through animal slaughter). The second-largest group were vegans (who do not eat any products that are entirely or partially of animal origin). The third group was flexitarians (who focus on plant-based food but occasionally include meat or other products of animal origin in their diet). The least numerous

group were pescatarians (who eat mainly PBF but also include seafood, fish, and products of animal origin in their menu). The question about food philosophy offered the option 'other'. Those who chose it were asked to provide details of their diet. The most common answer among 'other' food philosophies was the omnivore diet. These people buy PBF most often out of curiosity or for the taste. Some respondents were vegetarians on their path to becoming vegans or limiting or excluding dairy products but still eating eggs or honey. Another group were people following the halal diet. Apart from pork, the halal diet excludes meat of such animals as dogs, wild boars, pests (such as rats), birds of prey with talons, carnivores with talons and fangs (such as lions), and slaughter animals not killed as per Islamic law. PBF is a safe and interesting alternative for people on this diet, so their presence in the sample is worth noting. The least numerously represented food philosophies include macrobiotic, whole-food diets, and people who used to belong to some of the groups above.

3. Results

3.1. Validation of the measurement model

Constructs: functional value, social value, and conditional value yielded unsatisfactory validity and reliability results. Therefore, we removed some observable variables from the constructs, namely functional value, conditional value, and epistemic value. The social value construct failed to meet the validity and reliability criteria even after removing some of its observable variables, so we excluded it from the model entirely. What is more, the factor loadings for variables of this construct were typically rather low. This means the observable variables were improperly selected and unable to measure the social value construct. The validity and reliability of the functional value construct were significantly hindered by variables related to the adequacy of PBF pricing, the Nutri-Score rating, and product packaging. Low factor loadings for these observable variables were probably caused by a relatively broad array of available PBF products. In the case of conditional values, the disturbing variables were those related to manufacturers who decided to introduce animal-based products to the market and manufacturers who falsely advertised their products as vegan or organic production methods. Low loadings for these questions are linked to the significant differentiation of the respondents regarding their diets and the time they would need to verify whether the food meets their conditions. Furthermore, time was also probably a factor reducing the results of some variables for epistemic value connected with an active search for information about the manufacturer's activities or product quality. Table 4 shows the model following revisions due to the issues discussed above.

Table 4.*Indicator reliability, convergent reliability, internal consistency*

Construct	Indicator	Factor loading	AVE >0.5	CR >0.7	Cronbach's α >0.7
Purchase intent of PBF	I1	0.886	0.647	0.879	0.816
	I2	0.826			
	I3	0.723			
	I4	0.774			
Functional value	F1	0.710	0.561	0.836	0.746
	F2	0.722			
	F5	0.809			
	F7	0.749			
Emotional value	E1	0.894	0.764	0.951	0.938
	E2	0.893			
	E3	0.817			
	E4	0.887			
	E5	0.902			
	E6	0.850			
Epistemic value	EP1	0.651	0.633	0.870	0.813
	EP2	0.634			
	EP3	0.918			
	EP4	0.930			
Conditional value	C1	0.813	0.647	0.879	0.816
	C2	0.865			
	C3	0.730			

Source: original research.

We tested discriminant validity with two criteria: the Fornell-Larcker criterion (Table 5) and the HTMT criterion (Table 6).

Table 5.*Discriminant validity: the Fornell–Larcker criterion*

	F	E	EP	C	I
F	0.749				
E	0.675	0.874			
EP	0.272	0.325	0.796		
C	0.238	0.317	0.218	0.805	
I	0.449	0.535	0.468	0.358	0.804

Source: original research.

The model satisfies the Fornell-Larcker criterion because the mean variance extracted for each construct is greater than the squared correlation between the construct and the other constructs in the model.

Table 6.*Discriminant validity: the Heterotrait-Monotrait Criterion*

	F	E	EP	C
E	0.801			
EP	0.341	0.322		
C	0.292	0.359	0.257	
I	0.547	0.604	0.468	0.457

Source: original research.

HTMT is the ratio of average heterotrait-heteromethod correlations to the average monotrait-heteromethod correlations. The heterotrait-heteromethod correlations are correlations between different constructs, and monotrait-heteromethod correlations are correlations between indicators within the same construct. The HTMT value for all the investigated constructs was < 0.90 . Therefore, the discriminant validity can be considered acceptable.

3.2. Identification of consumption values driving purchase intent of PBF

Having validated the measurement scales (analysed the measurement model), we proceeded to analyse the structural model. We determined the significance of paths between the constructs using bootstrap with 1000 samples. This way, we tested the significance of each construct by calculating the t-statistic and confidence intervals. The results are shown in Figure 5 and Table 7. R^2 for the purchase intent of PBF was 0.417, so the model explains 41.7% of the purchase intent of PBF variance variability. Figure 5 also includes results for β path coefficients. They help assess the strength and direction of relationships between independent variables (predictors) and the dependent variable. The highest β coefficient was identified for the epistemic value and emotional value constructs, while the lowest was found for the functional value construct. The four investigated predictors were significant, although the result for functional value was controversial because its t-statistic did not exceed 1.96. Therefore, we have confirmed three hypotheses, H 3.3, H 3.4, and H 3.5, and consider H 3.1 questionable. Hypothesis H 3.2 was not verified because of the poor results of validity and reliability revealed during measurement model verification.

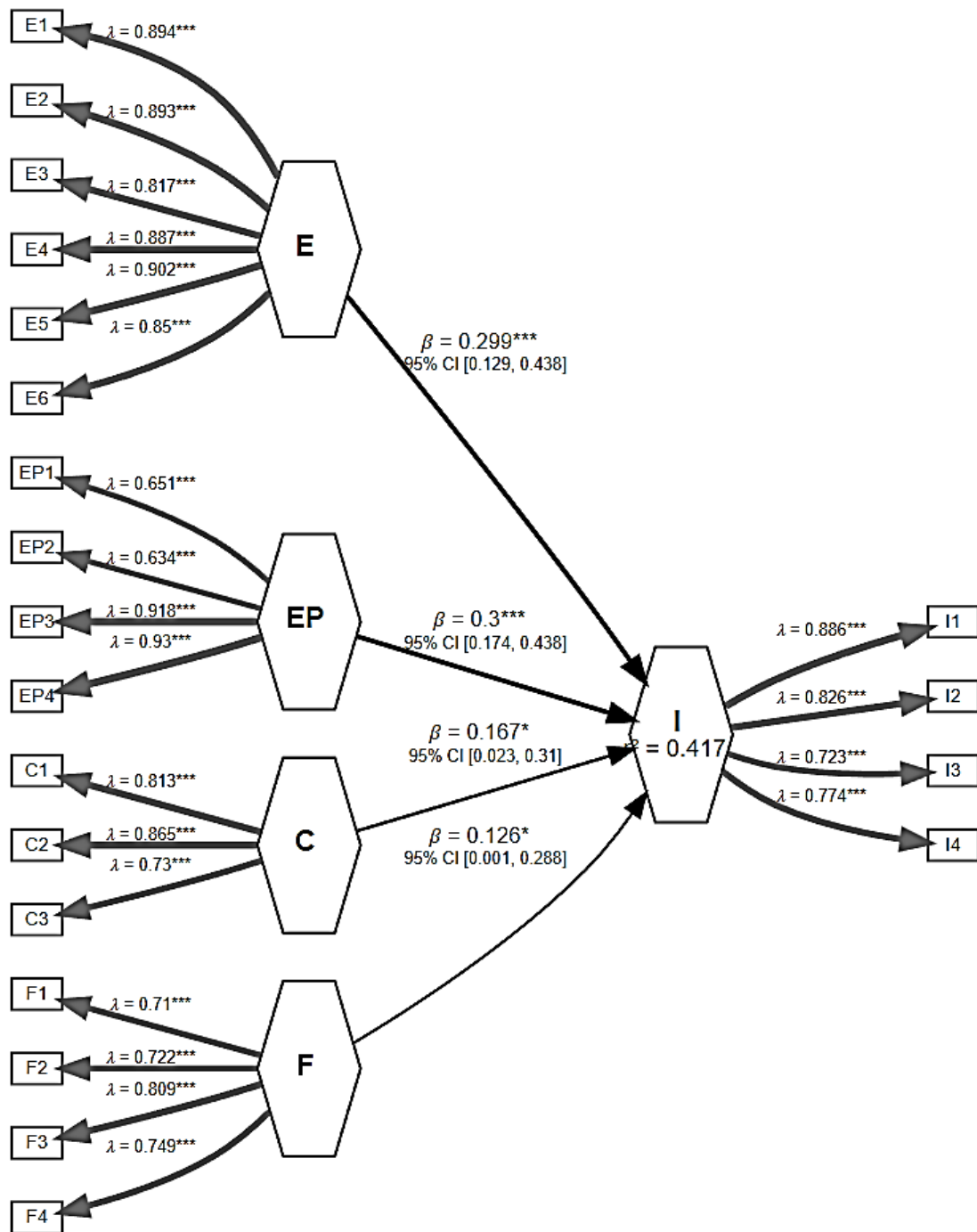


Figure 5. The influence of constructs on intent to use and actual behavior.

Source: original research.

Table 6.
Structural model assessment

	Original Est.	Bootstrap Mean	Bootstrap SD	t Stat	2.5% CI	97.5% CI	Supported
H 3.1: F→I	0.126	0.143	0.074	1.696	0.001	0.288	Yes/No
H 3.3: E→I	0.299	0.282	0.077	3.865	0.129	0.438	Yes
H 3.4: EP→I	0.300	0.304	0.067	4.456	0.174	0.438	Yes
H 3.5: C→I	0.167	0.170	0.074	2.264	0.023	0.310	Yes

Source: original research.

3.3. Analysis of the impact of categorical variables on the constructs

We investigated the impact of selected sociodemographic variables on the constructs with the Kruskal-Wallis test (Table 8). The test results show that hypothesis H 4.1 has been confirmed only partially. Food philosophy significantly affects the purchase intent of PBF. The test also partially confirmed hypothesis H 5.1. We have confirmed the impact of food philosophy regarding functional and emotional values. We have also confirmed that age influences emotional value. The other sociodemographic variables did not significantly impact the investigated constructs and purchase intent of PBF, or we refrained from investigating them because of group sizes that were too small.

Table 8.

Results of the Kruskal-Wallis test

Categorical variable	Construct	Chi ²	P-value
Food philosophy	I	26.088	< 0.001
	F	28.266	< 0.001
	E	20.252	< 0.001
Age	E	10.763	< 0.001

Source: original research.

We identified significantly different pairs in the Kruskal-Wallis test with post hoc Conover's test. It revealed that for the purchase intent of PBF, there are significant differences between pairs of the following groups: a) flexitarians and pescatarians, b) others and pescatarians, c) vegans and flexitarians, d) vegans and others, e) vegetarians and others, and f) vegetarians and flexitarians. The test results are shown in the Appendix (Table A1). Differences regarding the purchase intent of PBF between most of the pairs may stem from different degrees of investment into plant-based diets exhibited by the groups. Philosophies 'other' and 'flexitarian' are the most common ones, which may be due to their more relaxed attitudes towards restricting intake of products of animal origin. Conover's test for functional value (Appendix, Table A2) identified the following significantly different pairs: a) flexitarians and pescatarians, b) others and vegans, c) flexitarians and vegans, d) vegetarians and vegans, and e) vegetarians and flexitarians. Apparently, there are considerable differences between almost all pairs of food philosophies regarding functional value. This may be due to the diverse practical implementations of each group's philosophy. Conover's test for emotional value (Appendix, Table A3) identified significant differences between a) vegans and flexitarians, b) vegans and others, c) vegans and pescatarians, and d) vegans and vegetarians. Vegans are a remarkable group in this case, appearing in each pair. This is probably due to their profoundly emotional attitude towards their food philosophy. It is the most restrictive group, so their choices need to be firmly grounded in a value to allow them to stand by their beliefs. Clearly, it was emotional value for them. We presented the distribution of answers for the values vs food philosophy on a box plot (Figure 6). It clearly demonstrates that the 'other' philosophy group gave particularly diversified answers to the statements. Another interesting conclusion is that vegans, the most radical group, were also the most unanimous concerning nearly all values.

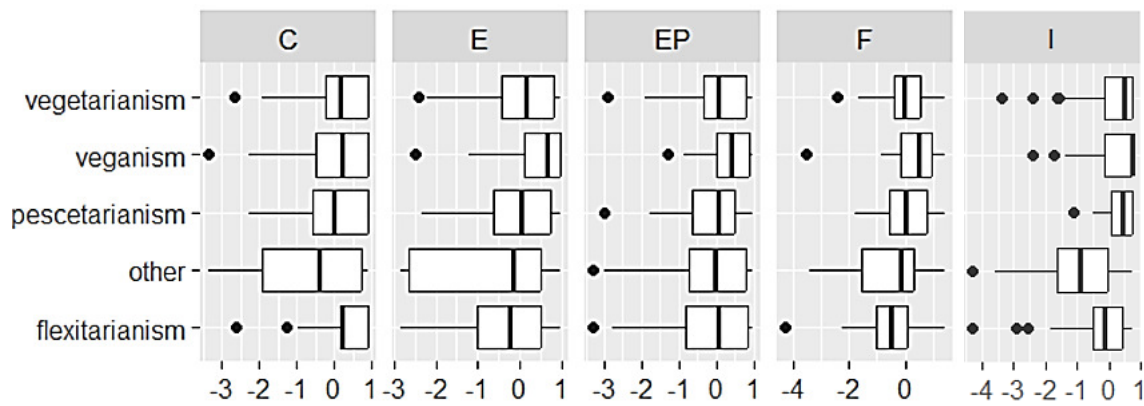


Figure 6. Impact of food philosophy on consumption values and purchase intent.

Source: original research.

In addition to the sociodemographic variable of food philosophy, Conover's tests also revealed significant differences in emotional value between age groups (Appendix, Table A4). These pairs include a) people aged 36 to 45 (Generation Y) and people aged 18 to 25 (Generation Z), b) people aged 36 to 45 and people aged over 45 (combined Generation X and Baby Boomers). This means that the emotional attitude of Generation Y is significantly different. The association is visualised in Figure 7.

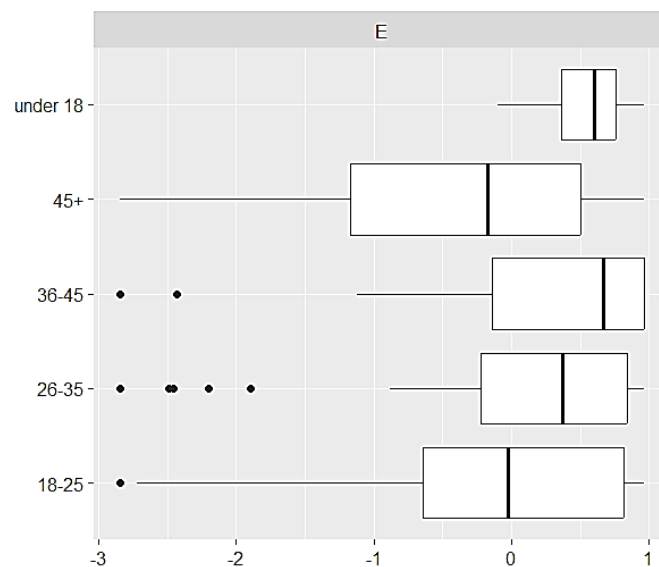


Figure 7. Impact of age on emotional value.

Source: original research.

4. Discussion

The results support conclusions regarding drivers of purchase intent of PBF in Poland. Four out of five scales measuring consumption values for PBF are valid and reliable. Social value was the only one for which we could not find appropriate statements for the

questionnaire to use as observable variables measuring this value. The observable variables with acceptable validity and reliability metrics for functional values were connected with the high quality of such products, better impact on the cardiovascular system, and environmental functionality of PBF, i.e. lower consumption of water and greater environment-friendliness. In contrast, emotional value was measured validly and reliably by all the observable variables we proposed. They concerned feelings related to saving Earth's environment, particularly animals, and a belief that one is doing what is morally right. Epistemic value was measured with variables concerning the willingness to check product ingredients, compare it with others, and search for information about PBF. Our results are consistent with (Schiano et al., 2020) regarding the three consumption values. Conditional value was measured mainly with pricing conditions and trust in the actual climate policy of the manufacturer.

Our research into the influence of individual consumption values on the purchase intent of PBF demonstrated that the greatest impact is exerted by epistemic value and emotional value. It means that Polish consumers exhibit significant curiosity and emotional attitudes towards PBF. We believe it to be caused by reports on animal welfare and climate crisis in the media. In this regard, our results are consistent with outcomes in (Schiano et al., 2020) but differ from those in (Adamczyk et al., 2022). Another important group of drivers of PBF purchase was conditional value. Our results confirm Polish consumers' sensitivity to the price of PBF. Functional value was the least relevant to the purchase intent of PBF. This is a surprising result because functional value usually affects purchase intent the most. It is probably because traditional food, especially dairy products, is considered healthy in Poland (cf. Adamczyk et al., 2022). It may be a significant barrier to PBF. Possibly, PBF will become more popular as the Polish population ages. We believe functional value of the products will grow more important.

Our investigation into the impact of sociodemographic variables on individual consumption values and purchase intent of PBF revealed that the most influential variable is food philosophy. The group the least willing to buy PBF were those defining themselves as 'other': the least attached to plant-based diets. The most significant differences in terms of functional value were found for vegans and then vegetarians. This means that these groups are the most discerning regarding functional value. Vegans were also the most outstanding in terms of emotional value, meaning they are the most sensitive to emotional values. Emotional value depended on age, and the most emotionally sensitive age group were Generation Y.

5. Conclusions

Practical implications

Our study of the impact of consumption values of plant-based food on the purchase intent of the food is dedicated to businesses manufacturing and selling plant-based products. By presenting the impact of individual consumption values on purchase intent, we offer empirical proof of how to shape marketing campaigns for such products in countries like Poland. Considering the current awareness of these societies, we recommend focusing on epistemic and emotional values and stimulating the market with conditional value focused on pricing. Communication targeting vegans and vegetarians should prioritise emotional and functional value.

Research limitations

The sample was relatively small with 208 respondents. As a result, the group is only slightly varied in terms of age and demographics. The present results could be corroborated by a repeated survey on a larger and more diversified sample. Another apparent limitation is the 'other' food philosophy option, which encompassed too extensive a spectrum of category variants, hindering conclusions. Future research should include more choices of food philosophies in the questionnaire.

Further research

Future analyses could investigate moderation, which is the impact of individual moderating variables, sociodemographic variables in this case, on the strength and direction of associations between two other variables, such as functional value and purchase intent. We could also build separate models for individual food philosophies and compare them. Another expansion of the study would be to invite respondents from various countries to investigate cultural differences.

Appendix

Table A1.

Results of Conover's test for purchase intent of plant-based food depending on food philosophy

Food philosophy	flexitarianism	other	pescatarianism	veganism
other	1.734 0.042			
pescatarianism	-2.186 0.015	-3.53 <0.001		
veganism	-3.087 0.001	-4.560 <0.001	-0.188 0.426	
vegetarianism	-2.714 0.004	-4.267 <0.001	0.208 0.418	0.578 0.282

Source: original research.

Table A2.

Results of Conover's test for functional value of plant-based food depending on food philosophy

Food philosophy	flexitarianism	other	pescatarianism	veganism
other	-0.435 0.332			
pescatarianism	-2.195 0.015*	-1.617 0.054		
veganism	-5.111 <0.001	-3.929 <0.001	-1.862 0.032	
vegetarianism	-2.821 0.003	-1.919 0.028	0.130 0.448	2.940 0.002

Source: original research.

Table A3.

Results of Conover's test for emotional value of plant-based food depending on food philosophy

Food philosophy	flexitarianism	other	pescatarianism	veganism
other	0.273 0.393			
pescatarianism	-0.988 0.016	-1.143 0.127		
veganism	-3.892 <0.001	-3.654 <0.001	-2.163 0.016	
vegetarianism	-1.943 0.003	-1.966 0.025	-0.495 0.311	2.483 0.007

Source: original research.

Table A4.

Results of Conover's test for emotional value of plant-based food depending on age

Age	18-25	26-35	36-45	45+
26-35	-1.564 0.060			
36-45	-2.570 0.005	-1.242 0.108		
45+	0.992 0.161	1.880 0.031	-2.598 0.005	
<18	-1.269 0.103	-0.764 0.022	-0.247 0.403	-1.643 0.051

Source: original research.

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TOWARDS SUSTAINABLE LOGISTICS: THE CASE OF SMALL AND MEDIUM-SIZED ENTERPRISES

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Purpose: The purpose of the article is to identify changes that have occurred in the conditions for the development of sustainable logistics in small and medium-sized enterprises during the post-pandemic period.

Design/methodology/approach: Empirical research was conducted in the fourth quarter of 2020 and the first quarter of 2024 among a group of 50 small and medium-sized enterprises operating in Poland. An electronic survey was used to carry out the research.

Findings: According to the research results, the post-pandemic period is characterized by significant changes in the conditions for the development of sustainable logistics in small and medium-sized enterprises. Increasing pressure from stakeholders and tangible benefits from already implemented solutions have made the implementation of sustainable solutions in the logistics of small and medium-sized enterprises increasingly common.

Research limitations/implications: The research is national in scope; in the future, it would be advisable to conduct research at an international level.

Practical implications: The research facilitated an understanding of the mechanisms behind the development of sustainable logistics in small and medium-sized enterprises and the creation of a catalog of best practices for implementing sustainable practices in business logistics.

Originality/value: The article enabled the identification of current conditions for the development of sustainable logistics in the operations of small and medium-sized enterprises.

Keywords: sustainable logistics; sustainable development; CO₂ reduction; small and medium-sized enterprise.

Category of the paper: Research paper.

1. Introduction

Civilizational development is a universally accepted and desired process. It drives humanity to use increasingly advanced technologies, such as those related to mobility. However, alongside its undeniable benefits, this development results in a growing demand for natural

resources and an escalating negative impact on the environmental and social surroundings. Environmental pollution not only affects the ecosystem but also significantly deteriorates human health. The pressure to reduce the negative impact on the natural environment and to consider social aspects extends to logistics processes as well. As a result, in the realms of economic, ecological, and social objectives, managers and/or business owners of both small and large enterprises must seek new, more sustainable solutions that allow them to adapt to current operating conditions (Carter, Easton, 2011). Nevertheless, it is unimaginable for modern enterprises to operate without substantial support from logistics. In other words, regardless of the size, scale, and scope of a business, logistics processes are an integral part of every operation. Therefore, the goal is not to reduce the scale of logistics processes but rather to transform the methods used in this area.

A review of the literature has shown that the scope of sustainable solutions implemented in enterprises depends on their size (Gonzalez-Benito, Gonzalez-Benito, 2006; Zhu et al., 2008; Chun et al., 2015). For the largest enterprises, the transformation process toward sustainable practices in logistics appears to be easier, primarily due to the resources they possess. In contrast, for smaller enterprises, sustainable transformation may prove significantly more challenging, undoubtedly as a result of the specific characteristics of these businesses (Denisa, Zdenka, 2015).

This article is a continuation of research initiated in 2020 on the development of sustainable logistics in small and medium-sized enterprises. Since 2020 was a particularly difficult year for business operations due to the ongoing COVID-19 pandemic, the research was repeated in 2024. This approach enabled the identification of changes that occurred in the conditions for the development of sustainable logistics in small and medium-sized enterprises during the post-pandemic period, which constitutes the objective of this article.

2. Literature review

2.1. The essence of sustainable development in logistics

The role of business entities is no longer solely focused on maximizing profits but also on assessing how their activities impact the local community, the local labor market, and the natural environment in the long term (Bajdor et al., 2021). These activities are mainly related to the concept of sustainable development, which involves meeting the needs of the present generation while ensuring that future generations have the ability to meet their own needs. This idea was presented in 1987 in the Report of the World Commission on Environment and Development, titled “Our Common Future,” which emphasizes intergenerational solidarity

and aims to actively include all social groups in developmental processes while taking care of the natural environment (Lis et al., 2023).

The concept of sustainable development integrates three main, interconnected, and complementary areas: economic, environmental, and social. The economic area addresses challenges such as: the instability of the national economy, insufficient fulfillment of basic societal needs, inflation, high levels of economic power concentration, external imbalances, such as dependence on raw materials, state debt, inadequate provision of public goods, and unfair income distribution. The ecological dimension primarily involves issues such as: climate change, the destruction of ecosystems, biodiversity and landscape diversity, depletion of non-renewable resources, and threats to human health (e.g., harmful substances, radiation, noise). The social pillar concerns matters such as: democracy and the rule of law, poverty, lack of social security, demographic issues, inequalities in various areas, lack of internal and external security, and burdens on health and quality of life (Rogall, 2010). To achieve sustainable development, policies in these three areas must cooperate and support each other. Enterprises should consider all three aspects to increase economic value while simultaneously reducing their environmental impact and improving people's quality of life (Chiesa et al., 1999). Sustainable development thus entails a long-term approach, focusing on finances, people, communities, and the environment (Peto, 2012).

A review of the literature indicates that the idea of sustainable development is now embedded in the key factors influencing modern logistics (Centobelli et al., 2017; Karaman et al., 2020; Seroka-Stolka et al., 2019; Evangelista et al., 2018; Richnák, Gubová, 2021; Rakhmangulov et al., 2018; Kumar, 2015; Jum'a et al., 2021; Baah et al., 2020). As a result, the concept of sustainable logistics has emerged in the literature, understood as a management concept that integrates sustainable development with the logistics system. A sustainable logistics system focuses on logistics operations (such as supplier selection, procurement, warehousing, and distribution) to reduce company costs, minimize its environmental impact, and address the impact it has on society. In other words, sustainable logistics offers companies economic, environmental, and social benefits, such as improved asset utilization, enhanced customer service, increased energy efficiency, reduced impact on the community, and improved quality of life (Wichaisri, Sopadang 2014).

In Europe, particularly in the European Union, the potential of logistics to reduce the negative impact on the natural environment and society has been recognized for many years, with measures such as the introduction of regulations on emission standards. According to the European Environment Agency, about a quarter of total CO₂ emissions in the EU in 2019 came from the transport sector, of which 71.7% was from road transport (European Parliament, 2019). A significant milestone was reached in 2024. From this point, the first period of mandatory data collection for non-financial reporting on the ESG indicators achieved by companies began. These indicators include environmental protection, social policy, and corporate governance (*Environmental, Social, and Governance*). An important element in

the field of sustainable development and reporting is the CSRD (Corporate Sustainability Reporting Directive), which was adopted by the European Parliament on November 10, 2022. It introduced changes to the European corporate reporting system by establishing mandatory Sustainability Reporting Standards (*European Sustainability Reporting Standards*). Companies will be required to determine both the impact of their activities on the environment and their own exposure to risks related to climate change. In this context, the logistics area will be particularly monitored by managers concerning the impact their companies have on the environment (mainly in terms of transport and warehousing). The new regulations included in the CSRD Directive oblige selected, initially the largest enterprises, to monitor, document, and report structured data from the areas of Environmental, Social, and Governance, including issues related to climate change, pollution, the circular economy, as well as biodiversity and human rights (Ciesielska, 2022; Kamiński, 2024). The first sets of data for the 2024 financial year will be published in the first half of 2025, and in subsequent years, they will apply to increasingly smaller companies, including small and medium-sized enterprises listed on the EU regulated market (Kamiński, 2023). Companies will report their own ESG indicators and require data from their subcontractors.

2.2. Corporate Actions in Sustainable Logistics

The need for companies to take action in the field of sustainable development has been discussed for a long time. However, until now, these actions have primarily focused on environmental protection, including reducing greenhouse gas emissions, decreasing energy consumption, and using recycled materials. Currently, both the UN and the European Commission emphasize the importance of treating sustainable development much more broadly, considering not only environmental issues but also social and labor-related matters (Kasiarz, 2021).

In light of the growing environmental and social awareness within logistics, managers are increasingly focusing on innovative and ecological solutions, placing sustainable development at the heart of their business strategies. Solutions such as fleet electrification, supply chain optimization, and sustainable packaging, although promising, require significant investments and the reorganization of processes.

Large and medium-sized companies are paying more attention to whether their storage spaces meet the standards typical of eco-friendly warehouses. An increasing number of warehouses are equipped with solar panels on their roofs, which helps reduce the consumption of traditional electricity and allows them to achieve energy-efficient building status. LED lighting has become the standard, as it is more efficient and energy-saving compared to conventional light bulbs, contributing to reduced energy consumption. Green warehouses effectively manage all types of waste, which are either fully or largely recycled, generate less waste, and most of it can be reused. They are also increasingly using electric vehicles

(e.g., forklifts) and autonomous warehouse robots to carry out more complex warehouse operations.

An example of a company implementing sustainable logistics practices is FM Logistic. FM Logistic consistently implements one of the main pillars of its long-term strategy, which is the development of sustainable multi-channel supply chains. The company's efforts in this area are known as “Supply Change” and aim to reduce environmental impact, including minimizing the carbon footprint. FM Logistic's new facilities are designed according to the highest industry standards and are certified under the LEED for Sustainable Construction system for Warehouses and Distribution Centers. The company's goal is to develop a fully environmentally neutral warehouse model by 2030. They are implementing modern solutions that allow for space optimization, increased energy efficiency of buildings, and reduced consumption of potable water. Since January 2021, all FM Logistic-owned facilities in Central Europe are fully powered by electricity from renewable sources—specifically, photovoltaic panels. The company has initiated a project in which energy produced by photovoltaic panels is used for the production of green hydrogen. Eventually, the hydrogen produced will power forklifts in warehouses and trucks.

Another significant area of development in sustainable logistics is the electrification of the transport fleet, offering substantial ecological and economic benefits. This process involves replacing internal combustion engine vehicles with their electric counterparts, leading to a significant reduction in harmful emissions such as carbon dioxide, nitrogen oxides, and particulate matter. Electric vehicles, due to fewer moving parts, also offer lower operational and maintenance costs, making them an attractive alternative for logistics and transport companies. Aspects of fleet electrification include: initial investments and operating costs, charging infrastructure, vehicle autonomy and route planning, staff training, and the impact on the company's image. The development of charging infrastructure is a critical requirement for the effective electrification of transport fleets. For logistics and transport companies, building and accessing the appropriate charging infrastructure is essential to ensure operational continuity, delivery efficiency, and adherence to schedules. Key aspects of expanding charging infrastructure that businesses must consider include: strategic location planning, investments in fast charging, collaboration with energy suppliers, intelligent charging management, and regulations and standards. Examples of companies implementing such actions are presented in Table 1.

Table 1.*Selected practices of companies in the field of sustainable logistics*

Enterprise	Measure
LPR - La Palette Rouge sp. z o.o.	Pallet rental: Pallets are reused and exchanged multiple times a year. Returned pallets are checked, sorted, and repaired before reuse. Pallets beyond repair are recycled. Wood used for pallet production and repair comes from responsibly managed forests. Damaged pallets are repurposed into heating pellets or animal bedding.
Solidaris Sp. z o.o.	Purchase of two fully electric Volvo trucks.
DHL Parcel Polska Sp. z o.o.	Purchase of electric MAN eTGE delivery vans for their courier fleet. Implementing the GoGreen policy.
DPD Polska Sp. z o.o.	Purchase of 50 electric buses and plug-in hybrid vehicles. Installation of charging stations. Air quality monitoring with sensors installed on vehicles and in branches. Use of biodegradable packaging materials. Installation of photovoltaic farms. Installation of air quality monitoring sensors in Warsaw.
InPost Sp. z o.o.	Purchase of 500 electric vehicles.
Hipra Polska Sp. z o.o.	Purchase of 9 fully electric vehicles. Installation of 10 electric vehicle charging stations. Installation of 2,798 solar panels on the roofs of five warehouses.
Carrefour Polska Sp. z o.o.	Installation of photovoltaic systems on the roofs of 13 Carrefour stores in Poland.
Knauf Industries Polska Sp. z o.o.	Komebac returnable packaging – plastics processing. Designing products for recycling and reuse.
TARGOR-TRUCK Sp. z o.o.	LNG/BioLNG-powered fleet. Certified by LNG/BioLNG fuel suppliers confirming a 100% CO2 emission reduction in the fleet. Ready for implementation of the e-CMR electronic consignment note.
Rohlig Suus Logistics S.A.	Internship program for students and people over 50. A modern multi-customer warehouse (with an A+ class rating and currently undergoing BREEAM certification at the highest possible level – Outstanding). It also features a photovoltaic system and LED lighting with an intelligent control system (DALI). Electric vehicle chargers have been installed in front of the warehouse, and flower meadows have been planted. The office has been designed with the "Office of the Future" organizational culture in mind to ensure the highest comfort for employees in carrying out their daily tasks. The branch also has a special rest area for drivers, and a picnic and recreational area (with football and basketball fields) is located near the building.
ID Logistics Polska S.A.	Emission-free deliveries for PepsiCo Polska using electric delivery vehicles. Building a low-emission transport fleet in Poland. Specialized training by Renault Trucks on electric vehicle operation and optimal driving.

Source: own study based on: LPR - La Palette Rouge sp. z o.o. Retrieved from: <https://www.lpr.eu/pl/30.10.2024>, Solidaris Spółka z o.o. Retrieved from <https://solidaris.pl/?lang=pl> 30.10.2024, DHL Parcel Polska Sp. z o.o. Retrieved from: <https://www.dhl.com/pl-pl/microsites/supply-chain/fulfillment-network/why-dhl/sustainability.html>, DPD Polska Sp. z o.o. Retrieved from: <https://www.dpd.com/pl/pl/zrownowazony-rozwoj/> 30.10.2024, InPost Sp. z o.o. Retrieved from: <https://inpost.pl/strategia-esg> 30.10.2024, Hipra Polska Sp. Z o.o. Retrieved from: <https://www.hipra.com/pl/polityka-srodowiskowa> 30.10.2024, Carrefour Polska Sp. z o.o. Retrieved from: <https://serwiskorporacyjny.carrefour.pl/zrownowazony-rozwoj> 30.10.2024, Knauf Industries Polska sp. z o.o. Retrieved from: <https://knaufappliances.com/pl/zrownowazony-rozwoj/> 30.10.2024, TARGOR-TRUCK Sp. z o.o. Retrieved from: https://www.logistyka.net.pl/aktualnosci/transport-i-spedycja/item/95522-targor-truck-stawia-na-pojazdy-napedzane-lng?utm_source=newsletter_890&utm_medium=email&utm_campaign=newsletter-portalu-logistyka-net-pl-wydanie-635&aid=22263 30.10.2024, Rohlig Suus Logistics S.A. Retrieved from: https://www.logistyka.net.pl/aktualnosci/item/95018-suus-organizuje-program-stazowy-kierowany-do-studentow-i-do-osob-50?utm_source=newsletter_861&utm_medium=email&utm_campaign=newsletter-portalu-logistyka-

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Implementing economic and environmental actions, as well as supporting the development of natural, social, and human capital in the logistics sector, is beneficial for companies and positively impacts their long-term growth. Emphasizing so-called “longtermism” is expected to have a positive effect on companies' financial performance as well, enabling management to increase investments of financial surpluses in innovations and projects, including in the area of sustainable logistics.

3. Methodology

The empirical research that formed the basis for preparing this article was conducted in the fourth quarter of 2020 and the first quarter of 2024, involving a group of 50 small and medium-sized enterprises operating in Poland. The first study was carried out during the Covid-19 pandemic. This was a very difficult period for business operations and may have influenced the perceptions of certain phenomena among the representatives of small and medium-sized enterprises participating in the study. Taking this into account, the study was repeated in the post-pandemic period. This approach enabled a comparative analysis of the results obtained.

In both studies, the sample selection was quota-based. The predominant type of business activity according to the Polish Classification of Activities (PKD) was considered. The research was conducted using an electronic survey questionnaire, supported by telephone assistance. The same contact database was used in both studies. In both 2020 and 2024, the respondents were primarily business owners and senior and middle management representatives. The structure of the research sample is presented in Table 2.

Table 2.*Quantitative structure of the surveyed sample (2020 and 2024)*

PKD sections		2020		2024	
		Small 10-49	Medium 50-249	Small 10-50	Medium 50-250
B	Production	10	5	10	5
C					
D					
E					
F	Construction	5	1	5	1
G	Trade	10	2	10	2
H	Transport and Warehousing Management	3	1	3	1
I	Other services	10	3	10	3
J					
L					
M					
N					
P					
Q					
R					
S					
TOTAL		38	12	38	12

Source: author's own study based on Central Statistical Office data.

In recognizing the conditions for the development of sustainable logistics in the studied small and medium-sized enterprises, the influence of various stakeholder groups (both internal and external) was taken into account, driven by the already achieved or yet-to-be-established effects (economic, social, and environmental) of sustainable solutions. On the other hand, as limiting variables for the mentioned development, different types of barriers (internal and external) were identified.

4. Results and discussion

The actions of enterprises carried out within the framework of sustainable logistics can be driven by the influence of various stakeholder groups. In the conducted research, the following were taken into account: the government and other legislative institutions (e.g., the EU), non-governmental organizations and lobbyists, society, suppliers, competitors, the supply chain leader, customers, logistics service providers, owners, managers of the enterprises, and employees of the surveyed companies. The impact of individual stakeholder groups on the development of sustainable logistics in the studied small and medium-sized enterprises was assessed by respondents using a 5-point Likert scale – the results obtained are presented in Table 3.

Table 3.

Stakeholders' influence on the development of sustainable logistics in the surveyed small and medium-sized enterprises (2020 and 2024)

Stakeholder/year of study	2020	2024
Legislative institutions	3.1	4.4
Non-governmental organizations and lobbyists	2.3	3.4
Society	2.9	3.7
Suppliers	3.1	4.3
Competitors	3.2	4.1
Supply chain leader	2.9	4.3
Customers	3.9	4.1
Logistics service providers	3.2	4.2
Owners	3.0	4.3
Managers	3.2	4.1
Employees	3.2	3.7

Source: own research; the table presents the average magnitudes of the responses obtained.

In 2020, according to the respondents' declarations, the highest influence on the implementation of sustainable logistics in the surveyed enterprises came from the customers of these enterprises ($\bar{x} = 3.9$). The second highest influence was attributed to competitors and logistics service providers, as well as to managers and employees of the surveyed enterprises ($\bar{x} = 3.2$). In 2024 (compared to 2020), there were significant changes regarding the impact of the stakeholders. Firstly, the influence of all stakeholder groups on the implementation of sustainable solutions in the surveyed small and medium-sized enterprises increased. Secondly, the variation in the influence of all stakeholder groups decreased. In 2024, the highest influence on the implementation of sustainable logistics in the surveyed enterprises came from: legal regulations ($\bar{x} = 4.4$), supply chain leaders, suppliers, and company owners ($\bar{x} = 4.3$), and logistics service providers ($\bar{x} = 4.2$). Considering the differences in the strength of influence from individual stakeholder groups in 2020 and 2024, the greatest increase was observed in the influence of supply chain leader and non-governmental organizations (48%), owners (43%), and legislative institutions (42%) – Figure 1.

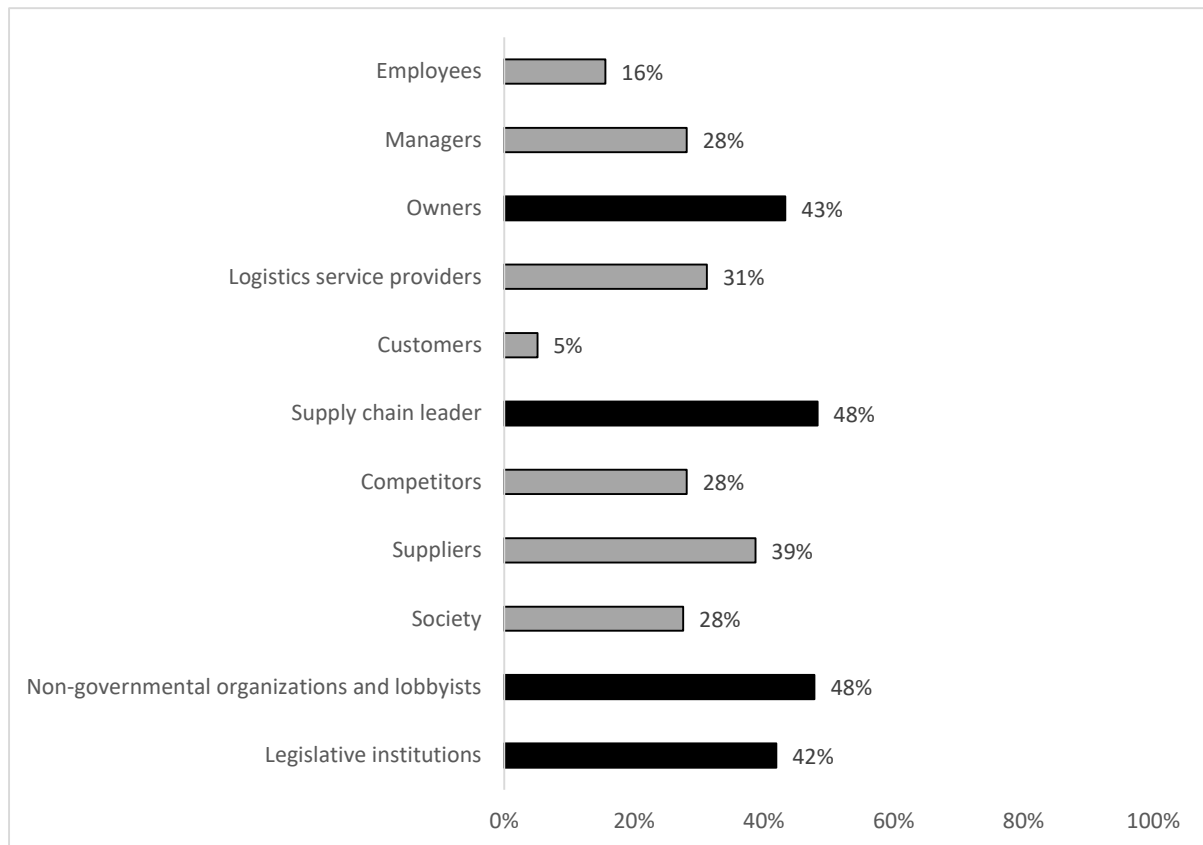


Figure 1. Changes in the Influence of Stakeholders on the Development of Sustainable Logistics in the Surveyed Small and Medium-Sized Enterprises – Relative Increases.

Source: Own research; the chart presents the relative differences between the average declared influence of stakeholders in 2024 and 2020.

The variation in the results obtained in 2020 and 2024 reflects the dynamic changes in the operational conditions of the surveyed small and medium-sized enterprises. In 2020, due to the ongoing COVID-19 pandemic, the focus of most stakeholders was on adapting to the new operational conditions and, above all (especially for the smallest enterprises), on the desire to survive this difficult period. Actions undertaken in the area of sustainable logistics at that time were severely limited and, in most cases, served as a response to specific customer requirements or the need to adapt to standards set by competitors. The influence of logistics service providers on the development of sustainable logistics in the surveyed enterprises was (and still is) a result of the extensive cooperation between the SME sector and representatives of the TSL market (Transport, Freight, Logistics). The nature of smaller enterprises prevents them from achieving economies of scale in their logistics operations (Kisperska-Moroń et al., 2010), which arise from the size of the enterprise, its potential, infrastructure, and the scale of operations. In such conditions, smaller enterprises acquire logistics competencies from the market through so-called logistics outsourcing, and thus, the sustainable practices of logistics service providers are adapted within the group of surveyed enterprises. For managers and employees, the implementation of sustainable solutions was most likely driven by the desire to achieve

specific social outcomes, including the need to ensure proper working conditions during the pandemic, especially in the area of logistics processes.

The year 2024 marked a time when enterprises experienced completely different operational conditions compared to 2020. In the post-pandemic period, the need to reduce the negative impact of logistics on the natural environment is becoming increasingly significant. The European Commission's Green Deal policy has outlined the framework for the energy transformation of enterprises operating within the European Union (European Commission, 2021). The plan to achieve climate neutrality in Europe by 2050 also includes changes in logistics operations. Moreover, the accelerated need to reduce dependence on raw materials from the Russian Federation, as a result of the war in Ukraine, is causing a rise in the prices of conventional energy resources and leading to increased costs of material flows. As a result, in the areas of economic, social, and environmental goals, managers and/or business owners must seek new solutions that enable adaptation to these new operational conditions. Secondly, the Directive of the European Parliament and the Council (EU) 2022/2464 of December 14, 2022 (CSRD) – the Corporate Sustainability Reporting Directive – introduced, starting January 1, 2024, the obligation to report on sustainability in accordance with the European Sustainability Reporting Standards. This means that all large companies and small and medium-sized publicly listed companies will be required to include in their annual reports information on environmental, social, and human rights issues, as well as corporate governance. As a result of this new reporting requirement, interested user groups will have broader access to comparable, reliable, and high-quality data on sustainability. This will provide them with an additional tool to exert greater influence on businesses operating within their local communities. For the reporting entities themselves, this is an opportunity to demonstrate – through the ability to present their sustainability actions – that they are socially responsible. This will also make it easier for them to access capital for further development.

The changes introduced based on the aforementioned regulations were reflected in the results of the research conducted in 2024. The most significant increase in the influence of supply chain leader is undoubtedly a result of the implementation of the CSRD Directive provisions. This indicates that the largest companies, often acting as leaders in the supply chain (e.g., major manufacturers or distributors), will exert even greater pressure on their partners to adopt sustainable solutions. From the perspective of the surveyed small and medium-sized enterprises (SMEs), which in most cases belong to the group of partners for larger firms, the increased interest in implementing sustainable solutions among their owners will primarily be driven by the need to comply with the requirements of the supply chain leader or larger suppliers. Consequently, actions undertaken in the area of sustainable logistics will focus primarily on transportation and warehousing operations. Through the organizational and/or technological changes introduced, these actions will enable the achievement of not only economic objectives but also environmental and social goals (Table 4).

Table 4.

Declared effects of the development of sustainable logistics in the surveyed small and medium-sized enterprises (2020 and 2024)

Effects of sustainable logistics/year of study	2020	2024
reducing the costs of logistics processes	2.8	3.2
improving the company's competitive position	3.3	3.9
improving the company's image	3.1	3.6
increase in the efficiency of logistics processes	3.1	3.8
reducing the amount of waste generated (e.g. packaging waste)	2.7	3.4
reduction of CO ₂ emissions	2.4	3.5
reducing emissions of other harmful substances	2.5	2.6
reduction of noise	2.6	3.4
increase in energy efficiency	2.7	3.1
reducing the degree of use of natural resources	2.8	3.7
reducing the number of accidents at work	3.6	4.3
creating a good working climate	3.3	4.4
providing employees with a wide social package	2.6	4.3
ensuring safe working conditions for employees	3.6	4.1
providing employees with opportunities for development and promotion	3.0	4.4
providing employees with fair wages	3.3	4.3
reducing the degree of use of natural resources	2.8	3.7

Source: own research, the table presents the average magnitudes of the responses obtained.

The analysis of results regarding the declared effects achieved through the implementation of sustainable logistics by the surveyed small and medium-sized enterprises (SMEs) in 2020 and 2024 reveals that the post-pandemic period brought a significant increase in economic, environmental, and social effects. The most notable growth was observed in social effects, particularly in providing employees with extensive social benefits (an increase of 65%) and opportunities for development and promotion (an increase of 47%). For environmental effects, there was a substantial reduction in CO₂ emissions (an increase of 46%), which is closely linked to the strong pressure from stakeholders on decarbonizing logistics (Piecyk, McKinnon, 2010; Tacke et al., 2014; Böttcher, Müller, 2015; Furlan Matos Alves et al., 2017; McKinnon, 2018) (Figure 3).

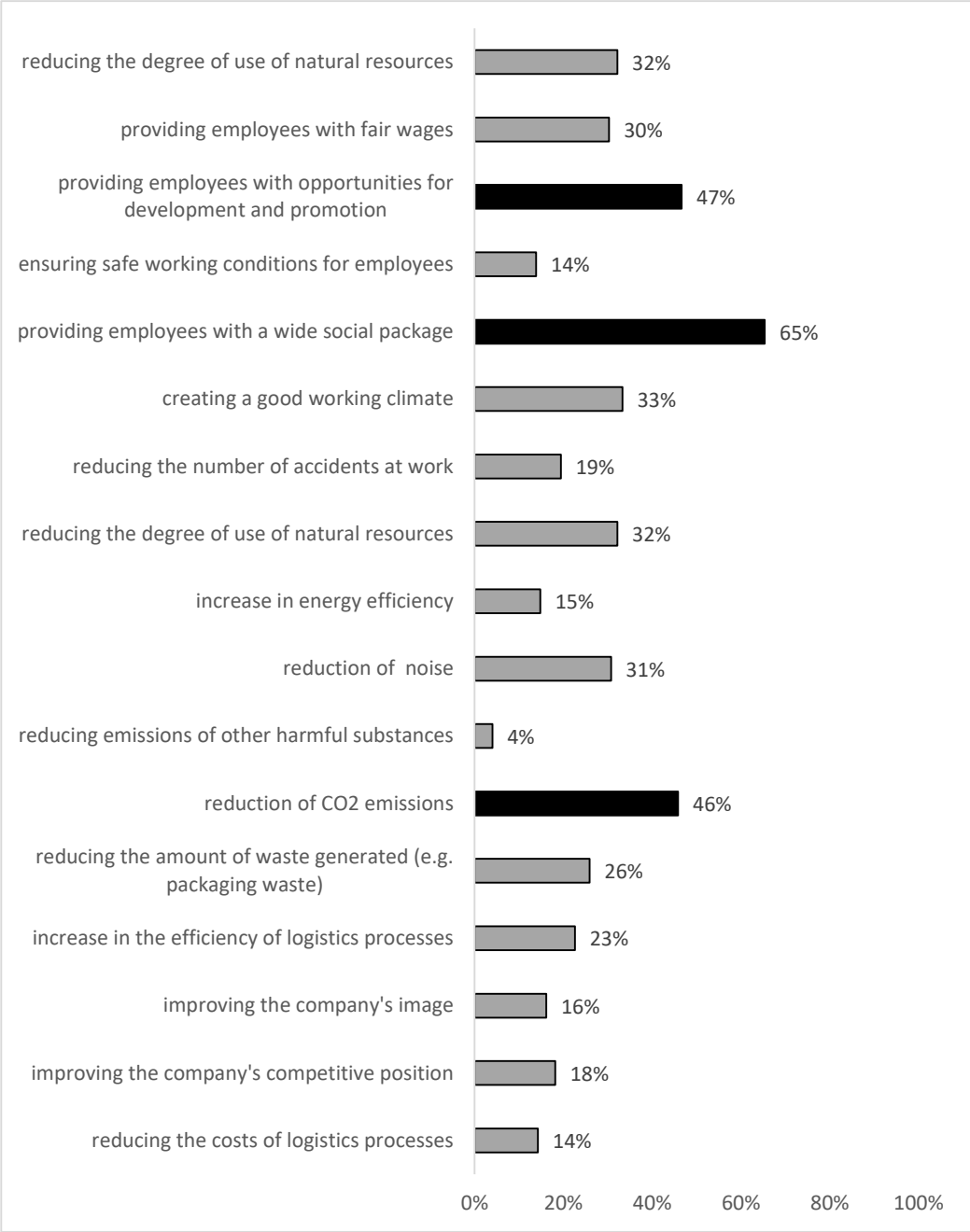


Figure 3. Changes in the declared effects of sustainable logistics development in the surveyed SMEs – relative increases.

Source: Own research; the chart presents relative differences between average declared effects achieved in 2024 and 2020.

A more detailed analysis of the study results indicates that while the levels of economic and social effects were similar in 2020, by 2024, social effects had surpassed economic effects. According to the authors, the lower levels of economic effects can be attributed to the discrepancy between the expectations of business owners and managers regarding economic objectives and the actual possibilities of achieving them. Additionally, the high results in the area of social effects achieved in 2024 stem from the necessity to retain valuable human resources with the requisite competencies. In this context, it is also worth mentioning the

challenges in attracting new employees, such as their migration away from the Polish labor market due to the war in Ukraine or the steadily increasing average age of workers in the broadly understood logistics sector. As for the relatively lower level of environmental effects (both in 2020 and 2024) compared to economic and social effects, this is undoubtedly linked to the less tangible nature of environmental goals. Compared to economic and social goals, environmental outcomes are harder for business owners and managers to identify. Moreover, achieving environmental objectives often requires collaboration with other supply chain partners, which, as the research indicates, can be challenging due to the specific characteristics of SMEs (Table 5).

Table 5.

Barriers to the development of sustainable logistics in the surveyed small and medium-sized enterprises (2020 and 2024)

Barriers to the development of sustainable logistics/year of study	2020	2024
financial barriers	3.7	4.3
lack of resources (non-financial)	3.3	3.9
small scale of operation	3.2	4.2
lack of knowledge and skills (know-how)	3.1	3.9
employee resistance	2.7	3.4
no possibility of influencing cooperators	2.8	3.9
lack of commitment from cooperators	2.8	3.9
industry specificity	3.2	4.0

Source: own research, the table presents the average magnitudes of the responses obtained.

When analyzing the research results, it is essential to note that a small business is not a little big business (Welsh, White, 1981). This distinction highlights the unique characteristics of small businesses, such as limited access to financial and non-financial resources, lack of know-how, and a smaller scale of operations – all of which constrain the development of sustainable logistics. The studies conducted by the authors in both 2020 and 2024 confirm these challenges. However, it is worth noting that in 2020, the surveyed enterprises assessed the significance of individual barriers to sustainable logistics development as lower than in 2024. The observed increase in the perceived significance of these barriers is likely due to the growing interest of the surveyed enterprises in sustainable solutions. As the scale of sustainable implementations expands, businesses are better able to identify and experience real limitations. Secondly, external barriers, such as the lack of commitment from cooperators and no possibility of influencing cooperators, saw a significant increase in importance in 2024 compared to 2020 – a rise of 38% (Figure 4). According to the authors, this situation reflects the evolving nature of sustainable logistics practices. Their implementation increasingly requires collaboration among multiple entities rather than being confined to a single enterprise.

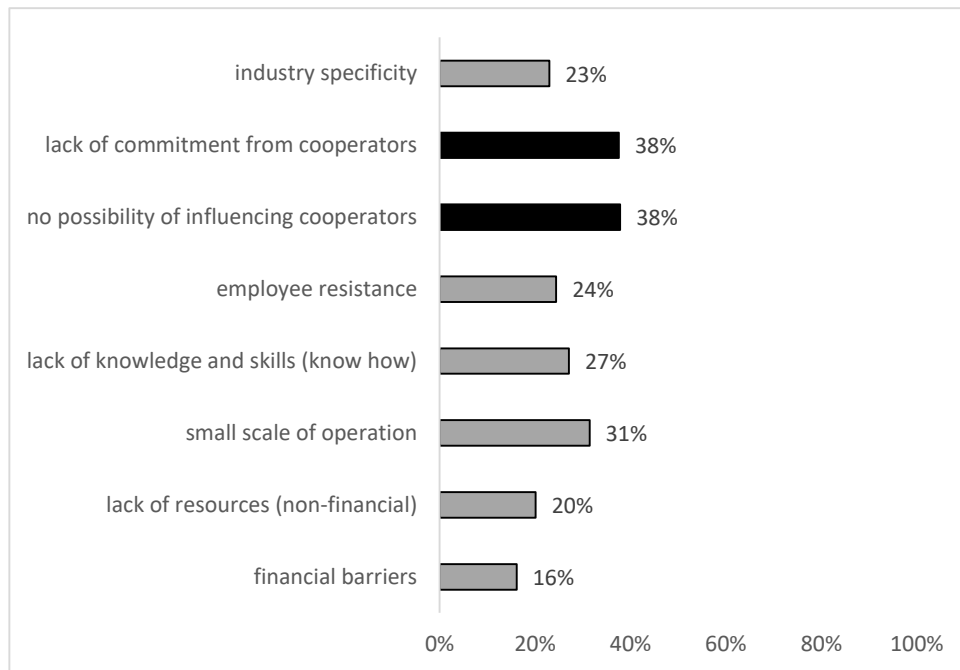


Figure 4. Changes in the barriers to sustainable logistics development in the surveyed SMEs – relative increases.

Source: own research; the chart presents relative differences between the average ratings of individual barriers in 2024 and 2020.

5. Conclusion

The development of sustainable logistics in the surveyed small and medium-sized enterprises is gaining momentum. According to the research findings, the post-pandemic period has been marked by significant changes in the conditions affecting the development of sustainable logistics in smaller businesses. By 2024, compared to 2020, the pressure from stakeholders to adopt sustainable logistics practices has noticeably increased. This trend is undoubtedly linked to the introduction of new legal regulations, which have amplified the influence of stronger supply chain participants relative to the surveyed enterprises. Additionally, in 2024, there was a significant rise in the declared outcomes, particularly social and environmental, achieved through the implementation of sustainable logistics. This includes providing employees with greater opportunities for growth and promotion, as well as achieving a much greater reduction in CO₂ emissions, aligning with the current trend of logistics decarbonization.

The recognized increase in the importance of barriers to sustainable logistics development, particularly external barriers, indicates that in the surveyed SMEs, the implementation of sustainable logistics is occurring not solely at the level of individual enterprises but through collaboration with other supply chain participants. In light of these findings, the authors

recommend continuing research on the mechanisms driving the development of sustainable logistics in SMEs, while also taking into account the dynamic context of their operating environment.

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THE ARCHITECTURE OF THINKING: REFLECTION, CRITICAL THINKING, SENTIMENT AND THEIR INFLUENCE ON ECONOMIC DECISION-TAKING

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Purpose: The article explores how emotions and authority influence inflation forecasts and economic decisions, highlighting the importance of critical thinking in reducing their impact.

Design/methodology/approach: The study conducted an experiment in which participants watched a film about the economic situation and then received either positive or negative comments from experts. The impact of these comments on participants' inflation forecasts was analyzed, using psychological tests to gain a deeper understanding of perception.

Findings: The study found that high cognitive reflexivity and economic knowledge did not fully protect against the influence of expert opinions. Participants' initial differences in inflation forecasting diminished after exposure to expert comments, with heuristic mechanisms often prevailing. Economic education increased knowledge and reflexivity but did not eliminate the impact of emotion and authority on decisions. Critical thinking helped reduce cognitive errors but did not completely eliminate them.

Research limitations/implications: The study's results are limited by the small sample size and specific decision scenarios, which may not capture the complexity of real economic situations. Future research should involve larger, more diverse participant groups and various economic contexts. Nonetheless, the findings highlight the importance of economic education in developing critical thinking to reduce cognitive errors influenced by emotions and authority.

Originality/value: The article offers a fresh perspective on economic decision-making by examining the interplay between cognitive reflexivity, economic knowledge, authority, and emotions. It reveals that while reflexivity and knowledge are crucial, they alone cannot prevent cognitive errors. Critical thinking emerges as a vital element of economic education. The study also underscores the need for analytical skills to enhance rationality in dynamic economic, social, and political contexts.

Keywords: inflation, behavioural economics, behavioural psychology, decision making, media communication, cognition, language pragmatics.

Category of the paper: Research paper.

1. Introduction

This paper examines the impact of sentiment and authority on inflation forecasting and economic decision-making. In particular, it investigated whether high levels of cognitive reflexivity and economic knowledge can protect individuals from irrational cognitive distortions in financial decision-making. For the purposes of the experiment, a psychometric test developed by Anna Matczak was used to assess cognitive reflexivity as a cognitive style focused on introspection and analysis of internal experiences.

In the first part of the article, critical thinking was defined as the capacity for rational and conscious analysis as a tool for reducing cognitive distortions in decision-making processes. Cognitive reflexivity was then characterised in detail based on Matczak's approach. The two phenomena - critical thinking and cognitive reflexivity - were then juxtaposed, examining their interrelationship and potential limitations in the context of the influence of emotional and authoritarian factors. The results of the experiment showed that both sentiment and authority can significantly influence economic decisions, regardless of the participants' level of cognitive reflexivity. It was found that although cognitive reflexivity promotes rational decision-making, its role in protecting against irrational cognitive distortions is limited. Given the results of the study, critical thinking was proposed as a potential remedy for these distortions. Nevertheless, it was emphasised that further research is needed to fully assess the effectiveness of critical thinking as a tool to reduce the influence of emotion and authority on economic decision-making.

2. Literature review

2.1. Critical thinking vs. irrationality

Critical thinking is a complex intellectual process that involves the objective analysis and evaluation of information, arguments and situations with the aim of forming logical, well-founded conclusions (Nęcka, Szymura, Orzechowski, 2013). In the academic literature, critical thinking is often seen as an essential skill in the media space for effective information processing and informed decision-making. As Paul and Elder (2006) note, critical thinking not only supports learning, but also develops the skills needed to solve problems in different areas of life. Key elements of critical thinking include the ability to reason, assess the credibility of information and the ability to question one's own beliefs and be open to new perspectives. It is not only a skill, but also an attitude that requires openness and intellectual honesty. Critical thinkers are able to effectively problem-solve and challenge themselves, making this skill invaluable in everyday life, work and new media.

However, as research by Nobel laureate Daniel Kahneman (2011) shows, even the most informed thinking can be influenced by a number of cognitive traps that interfere with decision-making. One is the confirmation trap, which is the tendency to seek out information that is consistent with one's own beliefs and ignore those that might challenge them. Another is the anchoring effect, in which the first piece of information processed by the recipient influences his or her subsequent decisions and judgements, even if it is irrelevant. Another trap is the illusion of control, i.e. the belief that people can influence random events, which often leads to erroneous judgements. These traps arise from heuristics and cognitive errors that cause human thinking to be sometimes distorted and not always rational (Kahneman, 2011). In contrast, Dan Ariely, a specialist in behavioural economics, draws attention to the common manifestations of irrationality in human behaviour. In his book *The Power of Irrationality*, Ariely (2012) provides numerous examples of situations in which human decisions are predictably irrational. The 'free-for-all' effect illustrates the tendency to assign high value to things offered for free, even though their actual value may be low. Ariely's research shows that customers choose Hershey's chocolates 90% of the time when they are offered for free, even when in reality the more valuable Lindt truffles cost only US\$0.26. Another mechanism is the theory of relativity, in which people judge the value of objects based on how they compare with others. A more expensive product placed next to a cheaper one often appears more valuable, even if its actual quality remains the same. Ariely also points to the phenomenon of procrastination, which is the tendency to put off important decisions and actions until later, resulting from a resistance to taking actions that involve risk or effort. This phenomenon leads to the postponement of important issues, which can have negative consequences. In his research, Ariely also describes the phenomenon of rationalised dishonesty, which refers to situations in which people, given the opportunity to gain financial benefits, rationalise their dishonest behaviour while considering themselves honest. This phenomenon shows how flexible human morality can be in the face of material gain. Decision paralysis, on the other hand, refers to a situation in which people are presented with too many options to choose from, so that they may feel overwhelmed by this, ultimately leading them to abandon any decision, which in turn causes frustration and reduces satisfaction with the choices they have made. The IKEA effect is another example illustrating human irrationality and occurs when consumers assign a higher value to items they have made or assembled themselves, as in the case of IKEA furniture, for which they are willing to pay more than for ready-made products. Also important in everyday decisions is a mechanism that Ariely calls the 'pain of loss' or the phenomenon of emotional discomfort associated with loss. This pain is usually much stronger than the joy of achieving a gain of equal value. This makes people more inclined to avoid risk than to pursue gain, driven mainly by the desire to protect themselves from loss. Another manifestation of irrationality is illogical financial choices, resulting from different approaches to money. Consumers find it easier to spend money gained from winning the lottery than money they have earned themselves. In addition, the placebo effect reveals how strongly human decisions can be influenced by

expectations. People often believe in the efficacy of drugs or therapies simply because they think they will work, which shows how human beliefs influence the perceived effectiveness of different actions. These examples illustrate how irrationality is ingrained in everyday consumer decisions and how different factors can distort a person's judgement in the decision-making process.

According to Dan Ariely, it is critical thinking, the definition of which was quoted at the beginning of this chapter, that provides an effective remedy for the tendency towards irrational decisions. One of the key aspects of critical thinking is the analysis and evaluation of information. Critical thinkers are more likely to question often erroneous automatic reactions, allowing them to seek reliable evidence and make informed decisions. Questioning is another important element of critical thinking, as it encourages reflection on the motives behind people's decisions. Ariely draws attention to the fact that human choices are predictably irrational and often made unconsciously. Awareness of cognitive errors is another defence mechanism against irrationality. Critical thinking makes it possible to identify the pitfalls of thinking, allowing a more informed approach to analysing situations and avoiding the influence of heuristics, simplifications or automatisms in thinking on decisions made in many areas of human life. Overt Dan Ariely points to openness to new perspectives as an inhibitor of irrationality in the architecture of thinking. It requires the readiness and intellectual and emotional maturity of the human individual to change position under the influence of new evidence. Ariely notes that people often cling to beliefs even in spite of facts, leading to unfavourable decisions. Critical thinking promotes flexibility and acceptance of nuance, allowing people to adapt to new information.

2.2. Cognitive reflectiveness and irrationality

Cognitive reflectiveness, defined as the ability to reconsider, analyse, and assess one's own thoughts and beliefs, plays a pivotal role in the decision-making process. In psychological literature, cognitive reflectiveness is described as a process of conscious control over one's thinking, enabling the careful consideration of available information and more accurate decision-making. Through reflectiveness, an individual gains greater resistance to impulsivity and cognitive biases that may lead to suboptimal decisions (Matczak, 2011). Reflection is a process that accompanies individuals at various stages of adulthood and is associated with specific internal experiences that influence the interpretation of situations one faces (Matczak, 2020). The introspective nature of reflection allows an individual to analyse their internal experiences, actions, and states of consciousness. Matczak (2020) suggests that reflection particularly applies to individuals in a state of doubt, who strive to understand their behaviour in the context of the situation, identifying their personal theories and transitioning from the subconscious to full awareness. Reflection is a dynamic and developmental process that not only promotes a critical perspective on past experiences but also facilitates future planning and the development of self-awareness. According to Matczak (2020), reflection takes on different

qualities at various stages of adulthood, shaped by developmental norms and life experiences, which form its foundation. Although reflection can foster personal growth and the acquisition of life wisdom, it does not guarantee these outcomes. The potential for reflective functioning is available to all adults, although not all fully utilise it.

Cognitive reflectiveness also engages the ability to critically evaluate and control one's thoughts. This enables an individual to consciously "brake" automatic reactions and reconsider their choices before making decisions. Such an approach promotes resistance to emotional influences and social pressure, which, in an economic context, can translate into more deliberate and reasoned financial management. Critical analysis of one's thoughts also helps in reducing cognitive biases such as hindsight bias or anchoring, which often lead to flawed assessments of financial situations. Cognitively reflective individuals, aware of these biases, are less prone to impulsive consumption and behaviours driven by advertising. Research indicates that individuals with higher cognitive reflectiveness are more likely to make sound financial decisions and avoid typical cognitive biases, such as hasty purchases, emotional investing, or decisions influenced by fleeting trends (Juanchich et al., 2019).

Cognitive reflectiveness is reflected in Daniel Kahneman's (2011) theory of thinking systems, in which the fast, intuitive System 1 is contrasted with the slower, analytical System 2. Cognitive reflectiveness is strongly linked to System 2, as it requires conscious, effortful analysis of information. This allows an individual to "switch" from the automatic System 1 to the deliberate System 2, often leading to more thoughtful decisions. In financial contexts, this can result in less impulsivity and greater caution, which in turn leads to better risk management. Cognitive reflectiveness also facilitates a flexible and adaptive switching between intuitive thinking in System 1 and analytical thinking in System 2, which is particularly important in financial decision-making. For instance, when new, uncertain information arises in the financial market, reflective individuals are able not only to dismiss the immediate reaction of System 1 (such as an emotional response to sudden price changes) but also to consciously process this information using System 2. As a result, their decisions are less susceptible to risks arising from heuristics and cognitive biases that could lead to poor choices, such as excessive risk in investments or avoiding risk due to fear of failure.

The findings from the research conducted by Juanchich, Sirot, and Bonnefon (2019) emphasise that individuals with higher levels of cognitive reflectiveness exhibit greater resistance to cognitive effects such as heuristics or distorted perceptions of risk. One example of such effects is the anchoring heuristic, which leads to excessive reliance on initial information (the "anchor"), even when it is not relevant in the given context. Cognitively reflective individuals are able to consciously detach from initial impressions and analyse the situation based on actual facts and data. This kind of reflectiveness helps to avoid hasty decisions that, in the financial world, can lead to losses — for example, when an investor buys stocks merely due to a temporary price increase, ignoring fundamental market indicators. According to the researchers, cognitive reflectiveness also protects against hindsight bias,

which involves interpreting past events as more predictable than they actually were. This effect often leads individuals to make errors by relying too heavily on intuition or past experiences, rather than making an objective assessment of facts. Thanks to cognitive reflectiveness, individuals are more likely to analyse new information in a fresh context, leading to more accurate assessments of future opportunities and threats.

In the literature, cognitive reflectiveness is often described as a key component of emotional intelligence, which is defined as the ability to recognise, process, and manage emotional information and use it for adaptive functioning (Mayer, Salovey, 1997). Cognitive reflectiveness supports this process by enabling individuals to effectively distinguish between emotions and thoughts and to analyse facts independently of subjective experiences. In the context of financial decisions, this allows for making choices that are not only more thoughtful but also more emotionally stable, which is crucial in situations fraught with uncertainty and risk, typical of economic decisions. An example might be the situation in the investment market, where strong emotional pressure arises due to sudden price fluctuations. Individuals with well-developed cognitive reflectiveness are able to consciously identify the impact of emotions such as fear of loss or the euphoria of anticipated gains, allowing them to act more objectively rather than succumbing to transient emotions. This ability to separate emotions from the thinking process is a key aspect of emotional intelligence, contributing to greater emotional stability and more effective decision-making. Furthermore, cognitive reflectiveness supports the development of competencies related to emotional self-regulation, such as self-control or the ability to maintain composure under financial pressure. Cognitively reflective individuals who can analyse their emotions and their impact on decision-making are better prepared to manage stress and act in a manner consistent with their long-term financial goals. In this way, cognitive reflectiveness enhances the ability to make more conscious decisions in situations where emotions may jeopardise rational decision-making, which is a key aspect of emotional intelligence and holds particular importance in the rapidly changing financial environment and the new media landscape saturated with messages laden with strong emotional appeal.

2.3. The difference between cognitive reflectiveness and critical thinking

Cognitive reflectiveness, as described by Anna Matczak (2011), is a characteristic of cognitive style related to the tendency for careful and prolonged contemplation of hypotheses and the analysis of various solutions before making decisions. Individuals exhibiting reflectiveness adopt a thorough and insightful approach to tasks, enabling them to avoid errors and make more accurate decisions (Matczak, 2011). Cognitive reflectiveness is associated with response latency, as reflective individuals often consider multiple options, comparing them to select the best possible decision. In contrast, critical thinking is a broader cognitive process that focuses on evaluating arguments and evidence, as well as the ability to recognise and analyse various perspectives. Key elements of critical thinking include the assessment of arguments,

a structured approach to problem-solving, and self-awareness, which refers to the capacity to understand and question one's own beliefs (Paul, Elder, 2006).

Although cognitive reflectiveness and critical thinking share common elements, they differ in their objectives and processes of execution. Cognitive reflectiveness concentrates on the meticulous consideration and analysis of a problem, which aids in avoiding mistakes and making more informed decisions, while critical thinking is directed towards evaluating arguments and consciously making decisions based on available evidence. The process of reflectiveness often leads to delays in action, as the individual focuses on carefully considering all possible options. In the case of critical thinking, decisions are made more quickly due to logical analysis, making it more applicable in situations requiring swift and effective decision-making (Matczak, 2011; Paul, Elder, 2006). Cognitive reflectiveness is most commonly applied in the context of individual cognitive styles, which can be particularly beneficial in the learning process and in resolving personal issues. Conversely, critical thinking finds broader applications, such as in public debates, education, and everyday decision-making in both personal and professional contexts.

In summary, cognitive reflectiveness pertains to a deep analysis and contemplation of one's thoughts and decisions, whereas critical thinking is a more dynamic skill of evaluating information and arguments, allowing for conscious choices and careful decision-making based on available knowledge and evidence.

Recent research on cognitive reflectiveness indicates its growing importance in social and economic contexts, as well as in decision-making processes. The ambivalent role of reflectiveness is the subject of analysis by researcher Agnieszka Jankowska, who, in her article on cognitive reflectiveness, highlights situations where reflectiveness may lead to high cognitive costs and may hinder the perceptual process. Reflectiveness, often considered a positive trait, can lead to excessive analysis of situations. In cognitive terms, individuals who are overly reflective may spend too much time contemplating various options and analysing problems, making it difficult for them to make effective decisions. Jankowska points to the ambiguity of reflectiveness and suggests that in certain contexts it may even be "undesirable" (Jankowska, 2019). In situations requiring rapid decision-making or improvisation, excessive reflectiveness can become a hindrance. People may struggle to act under time pressure, resulting in decreased effectiveness of their actions. On the other hand, Ellen Langer, studying common cognitive tendencies in the modern world, notes that mindlessness is becoming increasingly dominant. Langer emphasises that reflectiveness remains a key competence in the face of growing individual autonomy and widespread access to information (Langer, 2016). Meanwhile, in her research on cognitive styles, Ewa Czerniawska points to significant differences between reflective and impulsive individuals, highlighting that reflectiveness influences the decision-making process. According to Czerniawska, reflectiveness can determine the way information is processed and solutions are selected, which is an important aspect of individual cognitive styles (Czerniawska, 2020). Elżbieta Hałas, in her sociological

examination of reflectiveness, underscores its significance for social theory and critical analysis. Hałas asserts that reflectiveness acquires particular value in social analysis, especially in light of complex interactions between the individual and the social system (Hałas, 2018).

Critical thinking plays a fundamental role as a tool for defending against emotional influences and manipulation, especially in the digital world saturated with information and disinformation. The ability to critically analyse content becomes a vital resource for individuals seeking to make informed rather than impulsive decisions. In an era of fake news and media manipulation, critical thinking supports effective filtering of information, which is crucial to avoiding misleading content. As noted by Lewandowsky and Cook (2020), individuals capable of critical thinking are better at identifying credible sources, distinguishing them from those employing manipulative techniques or bias. Critical thinkers are able to recognise moments when emotions distort judgments and exercise control over their reactions. Contemporary media often influence audiences through subtle manipulative techniques that appeal to emotions. Critical thinking acts as a barrier against media narratives aimed at eliciting specific emotional responses. According to Nęcki (2013), individuals with high critical thinking skills can recognise attempts at manipulation, allowing them to make more conscious decisions that are resistant to external pressure. One of the most important elements of critical thinking is the ability to ask questions that encourage deeper analysis of information and scrutiny of its sources. Ariely (2012) emphasises that critical thinkers are more likely to question the veracity of information and seek evidence rather than accepting content uncritically. This approach fosters decisions based on evidence rather than sentiment. Critical thinking also strengthens self-reflection, enabling individuals to better understand their own values and beliefs. Kahneman (2011) also notes that self-awareness is crucial in avoiding decisions based solely on emotions or fleeting impulses. Critical thinking further develops analytical skills essential for solving problems that require logical reasoning and calm analysis. This ability facilitates thoughtful decision-making, irrespective of emotional pressure, which, as Gigerenzer (2007) emphasises, is key to achieving accurate and balanced choices. According to the researcher, through the capacity to filter content, self-reflect, and analyse emotions, critical thinkers are more resistant to manipulation, which helps them maintain autonomy of thought and avoid irrational decisions.

3. Method description

The study was conducted between April 2023 and February 2024 among university students in Poland who are not analysts. A total of 412 participants took part in the experiment, including 326 women, 83 men, and 3 individuals who did not specify their gender. At the beginning, participants filled out a demographic questionnaire. Due to the dynamic economic situation in Poland during the study period, characterized by rising inflation, participants were shown

a video. The material aimed to standardize the cognitive understanding of the economic environment and neutralize media information presented in Polish media. By employing priming techniques, all participants responded to questions from the same cognitive level.

After watching the video, participants received a message that included a description of the economic situation and its prospects both domestically and internationally, along with information about an inflation rate close to the target value of 2.1%. After reviewing this message, participants estimated the inflation rate both qualitatively and quantitatively. In the next step, participants were randomly assigned to read either a positive version of an expert's commentary (Group P) or a negative version (Group N). They then had the opportunity to modify their inflation estimates. This approach allowed researchers to examine the impact of expert comments on students' perceptions of inflation and understand how different presentations of information could influence decision-making in the context of economic uncertainty.

During the experiment, participants completed an economic knowledge test. Based on the results, their level of knowledge was defined as low, average or high. To measure the level of cognitive reflexivity, the Reflexivity Questionnaire by Anna Matczak and Aleksandra Jaworowska (2020) was used.

4. Results

Table 1.

Tests for the normality of the distribution of the variable: percentage result obtained in the economic knowledge test for groups with low, average and high levels of cognitive reflectivity

Level of cognitive reflexivity	Test	Value of statistics	Value p
low	Test Shapiro-Wilka	0,95	0,0888
	Test Lillieforsa	0,19	p < ,01
average	Test Shapiro-Wilka	0,98	0,0001
	Test Lillieforsa	0,12	p < ,01
high	Test Shapiro-Wilka	0,90	0,0001
	Test Lillieforsa	0,18	p < ,01

Source: own study based on data collected in the author's study.

Regarding the group with a low level of cognitive reflexivity, based on the result of the Shapiro-Wilk test: $p = 0.0888$ at the significance level $\alpha = 0.05$, there is no basis for rejecting the hypothesis of normality of the distribution of the variable percentage score obtained in the test of economic knowledge. On the other hand, based on the result of the Lilliefors test: $p < ,01$ at the significance level $\alpha = 0.05$, the hypothesis of normality of the distribution of the variable should be rejected. Hence, it should be assumed that the distribution is not normal (Table 1).

Regarding the groups with average and high levels of cognitive reflexivity, both the Shapiro-Wilk test and the Lilliefors test indicate rejection of the hypothesis of normality of the distribution of the variable percentage score obtained in the economic knowledge test at the significance level of $\alpha = 0.05$ (Table 1).

Table 2.

Kruskal-Wallis rank ANOVA for the variable percentage score obtained on the economic knowledge test for groups with low, average and high levels of cognitive reflexivity $H(2, N = 409) = 16,91043$ $p = ,0002$

Level of cognitive reflexivity	N	Sum	Average value
low	35	5788,50	165,39
average	313	62350,50	199,20
high	61	15706,00	257,48

Source: own study based on data collected in the author's study.

There were statistically significant differences in the percentage score obtained in the economic knowledge test by group according to the level of cognitive reflexivity (Table 2).

Table 3.

The p-value for multiple comparisons (two-sided) for the variable percentage score obtained in the test of economic knowledge according to the level of cognitive reflexivity. Kruskal-Wallis test: $H(2, N = 409) = 16,91043$ $p = ,0002$

Level of cognitive reflexivity	low	average	high
low		0,3254	0,0007
average	0,3254		0,0013
high	0,0007	0,0013	

Source: own study based on data collected in the author's study.

Statistically significant differences for the variable percentage score obtained in the test of economic knowledge were noted between groups (Table 3):

- high and low levels of cognitive reflexivity,
- high and average levels of cognitive reflexivity.

Table 4.

Descriptive statistics for the variable percentage score obtained in the test of economic knowledge by group level of cognitive reflexivity

Level of cognitive reflexivity	N	Median	Lower quarters	Upper quarters	Quartile. Range
low	35	53,33000	40,00000	66,67000	26,67000
average	313	53,33000	46,67000	73,33000	26,66000
high	61	73,33000	60,00000	80,00000	20,00000

Source: own study based on data collected in the author's study.

The median percentage score obtained on economic knowledge for those with a high level of cognitive reflexivity was 73.33%, while it was 53.33% for those with low and average levels of cognitive reflexivity (Table 4).

Table 5.

Normality tests of the distribution of the variable first quantitative forecast of the level of inflation by group by level of economic knowledge

Level of economic knowledge	Test	Value of statistics	Value p
low	Test Shapiro-Wilka	0,43	p < 0,0001
	Test Lillieforsa	0,39	p < ,01
average	Test Shapiro-Wilka	0,55	p < 0,0001
	Test Lillieforsa	0,32	p < ,01
high	Test Lillieforsa	0,64	p < 0,0001
	Test Lillieforsa	0,26	p < ,01

Source: own study based on data collected in the author's study.

For all groups by level of economic knowledge, both the Shapiro-Wilk test and the Lilliefors test indicate the rejection of the hypothesis of the normality of the distribution of the variable first quantitative forecast of the level of inflation at the significance level $\alpha = 0.05$ (Table 5).

Table 6.

Kruskal-Wallis rank ANOVA for the variable first quantitative forecast taking into account the level of economic knowledge $H(2, N = 409) = 6,663278 p = ,0357$

Level of economic knowledge	N	Sum	Average value
low	39	8.000,50	205,14
average	246	53.191,00	216,22
high	124	22.653,50	182,69

Source: own study based on data collected in the author's study.

There were statistically significant differences in first inflation forecasting by group according to level of economic knowledge (Table 6).

Table 7.

The p-value for multiple comparisons (two-sided) for the variable first quantitative forecast by level of economic knowledge. Kruskal-Wallis test: $H(2, N = 409) = 6,663278 p = ,0357$

Level of economic knowledge	low	average	high
Low		1,0000	0,9027
average	1,0000		0,0300
high	0,9027	0,0300	

Source: own study based on data collected in the author's study.

Statistically significant differences were obtained for groups with average and high levels of economic knowledge (Table 7).

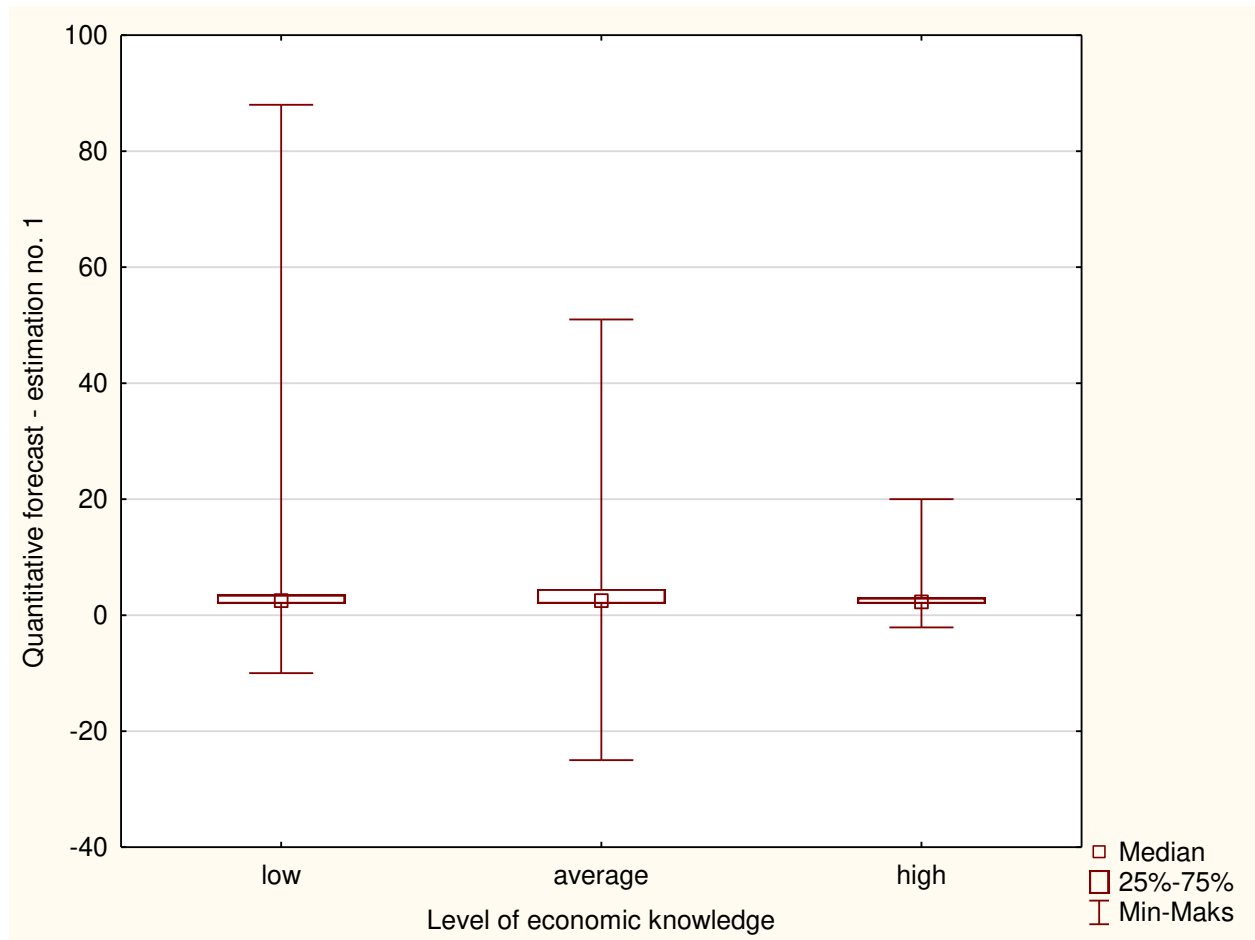


Figure 1. Distribution of results of the first quantitative inflation forecast by level of knowledge (N = 409).

Source: own study based on data collected in the author's study.

The medians of the first quantitative forecast in the group of people with an average and low level of knowledge obtained a value equal to 2.5 and in the group with a high level of knowledge 2.3. However, in the case of the quarterly deviation, the highest value is in the group of people with an average level of knowledge, i.e. 1.25, and the lowest in the group of people with a high level of knowledge, i.e. 0.5 (Figure 1).

Table 8.

Normality tests of the distribution of the variable second quantitative forecast of the level of inflation by group by level of economic knowledge

Level of economic knowledge	Test	Value of statistics	Value p
low	Test Shapiro-Wilka	0,50	p < 0,0001
	Test Lillieforsa	0,38	p < ,01
average	Test Shapiro-Wilka	0,50	p < 0,0001
	Test Lillieforsa	0,32	p < ,01
high	Test Lillieforsa	0,57	p < 0,0001
	Test Lillieforsa	0,32	p < ,01

Source: own study based on data collected in the author's study.

For all groups by level of economic knowledge, both the Shapiro-Wilk test and the Lilliefors test indicate the rejection of the hypothesis of the normality of the distribution of the variable second quantitative forecast of the level of inflation at the significance level $\alpha = 0.05$ (Table 8).

Table 9.

Kruskal-Wallis rank ANOVA for the second quantitative forecast variable taking into account the level of economic knowledge $H(2, N = 409) = 9,9637121$ $p = 0,6176$

Level of economic knowledge	N	Sum	Average value
low	39	8.518,00	218,41
average	246	50.766,00	206,37
high	124	24.561,00	198,07

Source: own study based on data collected in the author's study.

There were no statistically significant differences in second inflation forecasting by group according to level of economic knowledge (Table 9).

Table 10.

Wilcoxon paired rank order test for the variables first and second quantitative forecasts with consideration of the level of economic knowledge

Level of economic knowledge	N	T	Z	p
low	27	183,5000	0,132137	0,894876
average	169	5443,000	2,730627	0,006322
high	84	1654,000	0,584231	0,559065

Source: own study based on data collected in the author's study

When comparing the first and second estimates of inflation, statistically significant differences were found for the group of respondents with an average level of economic knowledge. In the group of respondents with low and high levels of economic knowledge, no statistically significant differences were found (Table 10).

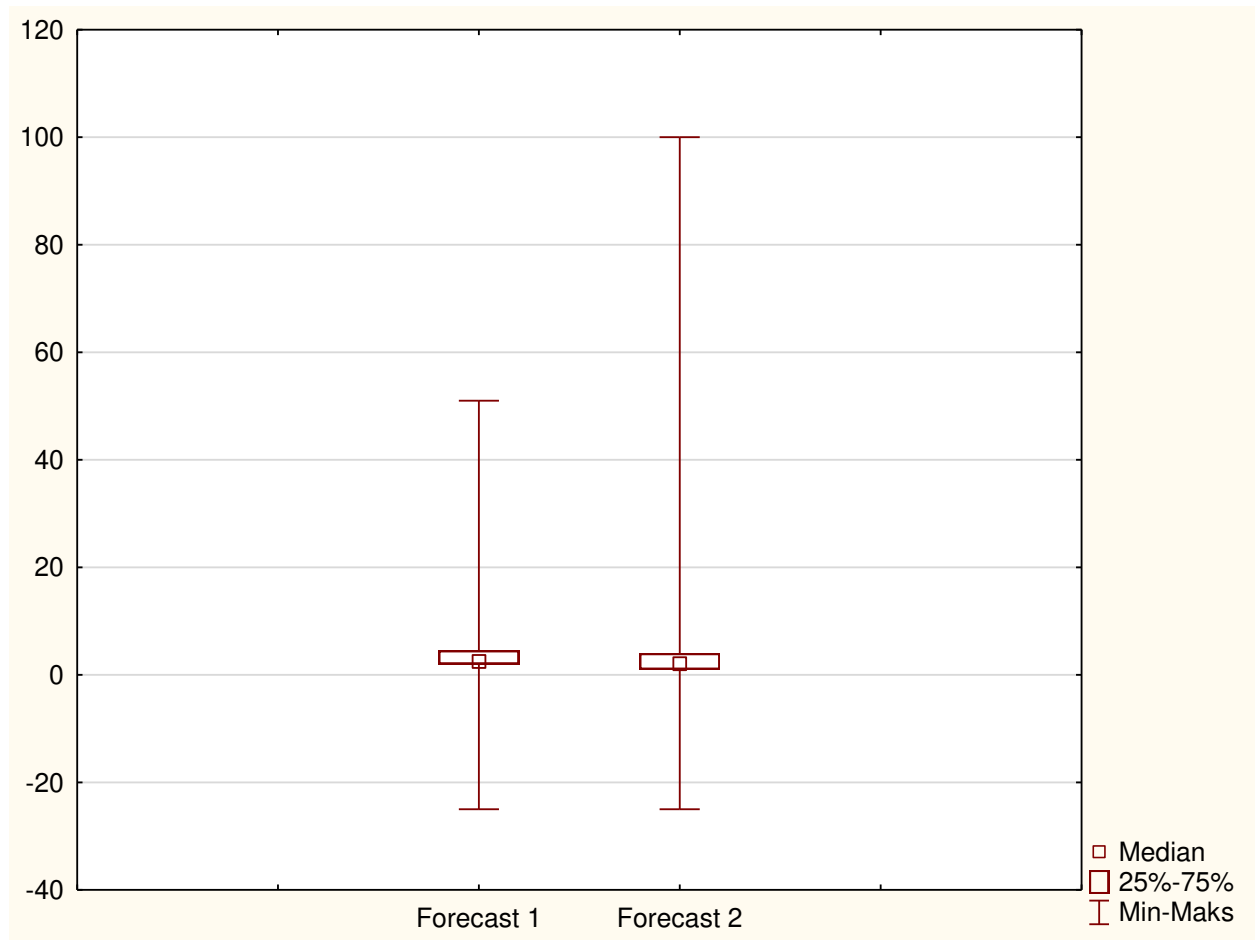


Figure 2. Distribution of results for the first and second quantitative inflation forecasts among people with an average level of economic knowledge.

Source: own study based on data collected in the author's study.

Analyzing the statistics for the first and second inflation estimates, taking into account the levels of economic knowledge of the respondents, the largest reduction in the median was obtained in the group of respondents with an average level of knowledge. For the first estimation it was 2.5 and for the second 2.10 (Fig. 2).

Table 11.

Wilcoxon paired rank-order test for the variables first and second quantitative forecasting with cognitive reflexivity level

Cognitive reflexivity level	N	T	Z	p
low	23	130,5000	0,228112	0,819559
average	214	9143,000	2,601782	0,009275
high	43	435,0000	0,458848	0,646343

Source: own study based on data collected in the author's study.

Further, comparing the first and second inflation estimates, statistically significant differences were found for the group of respondents with an average level of cognitive reflexivity. In the group of subjects with low and high levels of cognitive reflexivity, no statistically significant differences were found (Table 11).

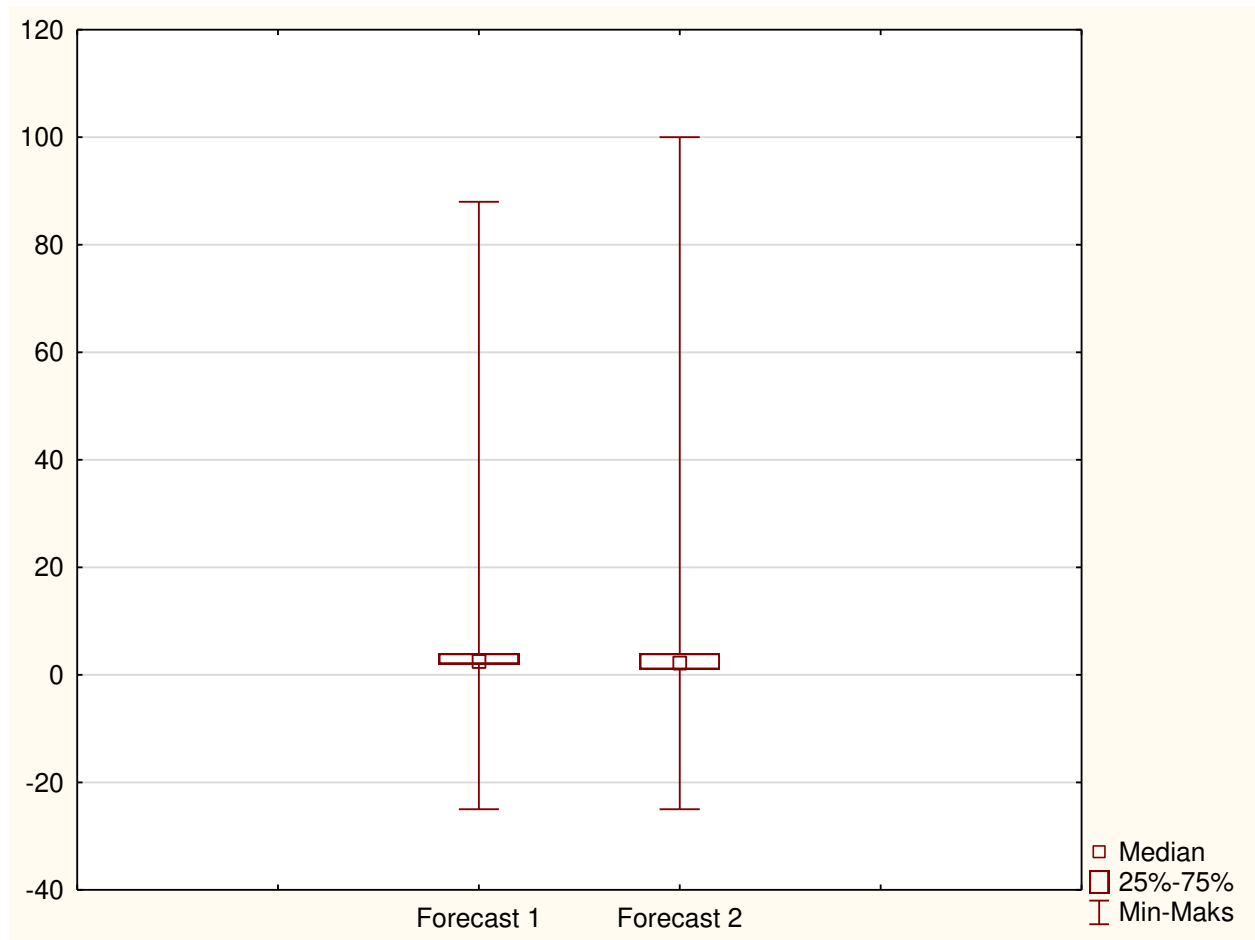


Figure 3. Distribution of scores for the first and second quantitative inflation forecasts in a group of people with average levels of cognitive reflexivity.

Source: own study based on data collected in the author's study.

The median for the group of respondents with an average level of cognitive reflexivity at the first estimate was 2.5, while at the second estimate of inflation – 2.20 (Fig. 3).

5. Discussion

The findings revealed that the group characterized by high cognitive reflectiveness made errors influenced by the sentiment contained in the expert commentary describing the economic situation, as well as by the authority of the person presenting it. Overall, statistical analysis indicated significant differences in the percentage scores obtained in the economic knowledge test between groups with high and average levels of cognitive reflectiveness, as well as between high and low levels. Furthermore, individuals with high cognitive reflectiveness achieved higher percentage scores in the economic knowledge test than those with average and low levels, suggesting a correlation between high knowledge levels and high cognitive reflectiveness.

Statistically significant differences were also found in the first inflation forecast, divided by economic knowledge levels among groups with average and high economic knowledge. However, no statistically significant differences were observed in the second inflation forecast, conducted after reading the expert comments, across groups according to their economic knowledge levels. This may indicate that regardless of their economic knowledge level, participants were estimating the inflation rate in a biased manner. Statistically significant differences were noted in both the first and second inflation forecasts within the group of individuals with an average level of economic knowledge. No differences were found in the groups with low and high economic knowledge, possibly due to small group sizes. Significant differences were also recorded in the inflation forecasts among those with an average level of cognitive reflectiveness, while no differences were noted in the low and high cognitive reflectiveness groups, again likely due to small group sizes.

The research on economic knowledge and inflation forecasting identified significant differences in results between groups with different levels of cognitive reflectiveness. Individuals with high reflectiveness scored better in the economic knowledge test compared to those with average and low levels. These results could suggest that critical thinking skills and a reflective approach to economic issues influence the ability to process and analyze information, which in turn reduces the risk of cognitive errors in estimating inflation levels. However, the experiment showed that high cognitive reflectiveness does not guarantee accurate inflation estimation. In the context of inflation forecasting, significant differences were observed only in the first forecast when grouped by economic knowledge levels. The groups with average and high economic knowledge differed significantly in their predictions. Yet, in the case of the second forecast, conducted after the participants reviewed expert comments, no statistically significant differences were recorded between the groups. This indicates that, regardless of economic knowledge levels, study participants were susceptible to distortions in their assessments, likely stemming from the influence of external information, including expert comments.

This situation underscores the importance of cognitive reflectiveness as a tool for reducing the risk of bias in decision-making. Individuals with higher levels of reflectiveness may be better at critically evaluating external information sources, thus avoiding pitfalls associated with excessive commentary, ultimately leading to more rational inflation forecasts. It is possible that participants, regardless of their economic knowledge, were equally susceptible to the structural features of expert messaging. Strongly biased comments may have neutralized differences arising from knowledge levels, suggesting that even individuals with higher knowledge levels were not resistant to this influence. This could lead to homogenization of forecasts and highlights the potential role of psychological heuristic mechanisms that affect how external information is interpreted, regardless of the knowledge possessed.

Consequently, the study's results suggest that in situations of high market uncertainty, authoritative comments can significantly influence economic decisions, even among individuals more competent in economic matters. This influence confirms the need to pay attention to how forecasts and market analyses are communicated in the media to avoid excessive emotional or biased messaging that could distort inflation predictions, leading to reactions that are not aligned with the actual economic situation. Therefore, critical thinking becomes a crucial tool in counteracting irrationality and susceptibility to sentiment that influences economic decisions. Practicing critical thinking is essential, as cognitive reflectiveness based solely on knowledge is insufficient when human irrationality, emotional influences, and authority come into play.

The study had several limitations. The respondents were young people, specifically students, excluding finance majors. Future studies should include other age groups to verify the potential influence of experience on decisions made in estimating inflation. Additionally, comparisons based on the field of study or profession would be valuable.

The socio-economic situation caused by the COVID-19 pandemic may have significantly impacted the study's results. During that period in Poland, inflation was a major issue, leading to extensive media discussion. This topic was widely covered in the media, with various perspectives on the causes and effects of inflation being debated. Although the authors of the experiment introduced an element aimed at neutralization, this may have affected participants to varying degrees.

6. Conclusion

This article summarizes the results of a study examining the impact of sentiment and authority on inflation forecasting and economic decision-making. The findings indicate that even high levels of cognitive reflectiveness and economic knowledge do not guarantee immunity to the influence of expert opinions. In the initial stages of forecasting, differences were observed among participants with varying levels of economic knowledge; however, after exposure to authoritative comments, these differences diminished. Such results suggest that individuals with higher knowledge, despite advanced cognitive reflectiveness, can still be susceptible to the structural features of expert messaging.

The vulnerability to authoritative messages, regardless of knowledge level, highlights the role of heuristic mechanisms that may neutralize the effects of cognitive reflectiveness and knowledge in decision-making processes. These findings emphasize the limitations of cognitive reflectiveness as a tool for minimizing the influence of emotions and authority, leading to a consideration of the role of critical thinking as a potential remedy.

Critical thinking, defined as the ability to independently analyze and evaluate information, may serve as an effective support in reducing irrational cognitive distortions, which tend to arise frequently in conditions of economic uncertainty. Therefore, developing critical thinking is proposed as an important element of economic education, complementing cognitive reflectiveness and enhancing resilience against emotional and authoritative influences. The study confirms that critical analysis of expert messages can support rationality in financial decisions, which is especially significant in rapidly changing economic conditions.

It is, however, advisable to continue research that more thoroughly analyzes the mechanisms by which emotions and authority influence decision-making processes and contributes to the development of effective training methods in critical thinking and cognitive reflectiveness.

Acknowledgments

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COMPETENCES OF LOGISTICS EMPLOYEES – SYSTEMATIC LITERATURE REVIEW

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Purpose: The main objective of the article is to cover the main directions of development of competences of logistics employees and explore researchers different points of view.

Design/methodology/approach: The research in the article consist of a systematic literature review described by Czakon (2015). All steps of the literature review were conducted from August to November 2024.

Findings: The Author based on literature review will point out the differences in the perception of competences logistics employees.

Research limitations/implications: The limitations include the adopted methodology and research strategy for the studies analysed and the restriction to only one database of scientific publications (Scopus). It is necessary to repeat the research presented in this article to conduct a comparative analysis, expanding the database of analysed studies, whether by including additional databases of scientific publications or by changing the research criteria.

Practical implications: the paper will have no practical implications.

Social implications: Building awareness of the need to introduce changes in the measurement employee competence level. This is due to the fact that not only experience and track records or academic qualification, but also soft skills and cultural fit refers are increasingly important in building a company's competitive advantage.

Originality/value: The analysis carried out allows further methodological work to be carried out on building tools to assess the competence level of logistics employees.

Keywords: competences, logistics.

Category of the paper: Literature review.

1. Introduction

In today's VUCA (Volatility, Uncertainty, Complexity, Ambiguity) world, we are facing a digital transformation and an ecological transformation. Thus, the perception of employees' knowledge, skills and social competences in terms of their effective use by employers is also changing. The changes taking place in logistics processes are not insignificant. This topic is highly relevant given that companies in the logistics industry are facing staffing issues including

a shortage of drivers and logistics professionals. This affects the ability to fulfil orders and maintain operational continuity.

The work of a logistician involves long working hours, frequent process changes and time pressure, which may deter potential candidates who are looking for a more sustainable lifestyle.

There is no consensus in the literature on the very definition of competence for instance: Filipowicz (2004), Kwiatkowska-Ciotucha et al. (2021), McKinnon et al. (2017). For the purposes of this study, it is assumed (Katinienė et al., 2021) that a competence is a set of personal applied abilities, skills and professional knowledge required to choose the necessary operational methods and to perform the activities/functions/work of a particular type.

Undoubtedly, the core competencies of logistics professionals have changed over the years. Therefore, in the first part of the consideration of competences, it was necessary to identify what changes have already taken place over the years. An analysis of the reports of Hays Poland (2019-2024) a leading company specialising in recruitment and HR services was carried out. The company's reports were chosen this due to the general availability of the reports, 50 years of experience in the industry and a scope of operations including: 40,000 client partnerships worldwide and 1,300+ jobs filled every day).

According to the Hays Poland report, there was a shortage of logistics professionals on the market in 2019, which is why employers were keen to interview candidates from other industries with a similar background or education. Companies were open to people who had experience on the 3PL/4PL (3th Party Logistics/Lead Logistics Provider) side. In 2020, the logistics industry was affected by the outbreak of the COVID-19 pandemic. The year was characterised by increased digitalisation in the transport industry and the automation of storage processes. As a result, there was an increased need for people with IT skills, more specifically people experienced in the implementation of ERP systems and with skills in the automation and robotisation of logistics processes. Companies quickly had to adapt to the new situation. The e-commerce sector developed rapidly, which influenced decisions to expand warehouse space and automate warehouse processes. In order to maintain the fluidity of distribution networks, companies continued to invest in solutions for optimal supply chain planning in 2021. A key role was played by the ability to analyse data and draw logical conclusions.

In 2022, a significant role could be seen in the implementation of technologies to optimise supply chains, specialisation in indirect purchasing, planning of logistics activities and optimisation of processes and costs, i.e. generating savings, improving service quality and reducing lead times. The year 2023 brought changes in competence needs. Employers have turned their attention to soft skills, such as negotiation, resistance to stress and quick decision-making. The preceding years have exemplified the importance of building supply chain resilience and risk analysis due to worsening raw material availability issues and high inflation. The relocation of logistics activities to our country has also become important, with the result that managers' responsibilities have expanded to international. In addition, environmental transformation has become a market trend.

The year 2024 sees a further need to optimise costs and strengthen supply chains. The importance of soft skills, which are increasingly placed on a par with technical skills, is being reinforced. Among other things, logisticians are increasingly required to be able to adapt quickly in changing conditions, to have analytical and communication skills or to be effective in managing several projects simultaneously.

Another strongly emphasised trend is the digitisation of logistics processes (including the trend of artificial intelligence, robotics and advanced technologies). Consequently, there has been an increased demand for logistics employees with interdisciplinary competences, who are innovative and have the skills to use modern tools to improve their work.

The above considerations are illustrated in Figure 1.

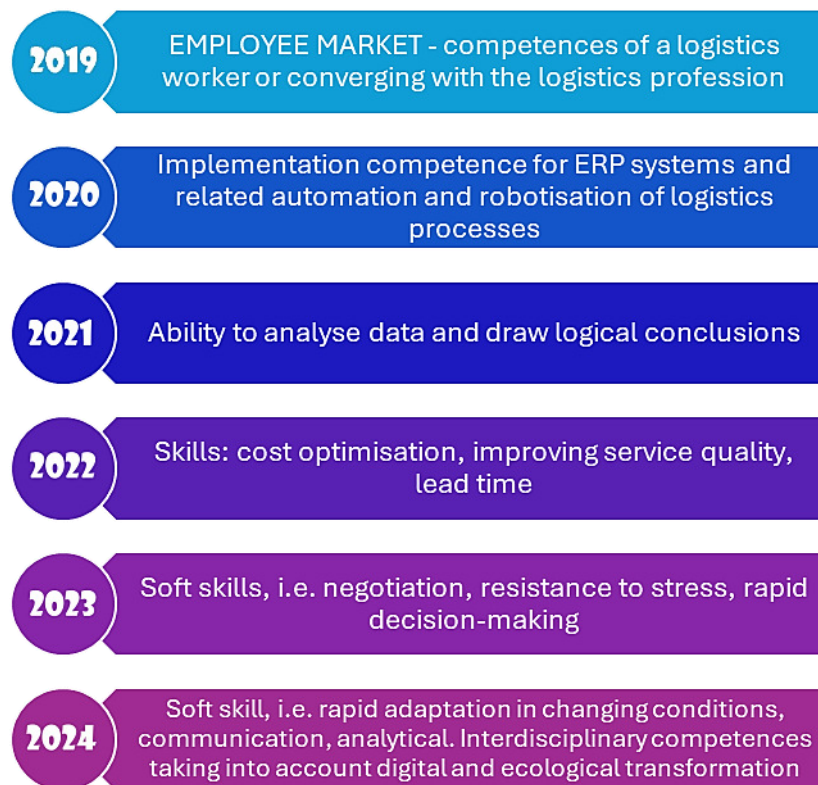


Figure 1. Employers' competence needs in relation to logistics employees over the years.

Source: own elaboration based on data analysis from Hays Poland 2019-2024 Reports.

Given these developments, it seems interesting whether research is being produced in a world of such dynamic of logistics, studies are being produced to measure the level of competence and competence for market needs.

2. Methodology and results

The research in the article consist of a systematic literature review described by Czakon (2015). All steps (Figure 1) of the literature review were conducted from August to November 2024.



Figure 2. Methodology adopted form systematic literature review, step by step.

Source: own elaboration.

First, the Author selected the publications to be analysed based on the Scopus database of scientific publications. An important step in the literature review is the selection of appropriate search criteria to establish the appropriate database for further analysis. Identification of keywords and fields of science. The Author decided to limit the search criteria included a combination of the word ‘competence’, ‘logistic’ or ‘transport’ to the query which resulted in 1 176 publications. The last step based on the above searches included published between 2019 and 2024, limited to open access, English language and articles only. This search resulted in 163 articles, which were subjected to further biometric analysis.

Table 1.

Steps in the retrieval of process and their results

Steps	Consecutive query steps	Query strings	Number of documents
1	‘competence’ and all words derived from it (i.e. competency, competencies) in title, abstract and keywords	TITLE-ABS-KEY (competen*)	574 770
2	‘competence’ and all words derived from it (i.e. competency, competencies) in title, abstract and keywords, publications in the fields Business, Management and Accounting, Economics, Econometrics and Finance	TITLE-ABS-KEY (competen*) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON"))	40 229

Cont. table 1.

3	All words derived from 'competence' cooccurring with word logistics or transport Publications in the fields Business, Management and Accounting, Economics, Econometrics and Finance	(TITLE-ABS-KEY (competen*) AND TITLE-ABS-KEY (logisti*) OR TITLE-ABS-KEY (transpor*)) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON"))	1 176
4	All words derived from 'competence' cooccurring with word logistics or transport Publications in the fields Business, Management and Accounting, Economics, Econometrics and Finance, timeframe 2019-2024, limited to open access, articles only, language limited to English	TITLE-ABS-KEY (competen*) AND TITLE-ABS-KEY (logisti*) OR TITLE-ABS-KEY (transpor*) AND PUBYEAR > 2018 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))	163

Source: own elaboration based on the Scopus database search results.

The Autor analysed the abstracts of the 163 articles. This analysis resulted in a reduction of the literature based to 20 articles because abstracts of 146 articles not related to the aim of the article.

The bibliometric analysis was performed using MS Excel and VOSviewer version 1.6.20. The analysis allowed to identify the most popular keywords along with their frequency.

Keywords provided by the authors in the selected 20 publications were examined. The sum of all keywords is 106, of which the most common are 'logistics' - 15 times and Supply Chain Management - 11 times, while 'leadership' and 'Sustainable development' - seven times each.

Table 2.

Most frequently occurring keywords from publications meeting the selection criteria after abstract analysis

Rank	Keyword	Frequency of keyword occurrence
1	Logistics	15
2	Supply Chain Management	11
3	Leadership	7
	Sustainable development	
4	Human	6
	Supply Chain	
5	Article	5
	Decision making	
	Air transportation	
6	3PL	4
	Competencies	
	Sustainability	
	Performance	
	Industry 4.0	
	Skills	

Source: own elaboration based on analysis performed in VOSviewer.

The Author then used VOSviewer to graphically represent the frequencies and links between keywords of articles for full-text analysis. The premise of minimum number of occurrences of a keyword: 4 – Fig. 3.

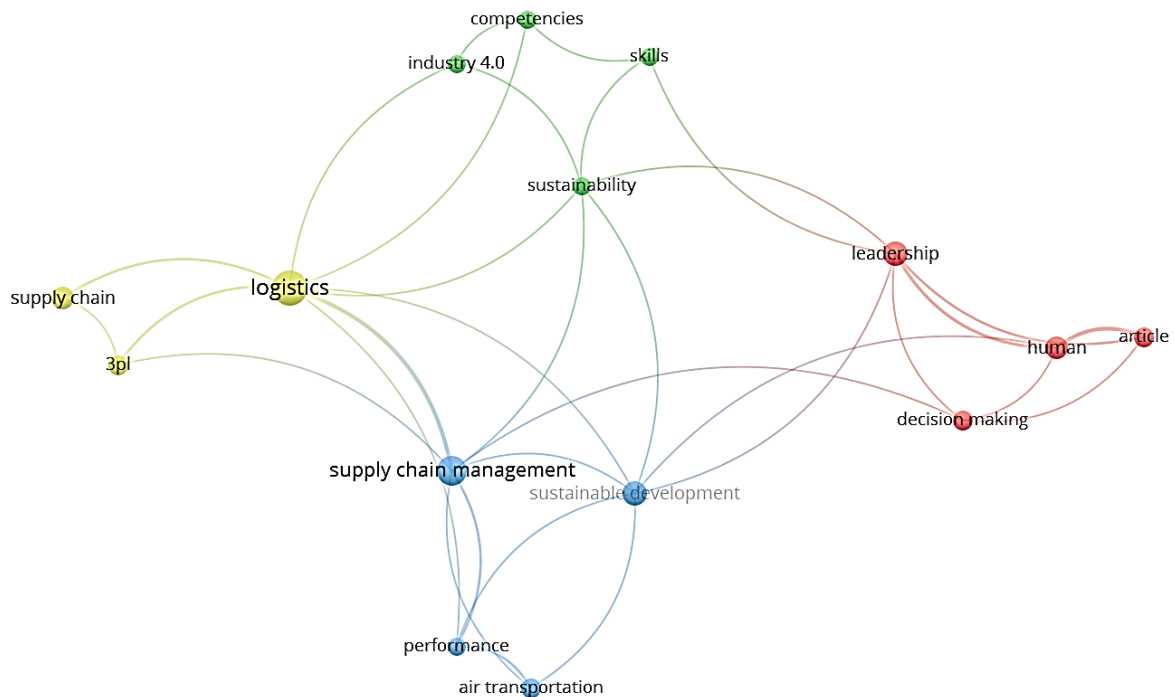


Figure 3. Keywords map based on the most popular keywords along with their frequency.

Source: own elaboration based on analysis performed in VOSviewer.

As can be seen in Figure 3, were identified 4 thematic areas (so-called clusters), which are represented by sets of related keywords.

The literature accepted for the study (20 publications) was subjected to full-text analysis. The first section will present the articles that were rejected with the reason.

The article Artz, Goodall, Oswald (2019) concerned on the first statistically representative international estimates of the extent to which employees have ‘bad bosses’ and research on Peter Principle (managers and supervisors are routinely promoted to one level too high relative to their abilities, within organizations) - does not apply to the competence of logistics professionals

Medeiros, di Serio & Moreira (2021) article based on case study Avon Brazil which aim is to develop in each student analytical competencies by evaluating current logistics processes.

The other articles analysed can be grouped: first group are those dealing with competencies in general i.e. competency framework, categories of competencies. Second group are articles dealing with both the logistics industry, transport industry and competencies. Third group are articles dealing with IT application, HR, leadership, logistics and competencies.

Group one: General research about competencies

Ali & Qureshi (2021) validate a scientifically developed competency framework and assesses the prospects of its application in specific industrial sector of Paksitan. The proposed framework was validated for having relevant content and likelihood of its usefulness. They show that the use of competency frameworks is often hindered because of conceptual ambiguity of methodological rigor in the development of such systems, and psychometric

issues. The authors propose that the competency framework could be verified in settings like other industries, larger geography, more diverse groups.

Larsson & Björklund (2020) Measures Developmental Leadership Questionnaire (DLQ) based on a structural equation modeling analysis, was used to assess leadership behaviors. The DLQ, contains items designed to measure the leader characteristic: task-related competence (two items), management-related competence (four items), social competence (two items) and stress management skill related competence (four items). Data was collected using the developmental leadership questionnaire from a sample of Swedish leadership course participants.

Kannan & Garad (2021) presented as attachment a list of core competencies required by employees to cope with the specific job and tasks in Industry 4.0 was derived, divided into the four main established categories of competencies: Technical, Methodological, Social and Personal to create a competency model tool to assess specific competencies of individual employees, by customizing it to specific department or job profile, and to identify the competence gap - the authors focused on the competencies required for quality management professionals to meet the needs of industry 4.0.

Group two: Competencies, logistics industry, transport industry

The main goal of research Andrejić, Kilibarda, Pajić (2022) was how to determine what factors and how affect employee's satisfaction and loyalty in the logistics sector in the Serbian. The results of the research show that employees working in logistics companies have to multiple skills and knowledge, such as professional knowledge, practical skills, knowledge of computer programs (such as excel, word, etc.), knowledge of the foreign language, personal characteristics, communication skills, interest in the job, motivation, persistence, etc.

Bremer & Maertens (2021) compared ten studies on future competencies from different countries, using the ESCO classification (European Skills/Competencies, qualifications and Occupations). They noticed that communication, collaboration and creativity are three competencies that should not be viewed individually as they are often interlinked. What is important the most common competencies – using of foreign languages. Other skills: working with computers and programming computer systems, solving problems and adapt to change. They focused on the air transport industry especially the future skills of flight attendants.

The main purpose of article Dobroszek (2020) was the required competences and tasks undertaken while taking into account current trends in supply chain management and its wider dimensions based on job advertisements addressed to the German market. The core competences were analysed. In both cases (logistics controllers or SC controllers) knowledge/cognitive competences prevails, the second place is occupied by personal/behavioural competences. Third place in the analysis was taken by functional competence. Values and ethical competences are rarely mentioned. The study fills the gap between theory and practice by pointing to the need to use a controller and shape the correct

profile (“engaging inspirer” or “creative maker”) to achieve faster efficiency and transparency of SCM required by the modern economy (e.g. Industry 4.0).

Drejeris, Katinienė, Vaičiūtė & Čiutienė (2024) focused on key competencies of logistics specialists i.e. group of explicit competencies (i.e. use of information technologies (technically complex) in transportation process) and group of tacit competencies (i.e. motivation to work, autonomy at work). They described how to measure creativity and innovation. The SAW and AHP methodologies were selected to research and evaluate the logistics specialists’ competencies based on criteria.

Thi Nong, Phuong & Duc-Son (2024) suggested that extended the research model by adding the effect of CJF (Competence-Job Fit) on employee performance and job satisfaction because the close relationship between employee competence and CJF. The authors applied competence relevant theories such T-model in logistics, KBV (Knowledge-based view), KSA (Knowledge - Skills – Ability) and Social exchange theory to explain the concept of competence and propose the moderating role of social exchange on the relationships between employee competence and employee performance and job satisfaction. Research findings confirm and support the positive impact of employee competence and CJF on business performance.

The aim of the empirical research Gołemska & Gołembski (2020) was, equally, to appraise the current state of the HRM design in logistics management, and to identify current trends in this area. The research tool was a survey questionnaire. The model of HR management in company logistics presented in article is merely a first attempt at characterizing this very important relation between the management of de facto human resources, and the management of material resources through the performance of logistics tasks.

Jena & Ghadge (2021) mentioned that to minimize the talent shortfall, logistics experts suggest that SCM managers must go through training and development (T&D) process for acquiring the necessary skills and gain competitive competencies to manage increasingly complex and dynamic SC processes. The purpose of their study was to explore the effect of intra HRM–SCM and joint HRM–SCM decisions on the performance of the supply chain.

Katinienė, Jezerskė & Vaičiūtė (2021) analysed the peculiarities of the competencies of logistics specialists and their use as a tool to ensure the development of logistics organisations and the quality of logistics services. They proposed three main competence groups can be distinguished which must be well- mastered: special competencies (to understand the principles of logistics and transport operations, i.e., the competencies required to fulfill the assignment); analytical competencies (the competencies needed to plan an optimal route, select cargo criteria, identify the needs of the clients, i.e., the competencies related to the analysis, synthesis, modeling methods); personal competencies (communication, cooperation with clients, i.e., self-management competencies). The applied multi-criteria evaluation method, i.e., n selected experts evaluated m indices by way of ranking.

Group three: Competencies, logistics industry, HR, leadership, IT application

Kuráth, Bányai, Sipos et al. (2023) indicate that trust between leaders and employees impacts organizational citizenship behaviors (OCBs), communication, performances, attitudes and intentions, like organizational commitment, job satisfaction, commitment to decisions made by the leader, cooperation, and information-sharing learning. They used a Confirmatory Factor Analysis (CFA). The research confirmed that trust and communication are distinguished factors of leadership success, whereas warmth is measured to have twice as much important as professional competence in building the former two.

Piwovar-Sulej & Bąk-Grabowska (2024) the aim of study was to identify the differences in employers' and workers' attitudes toward the development of future competencies, in the context of two FoEs: B2B contract and contract of mandate. The authors took services from a research agency to determine the sample size and collect data. The research sample consisted of 200 respondents (100 people representing each analysed FoE, i.e. dependent self-employment and contract of mandate; one respondent per company). The authors listed 14 detailed future competencies: technical/vocational, analytical, complex problem-solving, computer literacy, skills in the latest technologies, teamwork, virtual teamwork, creative thinking, interpersonal communication, proper nutrition, how to maintain physical health, stress resilience, ability to adapt to and act in new situations, including learning, command of foreign languages.

Alrashedi (2024) notes, that logistics firms face difficulties in matching available local talent with industry-specific job requirements. Author acknowledges that a clear lack of research specifically focusing on the unique challenges and opportunities within the logistics industry. He used the DEMATEL technique to analyse the important factors that impact the effectiveness of Human Resources (HR) Departments in logistics firms in Saudi Arabia and the multi-criteria decision making (MCDM) technique. Proposed parameters are considered significant factors and are given high priority, highlighting their crucial role in candidate selection and HR decision-making.

Zamkova, Polishchuk, Dovhan, Dovhan & Novytskyi (2023) proposed a conceptual model of a multi-level national system of professional training of logistics and supply chain specialists. They developed a T-shaped model of the competencies of modern logistics and supply chain managers which is based on a combination of deep hard and broad soft skills.

Pocatilu, Enăchescu & Diță (2020) presented the prototype of an application that combines semantic technologies with augmented reality (AR) in order to enhance the plain text from a CV content with context-aware information in regards to the technical background of the applicant. The authors developed the prototype of a CV screening system that helps the recruiter to upload the candidate's CV for a given position and displays a graph with the skills of the applicant and how those skills relate to others in the field. Conclusion: CV filtering process providing a more trustworthy approach than manual selection performed by the HR personnel.

The above analysis shows that the thematic area of competence in logistics is very broad.

3. Summary of the research results

The reflections and analyses of the research papers on competences in the logistics industry made it possible to realise the stated objective and answer the research questions posed. The growing interest in the topic of competencies is from the increasing instability of the environment for example COVID-19, the war in Ukraine, the progress and dynamic digital and ecological transitions.

Among the studies analysed, it can be identified three groups of publications on competences:

- general research about competencies,
- research about competencies, logistics industry, transport industry,
- research about competencies, logistics industry, HR, leadership, IT application.

Researchers focus their attention on a specific market e.g.: the Serbian market - Andrejić, Kilibarda, Pajić (2022), German market - Dobroszek (2020), Brazilian market - Medeiros, di Serio & Moreira (2021), industrial sector of Paksitan - Ali & Qureshi (2021) and Saudi Arabian market Alrashedi (2024). They stress that conditions force the search/exploration of specific competences. The main consideration is the degree of economic development or cultural differences.

The authors approach the classification of competences in different ways (Table 3).

Table 3.
Division of competences (based on literature review)

The author	Group of competences
Dobroszek (2020)	<ul style="list-style-type: none"> • knowledge/cognitive competences prevails, • personal/behavioural competences, • functional competence.
Katinienė, Jezerskė, Vaičiūtė (2021)	<p>The peculiarities of the competencies of logistics specialists.</p> <ul style="list-style-type: none"> • special competencies, • analytical competencies, • personal competencies.
Kannan, Garad (2021)	<ul style="list-style-type: none"> • Technical skills, • Methodological skills, • Social skills, • Personal skills.
Alrashedi (2024)	<ul style="list-style-type: none"> • Academic qualification, • Skills and competencies (practical skills, soft skills). • Experience and track records (involves evaluating the length of employment, range of duties, noteworthy achievements, and performance reviews). • Cultural fit refers. • Potential and future development.
Drejeris, Katinienė, Vaičiūtė, Čiutienė (2024)	<p>Key competencies of logistics specialists:</p> <ul style="list-style-type: none"> • group of explicit competencies (i.e. use of information technologies (technically complex) in transportation process). • group of tacit competencies (i.e. motivation to work, autonomy at work).

Cont. table 3.

Piwowar-Sulej, Bąk-Grabowska (2024)	technical/vocational, analytical, complex problem-solving, computer literacy, skills in the latest technologies, teamwork, virtual teamwork, creative thinking, interpersonal communication, proper nutrition, how to maintain physical health, stress resilience, ability to adapt to and act in new situations, including learning, command of foreign languages.
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Source: own elaboration based on literature review.

As can be seen (using 2024 as an example), there is no single, coherent set of competencies for the logistics employees.

Other interesting findings from the analysis include:

- Communication, collaboration and creativity are three competencies that should not be viewed individually as they are often interlinked (Bremer, Maertens 2021).
- Methodological rigor in the development of competence systems is hampered by conceptual ambiguity (Ali, Qureshi 2021)
- Values and ethical competence are rarely mentioned (Dobroszek, 2021).

From the literature research carried out, it is particularly important to note that there is no single set of competences needed to work in the logistics industry. The authors unequivocally point to the need to strengthen behavioural competences. Importantly, there is no consensus on the tool used to measure logistics competencies. The Author think that, the possibility of replicating the obtained results by others interested in conducting research in this area.

The present study is not without limitations: the results obtained are dependent on the adopted search criteria. Changing or extending the search criteria (other databases of scientific publications, different time frame, other keywords, narrowing down to other scientific fields). Also, repeating the study based on the same assumptions at a later stage may yield interesting results regarding the further evolution of research on the competence needs of logistics employees. Similarly, the application of other methods of analysis could be an interesting direction for further considerations.

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R&D EXPENDITURE IN CHALLENGING ECONOMIC TIMES. RESULTS FROM THE VISEGRAD GROUP COUNTRIES

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Purpose: The aim of the paper is to examine how R&D expenditure differs among the Visegrad Group countries in challenging economic environment.

Design/methodology/approach: The research uses a comparative analysis, zero unitarization method and a multivariate analysis. The application of these methods allows the division of the Visegrad Group countries according to the level of the R&D expenditure variables. The research is based on Eurostat data. The research period was 2011–2022, when the Visegrad Group countries faced inflationary pressure and the covid pandemic.

Findings: The results show a relatively high diversity among the Visegrad Group countries in terms of R&D expenditure. Czechia and Poland stand out with a very high level of R&D expenditure variables, which may indicate a high capacity for innovation and resilience despite challenging economic circumstances.

Research limitations/implications: The study has some limitations that could be areas for future research. As the study focuses on R&D expenditure by sector (in relation to gross domestic product) and on intramural R&D expenditure in the business enterprise sector and the government sector (in relation to total expenditure), it would be valuable to investigate whether the results obtained also hold for other measures of R&D expenditure. It might also be worthwhile to examine how the Visegrad Group countries differ from the other peripheral countries of the European Union in terms of R&D expenditure in times of challenging economic circumstances.

Practical implications: The results call for a further strengthening of conditions to support R&D expenditure, firms' innovation attitudes and knowledge transfer, among others, between the research system, government institutions and firms in order to support firms' resilience to changes in economic environment.

Originality/value: The research contributes to the discussion on firms' innovation activities and their adaptation to challenging economic circumstances. In this context, the study focuses on R&D expenditure and provides evidence on how expenditure in question differ across the Visegrad Group countries in times of inflationary pressure and the covid pandemic.

Keywords: R&D expenditure, innovation activities of firms, the Visegrad Group countries, challenging economic environment, resilience.

Category of the paper: research paper.

1. Introduction

In recent years, there has been an increase in studies related to the resilience of firms, regions and countries to challenging economic environment (Teixeira et al., 2013; van der Loos et al., 2024) in response to the financial crisis, periods of inflationary pressure and the covid pandemic (Wziątek-Kubiak, Pęczkowski, 2021). This is related to the need to study the attitude and maintenance of firms, regions and countries towards change in order to maintain or improve competitiveness (Pacheco et al., 2023). In this area, particular research interest has been placed on the drivers and sources of resilience of firms, regions and countries (Gupta, 2020, Van der Loos et al., 2024). In this context, an important strand of the literature has paid particular attention to firms' innovation activities as crucial for the resilience of firms, regions and countries in challenging economic times (Viana et al., 2023). This is because firms' innovation performance plays an essential role in the development of not only firms, but also regions and countries, affecting their competitiveness (Audretsch, Belitski, 2024). For this reason, studies on resilience have drawn attention to the drivers and sources of firms' innovation activities as support for adaptation to severe conditions, such as, among others, economic crises (Bristow et al., 2018; Pinto et al., 2019). In this respect, particular emphasis has been paid to research and development (R&D) activities as crucial for firms' innovation performance and firms' resilience to challenging economic environment (Gupta, 2020; Wyrwa, 2022). Studies on resilience have considered here not only R&D activities of firms, but also those of the research system and the government institutions as essential for knowledge transfer and innovation processes (Wyrwa, 2022). This is consistent with endogenous growth, resilience and knowledge spillovers theories (Viana et al., 2023; Audretsch, Belitski, 2024). Among the studies on R&D activities, one strand of the research has focused on R&D expenditure as important for firms' innovation activities and the resilience of firms and, consequently, of regions and countries.

The growing importance of the issues related to resilience of firms, regions and countries, as well as the drivers of firms' innovation performance in challenging economic times, have stimulated this research. As few studies have focused on the area of R&D expenditure in relation to the Visegrad Group countries, this research addresses this gap.

Therefore, the aim of this study is to examine how R&D expenditure differs among the Visegrad Group countries in challenging economic environment. The research was based on data from Eurostat. The research period was 2011-2022, when the Visegrad Group countries faced inflationary pressure and the covid pandemic. The hypothesis was tested using the comparative analysis, zero unitarization method and the multivariate analysis.

This research offers a compliment to the existing research on resilience of firms to challenging economic times and the ongoing discussion on the drivers of firms' innovation activities. The study pays special attention to R&D expenditure and shows how expenditure in question differ across the Visegrad Group countries. This study also sheds further light on R&D expenditure in the face of challenging economic environment.

The remainder of the paper is as follows: the first section presents the theoretical background and the hypothesis. The next section describes the data and the methodology applied to identify how R&D expenditure differs among the Visegrad Group countries in challenging economic times. The results are then presented and discussed. In the last section, the conclusions are presented, including implications, limitations and suggestions for further research.

2. Literature review

The debate on the drivers and sources of resilience of firms, regions and countries is still ongoing, as there is a growing need to understand the issues related to adaptation to challenging economic times (Engelen et al., 2021; van der Loos et al., 2024). In recent years, explicit attention has been paid in this area to the drivers and sources of firms' innovation performance (Asheim, Herstad, 2021). The reason for this is that firms' innovation performance could support the resilience of firms as well as regions and countries (Gupta, 2020; Engelen et al., 2021). This is because there are strong theoretical reasons to believe that firms' innovation activities affect on the competitiveness of regions and countries (Audretsch, Belitski, 2024). This link is of interest to the theory of endogenous growth and knowledge diffusion, which emphasises networks between firms and, inter alia, the research system and the government institutions. Building on this, scholars have considered various drivers and sources of firms' innovation activities in relation to firms' resilience to challenging economic times (Pinto et al., 2019; Viana et al., 2023). In this respect, R&D activities have received particular attention in recent years (Teixeira et al., 2013; Gupta, 2020). The importance of these stems from the fact that R&D activities are seen as a stimulator of firms' attitude towards innovation (Wziątek-Kubiak, Pęczkowski, 2021).

Regarding R&D activities and resilience, the increasing importance of R&D expenditure is considered in the studies as crucial for firms' innovation activities and their adaptation to challenging economic times (Bristow, Healy, 2018; Gupta, 2020; Engelen et al., 2021; Viana, 2022). The analysis of the literature in this area highlights different approaches to consider R&D expenditure, given its multidimensional nature. In this context, Viana et al. (2022) point to the importance of expenditure on research and development (in general term) for innovation and resilience processes. Bristow and Healy (2018), Gupta (2020), Engelen et al. (2021)

consider R&D expenditure of firms as essential for firms' adaptation to challenging economic circumstances. Other studies also point to the importance of R&D expenditure of the government and the higher education sectors as substantial in supporting firms' innovation activities and knowledge transfer (Blanco et al., 2020; Maikel et al., 2020; Rehman et al., 2020). In this sense, Maikel et al. (2020), analysing 28 OECD countries over the period 1995-2017, provide evidence that R&D expenditure of the government sector supports firms' innovation activities and helps firms to be resilient to economic crises. On the other hand, Blanco et al. (2020) analyse the convergence of R&D expenditure in the European Union countries (taking into account the financial crisis of 2008) and show different attitudes of firms' R&D expenditure, R&D expenditure of the government sector and R&D expenditure of the higher education sectors towards the economic crisis. Similarly, Rehman et al. (2020) focus on R&D expenditure of firms, the research system and the government institutions in the European Union (considering the financial crisis of 2008) and provide evidence that research and development expenditure of the government and the higher education sectors encourage and support firms' innovation performance in the face of economic crises.

The rising relevance of R&D activities is also observed in the studies on the Visegrad Group countries, which also consider the issues related to R&D expenditure. However, the majority of them refer to R&D expenditure in the context of innovation performance of firms and do not address the occurrence of the challenging economic environment. In this respect, among others, Ivanová and Žárská (2023) analyse R&D expenditure in the context of the aggregate innovation index. Hunady et al. (2017) provide evidence on the relationship between gross domestic R&D expenditure and the development of regions from the Visegrad Group countries. Another study by Bednarzewska and Zniczuk (2024) examines the drivers of triple helix cooperation readiness in the Visegrad countries, with a special focus on R&D expenditure. On the other hand, Bočková (2013) analyses R&D expenditure by sector in the Visegrad Group countries in comparison with the other countries of the European Union, and shows that the Visegrad Group countries are characterized by a low level of R&D expenditure during the period 2006-2011. Jabłońska (2020) examines the regions of the Visegrad Group countries in the terms of R&D activities (including also R&D expenditure) and shows the increase of R&D activities after the accession to the European Union countries.

Over the last couple of years, studies on R&D activities and the resilience of firms in the Visegrad Group countries have also been noted. However, they are relatively scant. Among these studies, Bachmann and Frutos-Bencze (2022) emphasise that R&D activities of universities, including those from the Visegrad Group countries, support the resilience of firms during the covid pandemic (through knowledge transfer and strengthening firms' innovation activities). Dorożyński and Kuna-Marszałek (2016) consider R&D activities when investigating the attractiveness of innovation in the Visegrad Group countries during the financial crisis of 2008. The emphasis on R&D expenditure and resilience in challenging economic times can also be seen in the studies of Kotorov et al. (2023) and Wibisono (2023).

In this context, Kotorov et al. (2023) analyse R&D expenditure under the covid pandemic in, among others, two countries of the Visegrad Group – Czechia and Poland. This research provides evidence that the covid pandemic has no long-term effect on total R&D expenditure. Another study, by Wibisono (2023), focuses on R&D expenditure in regions of the Visegrad Group countries during the financial crisis of 2008. In this respect, the research shows that R&D expenditure strengthens the innovation potential and resilience of Czechia, Hungary and Poland.

The above studies indicate the importance of R&D expenditure in challenging economic circumstances and encourage for further research. While there are only few studies focusing on R&D expenditure in the Visegrad Group countries in challenging economic times, this study aims to fill this gap. Therefore, the hypothesis of this study is as follows:

H: R&D expenditure differs among the Visegrad Group countries in challenging economic environment.

3. Methodology

In order to understand how R&D expenditure differs among the Visegrad Group countries in challenging economic environment, Eurostat data was used as a database providing information on the Member States of the European Union. The study includes R&D expenditure by sector (in relation to gross domestic product) to capture the changes in expenditure on research and development activities in times of economic shocks. In this respect, the research focuses on sectors such as: the business enterprise sector, the government sector and the higher education sector as related to the triple helix, which is crucial for knowledge transfer and innovation activities of firms. The study contains also intramural R&D expenditure as essential for an analysis of all expenditure on research and development (current expenditure and gross fixed capital expenditure for R&D) in relation to total expenditure. In this respect, the intramural R&D expenditure of the business enterprise sector and of the government sector have been taken into considerations. To indicate the changes in R&D expenditure among the Visegrad Group countries in challenging economic circumstances, the research period was 2011-2022. The main statistics of the variables used in the study and their description can be found in Table 1.

Table 1.
Descriptive statistics

Variable	Description	Mean	St. Dev.	Min.	Max.
R&D expenditure of the business enterprise sector (X_1)	R&D expenditure of the business enterprise sector (as a percentage of gross domestic product)	0.77	0.28	0.41	1.07
R&D expenditure of the government sector (X_2)	R&D expenditure of the government sector (as a percentage of gross domestic product)	0.20	0.09	0.09	0.33
R&D expenditure of the higher education sector (X_3)	R&D expenditure of the higher education sector (as a percentage of gross domestic product)	0.31	0.10	0.20	0.44
Intramural R&D expenditure of the business enterprise sector (X_4)	Intramural R&D expenditure of the business enterprise sector (as a percentage of total)	43.44	6.02	35.07	50.89
Intramural R&D expenditure of the government sector (X_5)	Intramural R&D expenditure of the government sector (as a percentage of total)	37.29	3.91	32.78	42.61

Source: own study based on data from Eurostat, 2024.

The hypothesis was tested using the comparative analysis, zero unitarization method and the multivariate analysis. The use of the comparative analysis enables to analyse how R&D expenditure differs among the Visegrad Group countries in challenging economic circumstances. The application of zero unitarization method and the multivariate analysis allow to examine how the Visegrad Group countries differ in the field of R&D expenditure in challenging economic times. The usage of these methods is motivated by their applicability in studies of differences between regions and countries (Kiselakova et al., 2020; Zygmunt, 2024). In order to understand how the countries of the Visegrad Group differ in the field of R&D expenditure under the occurrence of economic conditions of high constraints four classes were identified to show: (i) the Visegrad countries with a very high level of R&D expenditure variables, (ii) the Visegrad countries with a high level of R&D expenditure variables, (iii) the Visegrad countries with an average level of R&D expenditure variables, (iv) the Visegrad countries with a low level of R&D expenditure variables. A constant reference point was used to normalise the variables in the first step (Kukuła, Bogocz, 2014):

$$R(X_{jt}) = \max_{it} x_{ijt} - \min_{it} x_{ijt} \quad (1)$$

As the variables used in the study are stimulants, they have been standardised by means of the following formula (Kukuła, Bogocz, 2014):

$$z_{ijt} = \frac{x_{ijt} - \min_{it} x_{ijt}}{\max_{it} x_{ijt} - \min_{it} x_{ijt}}, \quad (2)$$

where $z_{ijt} \in [0,1]$; ($i = 1,2, \dots, n$); ($j = 1,2, \dots, m$); ($t = 1,2, \dots, l$).

The synthetic index was then used (Kiselakova et al., 2020):

$$SM_{it} = \frac{1}{m} \sum_{j=1}^m z_{ijt}, \quad (3)$$

where $z_{ijt} \in [0,1]$; $SM_{it} \in [0,1]$; ($i = 1,2, \dots, n$); ($j = 1,2, \dots, m$); ($t = 1,2, \dots, l$).

The countries of the Visegrad Group were then divided according to the following formula:

1. The Visegrad countries with a very high level of R&D expenditure variables:

$$SM_{it} \geq \overline{SM}_{it} + S(SM_{it}), \quad (4)$$

where $(i = 1, 2, \dots, n); (t = 1, 2, \dots, l)$.

2. The Visegrad countries with a high level of R&D expenditure variables:

$$\overline{SM}_{it} \leq SM_{it} < \overline{SM}_{it} + S(SM_{it}), \quad (5)$$

where $(i = 1, 2, \dots, n); (t = 1, 2, \dots, l)$.

3. The Visegrad countries with an average level of R&D expenditure variables:

$$\overline{SM}_{it} - S(SM_{it}) \leq SM_{it} < \overline{SM}_{it}, \quad (6)$$

where $(i = 1, 2, \dots, n); (t = 1, 2, \dots, l)$.

4. The Visegrad countries with a low level of R&D expenditure variables:

$$SM_{it} < \overline{SM}_{it} - S(SM_{it}), \quad (7)$$

where:

$(i = 1, 2, \dots, n); (t = 1, 2, \dots, l)$.

Where (Zygmunt, 2024):

$$\overline{SM}_{it} = \frac{1}{n} \sum_{j=1}^n SM_{it}, \quad (8)$$

where $(i = 1, 2, \dots, n); (t = 1, 2, \dots, l)$.

$$S(SM_{it}) = \sqrt{\frac{1}{n} \sum_{i=1}^n (SM_{it} - \overline{SM}_{it})^2}, \quad (9)$$

where $(i = 1, 2, \dots, n); (t = 1, 2, \dots, l)$

This procedure enables an analysis of how the countries of the Visegrad Group differ in terms of R&D expenditure in challenging economic environment.

4. Results and discussion

The results of the comparative analysis of the R&D expenditure variables for the Visegrad Group countries in challenging economic environment provide some interesting insights (Figures 1-5). Considering R&D expenditure by sector (Figures 1-3), the results show that the business enterprise sector stands out in terms of expenditure on research and development as the percentage of gross domestic product. This feature suggests that, despite the occurrence of conditions of high economic constraints faced by firms from the Visegrad Group countries between 2011 and 2022, a focus on improving innovation performance is evident. This may lead to an improvement in firms' competitiveness and strengthen firms' resilience to challenging economic times. This is in line with the study of Viana et al. (2023), which indicates that innovation activities of firms can be seen as increasing the ability of firms to adapt to changes in the economic environment.

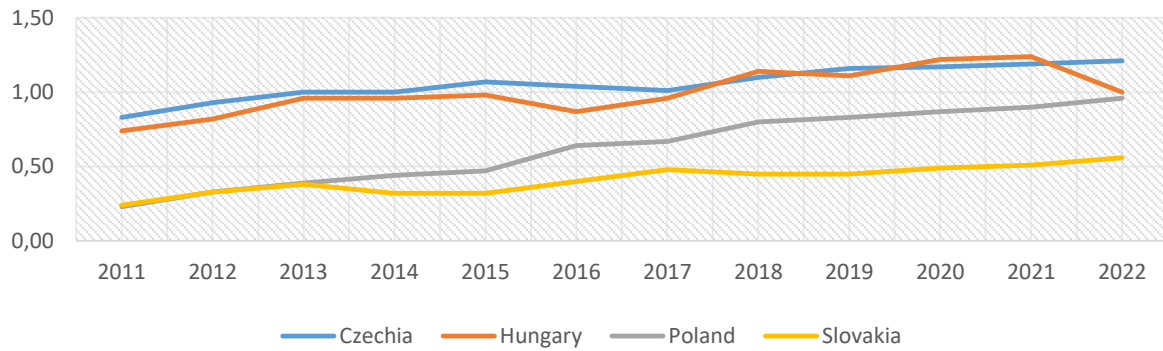


Figure 1. R&D expenditure of the business enterprise sector in the Visegrad Group countries in 2011-2022 (% of gross domestic product).

Source: own study based on data from Eurostat, 2024.

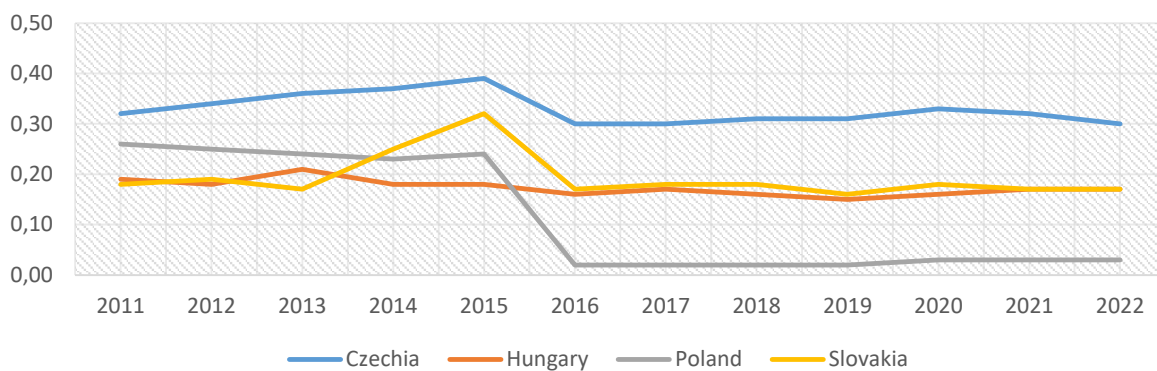


Figure 2. R&D expenditure of the government sector in the Visegrad Group countries in 2011-2022 (% of gross domestic product).

Source: own study based on data from Eurostat, 2024.

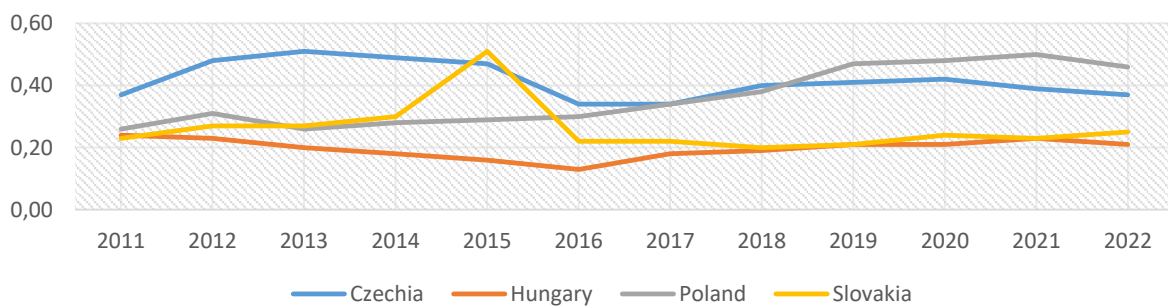


Figure 3. R&D expenditure of the higher education sector in the Visegrad Group countries in 2011-2022 (% of gross domestic product).

Source: own study based on data from Eurostat, 2024.

The results also reveal an upward tendency in R&D expenditure of firms from the Visegrad Group countries in the period 2011-2022, when firms are recovering from the financial crisis of 2008, and facing inflationary pressure and the covid pandemic. It shows that firms from the Visegrad Group countries tend to improve their ability to be innovate in challenging economic environment in order to be more competitive. Such a characteristic should be seen as positive and is consistent with the study by Wibisono (2023). According to the results, firms from

Czechia and Hungary were characterized by the highest level of R&D expenditure. This may be an indication of their higher potential for improving innovation activities of firms, their competitiveness and, consequently, the competitiveness of regions and countries.

Regarding the level of R&D expenditure of the government and the higher education sectors in the Visegrad Group countries, the results imply their increase until 2015. This may indicate the attitude of these sectors to become more competitive in order to support the development and resilience of regions and countries. This is in line with the study by Blanco et al. (2020) and Maikel et al. (2020). The significant decrease in research and development expenditure (as the percentage of gross domestic product) in these sectors is noticeable in 2016, which may be linked to the end of the programmes to support innovation in the European Union's 2007-2013 programming period. The results imply that since 2017 the level of R&D expenditure of the higher education sector is relatively increasing, which may indicate an ongoing need to strengthen the innovation potential of the research system. Significantly, this feature has been seen during the occurrences of inflationary pressure and the covid pandemic faced Visegrad Group countries during the analysed period. This should be treated as positive, as the research system is considered important for knowledge transfer to support firms' innovation activities. This is consistent with the study by Rehman et al. (2020), which suggests that the research system is crucial for the resilience of firms to challenging economic circumstances. Among the Visegrad Group countries, Czechia and Hungary have the relatively highest expenditure on R&D in the higher education sector, indicating relatively high potential for knowledge transfer. The results also imply that from 2016, the R&D expenditure of the government sector stands on the stable level despite challenging economic times. This may indicate that the government institutions are aware of the need to create conditions that support firms' ability to innovate. This is in line with the study provided by Maikel et al. (2020). The results show that among the Visegrad Group countries, Poland is characterized by the lowest level of expenditure on research and development in the period 2016-2022. This may lead to a potential deterioration in the government institutions to stimulate firms' innovativeness and their competitiveness, especially in the face of the need adapt to changes in the economic environment.

Regarding the intramural R&D expenditure of the business enterprise and the government sectors the results also imply important features (Figures 4-5).

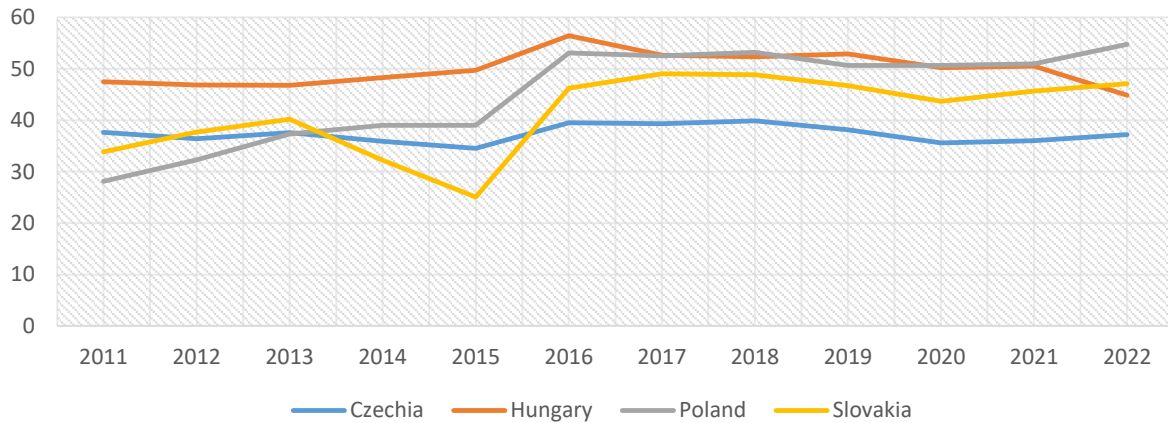


Figure 4. Intramural R&D expenditure of the business enterprise sector (% of total).

Source: own study based on data from Eurostat, 2024.

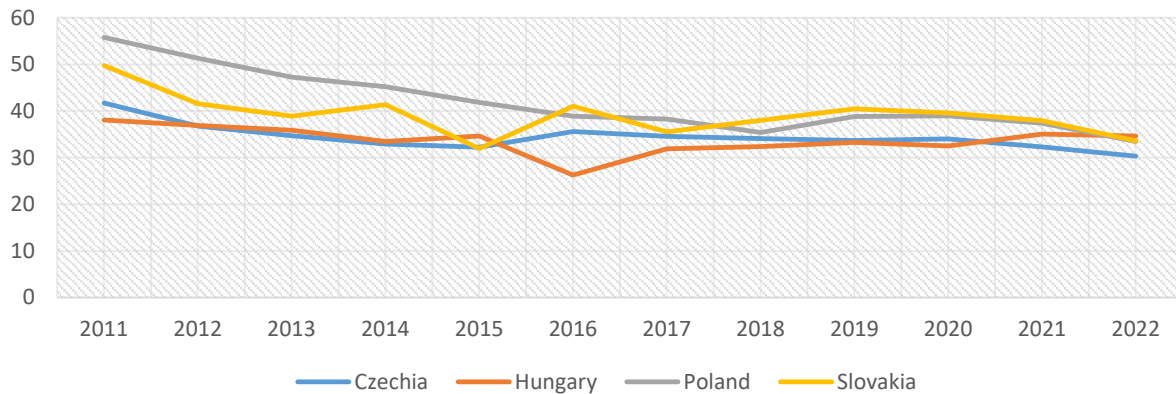


Figure 5. Intramural R&D expenditure of the government sector (% of total).

Source: own study based on data from Eurostat, 2024.

According to the results, the intramural R&D expenditure of the business enterprise sector in the Visegrad Group countries is characterized by a relative increase over the period analysed. This is particularly evident since 2016, when the share of intramural expenditure on research and development increased in all the Visegrad Group countries. The results suggest that this level of intramural expenditure on R&D has been maintained even during the occurrences of inflationary pressure and the covid pandemic, which Visegrad Group countries faced in the analysed period. This may indicate that firms from the Visegrad Group countries tend to strengthen their innovation activities in order to be more resilient to economic shocks associated with difficult conditions. This is consistent with the findings of Bachmann and Frutos-Bencze (2022). The results show that among the Visegrad Group countries, Hungary and Poland stand out in terms of the intramural R&D expenditure by the business enterprise sector. Czechia, on the other hand, is characterized by the lowest level of such expenditure, which may limit the ability of Czech firms to react quickly to different economic times.

The results also allow to observe the decreasing level of all expenditure on research and development (current expenditure and gross fixed capital expenditure on R&D) in relation to total expenditure in the government sector between 2011 and 2022. This feature is evident for

all the Visegrad Group countries and may lead to a reduced capacity to stimulate firms' innovation activities, especially when firms face challenging economic circumstances and need support. This may affect not only the competitiveness of firms, but also the competitiveness of regions and countries.

Considering the results of zero unitarization method and the multivariate analysis the findings provide evidence of the relatively high diversity among the Visegrad Group countries in terms of expenditure on R&D in the period 2011-2022 (Tables 2-4). This is in line with the stated hypothesis and offers some interesting insights.

Table 2.

Results of the multivariate analysis of R&D expenditure in the Visegrad Countries – part 1

2011			2012			2013			2014		
No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM
Very High			Very High			Very High			Very High		
1.	Czechia	0.740	1.	Czechia	0.656	1.	Czechia	0.606	1.	Czechia	0.646
Average			Average			High			Average		
1.	Hungary	0.398	1.	Hungary	0.364	1.	Hungary	0.447	1.	Poland	0.437
						Average					
2.	Poland	0.357	2.	Poland	0.352	1.	Poland	0.316	2.	Hungary	0.397
Low			Low			Low			Low		
1.	Slovakia	0.194	1.	Slovakia	0.184	1.	Slovakia	0.172	1.	Slovakia	0.289

Source: own study based on data from Eurostat, 2024.

Table 3.

Results of the multivariate analysis of R&D expenditure in the Visegrad Countries – part 2

2015			2016			2017			2018		
No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM
Very High			Very High			Very High			Very High		
1.	Czechia	0.659	1.	Czechia	0.727	1.	Czechia	0.683	1.	Czechia	0.650
High			High			High			High		
1.	Poland	0.484	1.	Poland	0.568	1.	Poland	0.670	1.	Poland	0.591
Average			Average			Average			Average		
1.	Hungary	0.430	1.	Slovakia	0.472	1.	Hungary	0.488	1.	Hungary	0.484
Low			Low			Low			Low		
1.	Slovakia	0.333	1.	Hungary	0.447	1.	Slovakia	0.423	1.	Slovakia	0.454

Source: own study based on data from Eurostat, 2024.

Table 4.

Results of the multivariate analysis of R&D expenditure in the Visegrad Countries – part 3

2019			2020			2021			2022		
No.	Co.	SM	No.	Co.	SM	No.	Co.	SM	No.	Co.	SM
Very High			Very High			Very High			Very High		
1.	Czechia	0.565	1.	Poland	0.686	1.	Poland	0.688	1.	Poland	0.670
2.	Poland	0.631	High			High			Average		
Average			1.	Czechia	0.585	1.	Hungary	0.590	1.	Czechia	0.528
			Average			Average					
1.	Hungary	0.475	1.	Hungary	0.481	1.	Czechia	0.505	2.	Hungary	0.526
Low			Low			Low			Low		
1.	Slovakia	0.413	1.	Slovakia	0.430	1.	Slovakia	0.426	1.	Slovakia	0.401

Source: own study based on data from Eurostat, 2024.

The results reveal, among others, that the diversity between the Visegrad Group countries in terms of R&D expenditure have changed over the period under consideration. This may be a consequence of the attitude and ability of firms, the research system and the government institutions to be innovative and competitive in the face of difficult conditions. According to the results, the highest diversity among the Visegrad Group countries can be observed between Czechia and Slovakia (in the almost the whole period 2011-2019) and between Poland and Slovakia (between 2020-2022). In this respect, Czechia (2011-2019) and Poland (2020-2022) have the very high levels of the R&D expenditure variables used in the study, compared to the other Visegrad Group countries. This implies that these countries, despite the occurrence of inflationary pressure and the covid pandemic, have the highest ability to strengthen firms' innovation activities through research and development expenditure. This may provide a greater ability to strengthen their resilience and competitiveness and, consequently, the resilience and competitiveness of regions and countries. This is in line with the study by Wibisono (2023). On the other hand, Slovakia, compared to the other the Visegrad Group, is characterized by the lowest level of the variables related to the R&R expenditure. This is observed throughout the period analysed suggesting that Slovakia may have a limited ability to react and adapt to changes in the economic environment. Such an occurrence may have an impact on the ability of Slovak firms to innovate. The results also show that the average level of the variables related to expenditure on research and development in Hungary is almost unchanged for throughout the period 2011-2022. This suggests that despite the challenging economic circumstances, Hungary maintained the average level of R&D expenditure. This suggests the potential of Hungarian firms, the research system and the government sector to maintain the resilience in challenging economic times.

5. Conclusions

This study adds to the discussion on firms' innovation activities and their resilience to challenging economic circumstances. In this respect, the article focuses on R&D expenditure and provides evidence on how expenditure in question differ across the Visegrad Group countries. The period 2011-2022, when the Visegrad countries faced inflationary pressure and the covid pandemic, was of particular interest. The results indicate the relatively high diversity among the Visegrad Group countries in terms of R&D expenditure. This may have consequences for firms' innovation performance and their adaptation to challenging economic times. The research shows that Czechia and Poland distinguish the very high level of R&D expenditure variables, which may indicate a high ability to strengthen innovation activities of firms despite challenging economic circumstances. The results also provide evidence that

Slovakia is characterized by the relatively low level of R&D expenditure variables. This may have implications for the resilience of Slovak firms to changes in the economic environment.

The study has implications for policy makers and practitioners. Regarding the importance of R&D expenditure for firms' innovation activities and their resilience to challenging economic environment, it seems important for policy makers to further strengthen the conditions to support firms' innovation attitudes as well as knowledge transfer between the research system (as a knowledge provider for innovation) and firms. On the other hand, firms should take actions to further strengthen their innovation performance to support resilience to challenging economic times.

There are limitations to this study that could be areas for future research. In particular, since this study focuses on R&D expenditure by sector (in relation to gross domestic product) and intramural R&D expenditure of the business enterprise sector and of the government sector (in relation to total expenditure) it would be beneficial to use other variables describing R&D expenditure and to examine whether the results obtained also hold for them. The other area of research that needs further attention is to examine the reasons for the observed discrepancies among the Visegrad Group countries in terms of R&D expenditure in challenging economic circumstances. Furthermore, as the study focuses on the Visegrad Group countries, a fruitful area of research would be to investigate how the Visegrad Group countries differ from the other peripheral countries of the European Union in terms of R&D expenditure in challenging economic environment.

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DETERMINANTS OF ENTREPRENEURIAL ACTIVITY IN THE PERIPHERY: A MICRO SPATIAL PERSPECTIVE

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Purpose: The paper aims to identify the extent to which the determinants of entrepreneurial activity differ at the micro spatial level in a peripheral region.

Design/methodology/approach: Based on a sample of 71 micro spatial NUTS-5 units (municipalities) that constitute the peripheral region, the Opolskie Voivodeship, Poland, we applied Hellwig's linear ordering method to test the research hypothesis. Data from the Local Data Bank of the Polish Central Statistical Office for the years 2015, 2020 and 2022 were used.

Findings: This study demonstrates that while the determinants of entrepreneurial activity in a peripheral region vary at the micro level, their spatial distribution in the Opolskie Voivodeship remains stable. Urban areas offer the most favourable environment for entrepreneurial activity, while rural units show more moderate conditions. Spatial units with the best conditions for entrepreneurship exhibited limited spillover effects to neighbouring areas.

Research limitations/implications: This study has limitations, including a focus on selected years and a limited set of determinants, which may not allow to capture the full range of determinants of entrepreneurial activity at the micro spatial level. Future research could increase robustness by including additional variables, comparing different time periods and using alternative data analysis methods at the micro spatial level.

Practical implications: The results suggest that regional development policies in peripheral regions should focus on improving underperforming micro spatial units while leveraging the strengths of those with better conditions for entrepreneurship. The lack of spillover effects from those units with the most favourable conditions for entrepreneurship to others highlights the need for localised interventions to support entrepreneurship in a more targeted way.

Originality/value: The paper contributes to the recent literature on regional entrepreneurship by focusing on micro spatial units (NUTS-5) in a peripheral region, uncovering spatial patterns that may be overlooked in broader regional studies.

Keywords: entrepreneurial activity, determinants, peripheral region, micro spatial diversity.

Category of the paper: Research paper.

1. Introduction

Entrepreneurial activity is widely recognised as a fundamental driver of economic growth and development (Acs et al., 2007). Previous research has mainly focused on individual-level factors influencing entrepreneurship, such as human capital and entrepreneurial motivations for growth (Huggins et al., 2017), and regional factors, such as economic infrastructure and access to networks (Sternberg, 2022). The role of entrepreneurship is particularly important in peripheral regions, which often face structural challenges such as limited access to financial resources, markets and skilled labour (Naudé et al., 2008; Fritsch, Wyrwich, 2013). However, despite the growing recognition of the importance of entrepreneurship for regional development (Brekke, 2015; Patel, Wolfe, 2023), the spatial diversity of the determinants of entrepreneurial activity in the periphery remains under-researched. This gap is particularly important given that such regions face specific constraints and challenges that differ from those of more developed regions. As a result, there is a need for an extended research into the region-specific factors that influence entrepreneurial behaviour. Recent studies emphasised how local context and regional specificities, including geographical and cultural factors, could strongly affect the entrepreneurial ecosystem (Stam, Welter, 2020). In addition, research showed how spatial variation within regions, related to the degree of agglomeration effect and knowledge spillovers, influences start-up rates in cities in developing countries (Duran, 2023). These findings highlight the need to study entrepreneurship through a spatial lens, since recognizing regional distinctness seems to be essential in shaping entrepreneurial outcomes in a periphery.

Therefore, the aim of the paper is to identify the extent to which the determinants of entrepreneurial activity differ at the micro spatial level in a peripheral region. We tested the research hypothesis using a sample of 71 micro spatial NUTS-5 units (municipalities) located in the peripheral region, Opolskie Voivodeship, Poland. We used Hellwig's linear ordering method to analyse the data. The data were obtained from the Local Data Bank of the Polish Central Statistical Office for the years 2015, 2020 and 2022.

Our research contributes to the literature on entrepreneurship and regional development by providing micro-level evidence on the spatially heterogeneous and persistent nature of entrepreneurial determinants in peripheral regions. We identify a lack of spillover effects between neighbouring units, when one of them is considered to be the most conducive to entrepreneurship, suggesting that local policies, infrastructure, and institutional frameworks play a crucial role in fostering or hindering entrepreneurship at the micro spatial level. These findings may have implications for regional development policies, in particular for the prioritisation of local interventions to promote entrepreneurship.

The remainder of the paper is structured as follows: the next section reviews the literature and develops the research hypothesis. The subsequent sections describe the research methodology, present the results and provide a discussion. Finally, the concluding remarks, limitations and suggestions for future research are presented in the last section.

2. Literature review

The region, or more specifically ‘location’ as emphasised by Acs et al. (2007), is crucial for entrepreneurial activity because it provides the resources and environmental conditions such as infrastructure, finance, policy, culture and the labour market, that influence entrepreneurial processes (Guerrero et al., 2021). These determinants of entrepreneurial activity are broadly categorised as demand and supply side, institutional and cultural determinants, and agglomeration effects (Bosma et al., 2008).

The demand-side reflects the extent to which there is potential demand for entrepreneurship, as indicated by factors such as per capita income and population density. Peripheral regions often face lower population densities and limited access to wider consumer markets, which limits the demand for goods and services (Duran, 2023). This reduced local demand can make it difficult for entrepreneurs to scale up their businesses (Buratti et al., 2022). Thus, as highlighted by Ross et al. (2015), spatial variation in local demand determinants can affect the need for ongoing entrepreneurship, resulting in regional disparities in this regard.

On the supply side, which reflects the extent to which a region has a latent entrepreneurial workforce, several determinants influence entrepreneurial activity. These include unemployment and human capital. The local unemployment rate serves as a key indicator of regional economic distress, reflecting the overall health of local businesses (Acs et al., 2007). When economic conditions worsen, latent entrepreneurial aspirations are often triggered, pushing individuals towards self-employment as a response to reduced employment opportunities (Ross et al., 2015). Moreover, educational opportunities are often limited in peripheral areas, leading to lower levels of skills development and training (Deller et al., 2019). The migration of educated young people to more developed regions, particularly cities (Glaeser et al., 2012), in search of better job opportunities aggravates this problem, creating a serious shortage of skilled labour for local entrepreneurial activity.

Institutional and cultural factors can either encourage or discourage entrepreneurial activity. From a local perspective, elements such as community support, social capital and the cultural environment play a crucial role in shaping entrepreneurial outcomes. This is particularly evident in non-urban regions, where, as Calispa-Aguilar (2024) points out, a supportive culture is of primary importance in promoting entrepreneurial activity. However, this environment is mostly not static (Malecki, 2018) and can evolve through the actions of entrepreneurs, business

environment institutions and other stakeholders. Ross et al. (2015) argue that the structure of the enterprise population matters, and that a positive entrepreneurial culture is created when a region has a significant number of small businesses, allowing a robust entrepreneurial support system to operate at the local level, providing access to resources and local knowledge.

While agglomeration typically promotes innovation and firm growth in urban areas (Sternberg, 2022), where proximity between firms, entrepreneurs and institutions facilitates knowledge spillovers, its absence in non-urban areas, particularly in peripheral regions, may limit access to resources, networks and market opportunities (Huggins et al., 2017). However, more isolated regions can overcome the lack of direct agglomeration effects by fostering informal knowledge sharing and creating collaborative networks (Audretsch et al., 2010).

Therefore, the regional spatial context can act as either a constraint or a facilitator of entrepreneurial activity. This underlines the important role of location in shaping entrepreneurship. Thus, the distribution of factors influencing entrepreneurial activity may differ at the micro spatial level within peripheral regions. We therefore propose the following hypothesis:

H1: The determinants of entrepreneurial activity exhibit variation at the micro spatial level within peripheral region.

3. Methods

In addressing the issue of spatial heterogeneity, we used a quantitative approach, as is widely used in previous research on the determinants of entrepreneurial activity (Acs et al., 2007; Sternberg, 2022; Miłek, 2023; Patel, Wolfe, 2023). As there may be a large number of such determinants, we used Hellwig's linear ordering method to identify the extent to which they differ at the micro spatial level in a peripheral region. Drawing on Jaśkiewicz (2020), we used this method to test our hypothesis and therefore to establish a single aggregate measure as a synthetic representation of the determinants of entrepreneurial activity, and consequently to order the micro spatial units accordingly. Therefore, we employed the following formula (Hellwig, 1968):

$$q_i = 1 - \frac{d_{i0}}{d_0} \quad (1)$$

where:

q_i – the aggregate measure,

d_{i0} – the distances of the objects from the reference object ($i = 1, \dots, n$),

$d_0 = \bar{d}_0 - 2s_d$, where: \bar{d}_0 – arithmetic mean of the distances of the objects from the reference object; s_d – standard deviation of the distance between the objects and the average distance from the reference object.

To calculate d_{i0} we used the following formula:

$$d_{i0} = \sqrt{\sum_j^m (z_{ij} - z_{0j})^2} \quad (2)$$

where:

z_{ij} – the standardised value of the j -th variable for the i -th object ($i = 1, \dots, n; j = 1, \dots, m$),

z_{0j} – the coordinates of the reference object ($j = 1, \dots, m$).

To calculate z_{ij} we used the following formula:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j} \quad (3)$$

where:

x_{ij} – the value of the j -th variable for the i -th object,

\bar{x}_j – arithmetic mean of the observations of the j -th variable,

s_j – standard deviation of observations of the j -th variable.

To calculate z_{0j} we used the following formula:

$$z_{0j} = \begin{cases} \max_i\{z_{ij}\} & \text{for the stimulant variables} \\ \min_i\{z_{ij}\} & \text{for the destimulant variables} \end{cases} \quad (4)$$

It is assumed that $q_i \in [0; 1]$, where $\max\{q_i\}$ stands for the greatest similarity to the reference object and $\min\{q_i\}$ for the least, which allows to rank the objects. It can also be used to group objects into classes of similar degree, where (Nowak, 1990):

the highest level: $q_i \geq \bar{q}_i + s_{q_i}$

high level: $\bar{q}_i \leq q_i < \bar{q}_i + s_{q_i}$

moderate level: $\bar{q}_i - s_{q_i} \leq q_i < \bar{q}_i$

low level: $\bar{q}_i < q_i < \bar{q}_i - s_{q_i}$

where:

\bar{q}_i – arithmetic mean of q_i ,

s_{q_i} – standard deviation of q_i ,

other as described above.

In this study we used data from the micro level, NUTS-5. The data were locally disaggregated at the level of 71 basic spatial units (municipalities) covering the Opolskie Voivodeship, Poland, which represents a peripheral area (Zygmunt, J., 2024). Our data were derived from the Polish Central Statistical Office's Local Data Bank for the following years: 2015, 2020 and 2022, in order to examine the extent to which the determinants of entrepreneurial activity vary at different points in time: most recently, during the COVID-19 pandemic (Zygmunt, A., 2024), and a decade ago.

Our study addresses all the determinants of entrepreneurial activity that we were able to capture, given the availability of data at the micro spatial level. The description of the variables used in the study to construct the aggregate measure of the determinants of entrepreneurial activity at the micro spatial level in a peripheral region is presented in Table 1.

Table 1.
Description of variables

Variable	Description	Nature
X1 Supply side: Unemployment rate	Registered unemployed as a percentage of the working age population (%)	Stimulant
X2 Cultural environment: the structure of the enterprise population (1)	SME enterprises (0-249 employees) per 10,000 inhabitants	Stimulant
X3 Cultural environment: business environment institutions	Business environment institutions per 10,000 enterprises	Stimulant
X4 Cultural environment: the structure of the enterprise population (2)	Share of enterprises with up to 9 employees in the total number of enterprises registered in the National Official Business Register (REGON) (%)	Stimulant
X5 Demand side: Population density	Population per square kilometre	Stimulant

Source: Own elaboration based on the Polish Central Statistical Office's Local Data Bank.

4. Results and Discussion

Table 2 provides the descriptive statistics of the variables used in the study. On average, the micro spatial unit considered in the study has a registered unemployment rate of 4.46% of the working age population, contains 909 SME enterprises per 10,000 inhabitants and has a population density of 134 inhabitants per square kilometre. Enterprises with less than 10 employees dominate the landscape, accounting for 96% of the total number of enterprises registered in the National Official Business Register. A comparison of the minimum and maximum values of the variables shows a high degree of homogeneity between units in terms of enterprise size. However, there is evidence of heterogeneity when examining other variables within the analysis.

Table 2.
Descriptive statistics of variables

Variable	X1	X2	X3	X4	X5
Mean	4.46	909.03	784.67	96.09	134.70
St. dev.	1.53	226.33	479.39	1.03	298.45
Min	1.70	517.00	123.80	93.20	28.00
Max	9.30	1846.00	2026.30	98.30	2496.20

Source: Own calculation.

We tested our variables for collinearity and discriminability. We found no evidence of strong collinearity between the variables (Pearson correlation coefficients were less than 0.7). However, we excluded variable X4 from further analysis due to its insufficient discriminatory power, evidenced by a coefficient of variation of less than 10%. Consequently, the final set of variables used to construct the aggregate measure of the determinants of entrepreneurial activity at the micro spatial level in a peripheral region consists of the following variables: X1, X2, X3, X5.

Table 3 provides the descriptive characteristics of the aggregate measure of the determinants of entrepreneurial activity in a peripheral region that we constructed for the micro spatial units using Hellwig's linear ordering method, whereas Table 4 shows the classification of these units according to the aggregate measure.

Table 3.
Descriptive characteristics of the aggregate measure of the determinants of entrepreneurial activity in a peripheral region

Year	2015	2020	2022
Mean	0.17	0.16	0.16
St. dev.	0.09	0.08	0.08
Min	0.03	0.04	0.03
Max	0.69	0.62	0.61

Source: Own calculation.

Table 4.
Ranking of micro spatial units by the aggregate measure of the determinants of entrepreneurial activity in a peripheral region

NUTS-5 code	Municipalities	2015		2020		2022	
		No.	q_i 2015	No.	q_i 2020	No.	q_i 2022
1661011	Opole	1	0.69	1	0.62	1	0.61
1601011	Brzeg	2	0.42	2	0.41	2	0.40
1611073	Zawadzkie	3	0.30	4	0.27	4	0.25
1602043	Kietrz	4	0.29	3	0.28	3	0.28
1607053	Nysa	5	0.24	6	0.23	11	0.21
1602033	Głubczyce	6	0.24	5	0.23	5	0.23
1607063	Otmuchów	7	0.23	7	0.23	10	0.22
1601033	Grodków	8	0.23	11	0.21	7	0.22
1607073	Paczków	9	0.23	8	0.22	6	0.22
1604013	Byczyna	10	0.22	9	0.22	8	0.22
1607042	Łambinowice	11	0.22	14	0.20	15	0.20
1603011	Kędzierzyn-Koźle	12	0.22	10	0.22	9	0.22
1601043	Lewin Brzeski	13	0.21	16	0.19	14	0.20
1601022	Skarbimierz	14	0.21	18	0.19	16	0.19

Cont. table 4.

1609073	Niemodlin	15	0.21	13	0.20	21	0.18
1606052	Wilków	16	0.20	17	0.19	13	0.20
1606012	Domaszowice	17	0.20	12	0.20	12	0.21
1605013	Gogolin	18	0.20	15	0.19	17	0.19
1606023	Namysłów	19	0.19	20	0.18	20	0.18
1609062	Murów	20	0.19	21	0.18	24	0.17
1610032	Lubrza	21	0.19	22	0.18	19	0.19
1607013	Głucholazy	22	0.19	19	0.19	18	0.19
1602022	Branice	23	0.19	25	0.17	27	0.17
1609032	Dobrzeń Wielki	24	0.18	44	0.13	47	0.13
1609042	Komprachcice	25	0.18	39	0.15	37	0.14
1604043	Wołczyn	26	0.17	26	0.17	26	0.17
1610013	Biała	27	0.17	40	0.15	33	0.16
1608033	Olesno	28	0.17	33	0.15	36	0.15
1610043	Prudnik	29	0.17	24	0.17	29	0.16
1609022	Dąbrowa	30	0.17	43	0.14	45	0.13
1603062	Reńska Wieś	31	0.17	27	0.17	25	0.17
1605023	Krapkowice	32	0.17	30	0.16	30	0.16
1605053	Zdzieszowice	33	0.17	23	0.17	23	0.17
1609012	Chrzastowice	34	0.17	37	0.15	41	0.14
1601062	Olszanka	35	0.17	31	0.16	28	0.16
1606032	Pokój	36	0.16	32	0.16	32	0.16
1607082	Pakosławice	37	0.16	29	0.16	31	0.16
1601052	Lubsza	38	0.16	38	0.15	34	0.16
1606042	Świerczów	39	0.16	35	0.15	22	0.17
1609123	Tułowice	40	0.16	28	0.16	35	0.15
1610023	Głogówek	41	0.15	46	0.13	39	0.14
1609112	Tarnów Opolski	42	0.15	36	0.15	40	0.14
1609052	Łubniany	43	0.15	42	0.14	42	0.13
1602013	Baborów	44	0.15	45	0.13	44	0.13
1609132	Turawa	45	0.14	41	0.14	43	0.13
1604023	Kluczbork	46	0.14	34	0.15	38	0.14
1609083	Ozimek	47	0.14	47	0.13	46	0.13
1608023	Gorzów Śląski	48	0.14	53	0.12	52	0.12
1609103	Prószków	49	0.13	49	0.13	50	0.12
1611043	Leśnica	50	0.13	55	0.11	58	0.11
1607092	Skoroszyce	51	0.13	52	0.12	48	0.12
1607033	Korfantów	52	0.13	58	0.11	55	0.12
1611053	Strzelce Opolskie	53	0.13	56	0.11	59	0.11
1609092	Popielów	54	0.13	54	0.11	54	0.12
1603052	Polska Cerekiew	55	0.13	48	0.13	49	0.12
1608043	Praszka	56	0.12	60	0.10	60	0.10
1603042	Pawłowiczki	57	0.12	59	0.11	57	0.11
1605042	Walce	58	0.12	50	0.12	53	0.12
1604032	Lasowice Wielkie	59	0.12	51	0.12	51	0.12
1607022	Kamiennik	60	0.11	57	0.11	56	0.11
1603032	Cisiek	61	0.10	62	0.09	61	0.09
1608052	Radłów	62	0.10	63	0.09	67	0.08
1608072	Zębowice	63	0.10	61	0.10	62	0.09
1608013	Dobrodzień	64	0.10	66	0.08	63	0.09
1611063	Ujazd	65	0.10	67	0.08	68	0.08
1603022	Bierawa	66	0.09	65	0.08	64	0.09
1605032	Strzeleczyki	67	0.09	64	0.09	65	0.09
1608062	Rudniki	68	0.08	68	0.08	66	0.08
1611012	Izbicko	69	0.06	69	0.07	69	0.05
1611033	Kolonowskie	70	0.06	70	0.05	70	0.04
1611022	Jemielnica	71	0.03	71	0.04	71	0.03

Note: No. - number of micro spatial unit (municipality) in the ranking. The table shows the results to two decimal places.

Source: Own calculation.

The results indicate that while the determinants of entrepreneurial activity exhibit considerable variation at the micro level (NUTS-5), the spatial pattern of these determinants remains broadly consistent over the years analysed. More specifically, the position of most micro spatial units in relation to other units with regard to the determinants of entrepreneurial activity, expressed by the aggregate measure, was largely stable over the years covered by the analysis. This finding is noteworthy, as it may indicate a relatively high degree of resilience to external shocks among most of the micro spatial units within a peripheral region. Alternatively, and more likely, it may indicate the presence of significant structural constraints that persist over time, thereby hampering entrepreneurial activity. For some micro spatial units, e.g. Świerczów, Olszanka, Kędzierzyn-Koźle, a positive change in the determinants of entrepreneurial activity was observed, reflected in a higher position in the ranking. Conversely, there was evidence of a significant worsening of the conditions for doing business in certain units, including Dobrzeń Wielki, Dąbrowa, Niemodlin, for which a significant drop in ranking was observed compared to previous years. However, due to the scope of the analysis, it was not possible to control for the factors (social, economic, political, environmental) that may have contributed to these changes.

Table 5 shows the classification of micro spatial units in a peripheral region into four groups with similar levels of determinants of entrepreneurial activity (low, moderate, high, the highest). As described above, the mean and standard deviation of the aggregate measure were used in order to establish these groups.

Table 5.

Classification by the level of determinants of entrepreneurial activity in micro spatial units in a peripheral region

Group	2015	2020	2022
low	Rudniki, Izbicko, Kolonowskie, Jemielnica	Izbicko, Kolonowskie, Jemielnica	Ujazd, Izbicko, Kolonowskie, Jemielnica
moderate	Olesno, Prudnik, Dąbrowa, Reńska Wieś, Krapkowice, Zdieszowice, Chrzastowice, Olszanka, Pokój, Pakosławice, Lubsza, Świerczów, Tułowice, Głogówek, Tarnów Opolski, Łubniany, Baborów, Turawa, Kluczbork, Ozimek, Gorzów Śląski, Prószków, Leśnica, Skoroszyce, Korfantów, Strzelce Opolskie, Popielów, Polska Cerekiew, Praszka, Pawłowiczki, Walce, Lasowice Wielkie, Kamiennik, Cisek, Radłów, Zębowice, Dobrodzień, Ujazd, Bierawa, Strzeleccki	Tułowice, Pakosławice, Krapkowice, Olszanka, Pokój, Olesno, Kluczbork, Świerczów, Tarnów Opolski, Chrzastowice, Lubsza, Komprachcice, Biała, Turawa, Łubniany, Dąbrowa, Dobrzeń Wielki, Baborów, Głogówek, Ozimek, Polska Cerekiew, Prószków, Walce, Lasowice Wielkie, Skoroszyce, Wielkie, Skoroszyce, Gorzów Śląski, Popielów, Leśnica, Strzelce Opolskie, Kamiennik, Korfantów, Pawłowiczki, Praszka, Zębowice, Cisek, Radłów, Strzeleccki, Bierawa, Dobrodzień, Ujazd, Rudniki	Olszanka, Prudnik, Krapkowice, Pakosławice, Pokój, Biała, Lubsza, Tułowice, Olesno, Komprachcice, Kluczbork, Głogówek, Tarnów Opolski, Chrzastowice, Łubniany, Turawa, Baborów, Dąbrowa, Ozimek, Dobrzeń Wielki, Skoroszyce, Polska Cerekiew, Prószków, Lasowice Wielkie, Gorzów Śląski, Walce, Popielów, Korfantów, Kamiennik, Pawłowiczki, Leśnica, Strzelce Opolskie, Praszka, Cisek, Zębowice, Dobrodzień, Bierawa, Strzeleccki, Rudniki, Radłów

Cont. table 5.

high	Nysa, Głubczyce, Otmuchów, Grodków, Paczków, Byczyna, Łambinowice, Kędzierzyn-Koźle, Lewin Brzeski, Skarbimierz, Niemodlin, Wilków, Domaszowice, Gogolin, Namysłów, Murów, Lubrza, Głuchołazy, Branice, Dobrzeń Wielki, Komprachcice, Wołczyn, Biała	Głubczyce, Nysa, Otmuchów, Paczków, Byczyna, Kędzierzyn-Koźle, Grodków, Domaszowice, Niemodlin, Łambinowice, Gogolin, Lewin Brzeski, Wilków, Skarbimierz, Głuchołazy, Namysłów, Murów, Lubrza, Zdieszowice, Prudnik, Branice, Wołczyn, Reńska Wieś	Głubczyce, Paczków, Grodków, Byczyna, Kędzierzyn-Koźle, Otmuchów, Nysa, Domaszowice, Wilków, Lewin Brzeski, Łambinowice, Skarbimierz, Gogolin, Głuchołazy, Lubrza, Namysłów, Niemodlin, Świerczów, Zdieszowice, Murów, Reńska Wieś, Wołczyn, Branice
the highest	Opole, Brzeg, Kietrz, Zawadzkie	Opole, Brzeg, Kietrz, Zawadzkie	Opole, Brzeg, Kietrz, Zawadzkie

Source: Own elaboration.

The results indicate that there were no significant changes in the level of determinants of entrepreneurial activity within micro spatial units in the peripheral region over the years analysed, regardless of the group size. The determinants of entrepreneurial activity were mainly characterised by medium to high levels in most of the micro spatial units in the Opolskie Voivodeship. The groups with the highest and lowest levels of these determinants were limited to a few spatial units. In particular, the spatial units identified as having the most favourable conditions for entrepreneurial activity remained constant over the years studied, including the voivodship capital (Opole), another urban unit (Brzeg) and two urban-rural units (Kietrz, Zawadzkie). Similarly, the composition of the units with the lowest levels of favourable determinants for entrepreneurial activity (Izbicko, Kolonowskie, Jemielnica) showed minimal change over the years analysed. With regard to the type of micro spatial unit, our results showed that urban units had the most favourable conditions for entrepreneurial activity in all the years covered by the analysis. Over 67% of rural units had moderate conditions for entrepreneurship. In contrast, urban-rural units demonstrated a balanced distribution of conditions, with equal proportions classified as either moderate or high.

The determinants of entrepreneurial activity across micro spatial units in a peripheral region are illustrated in Figures 1-3, where the intensity of the grey scale represents the level of these determinants. Darker shades correspond to higher aggregate measures that reflect the determinants of entrepreneurial activity in the region.

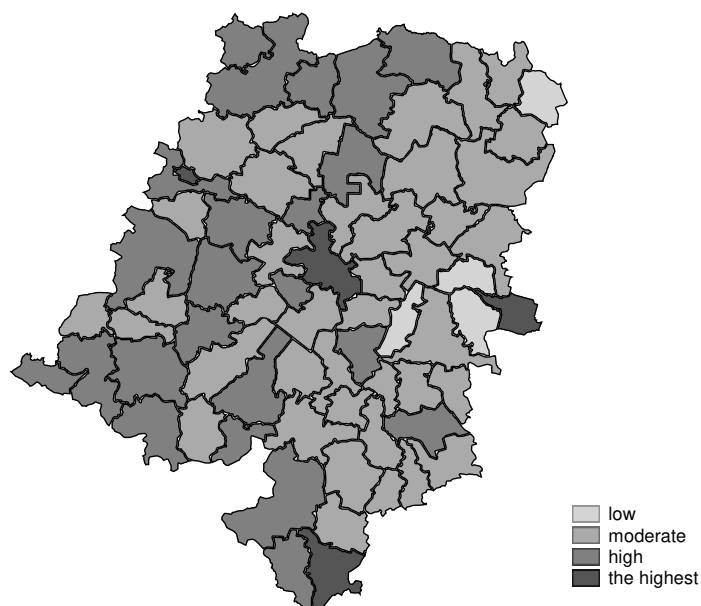


Figure 1. The spatial distribution of determinants of entrepreneurial activity across micro spatial units in the Opole Voivodeship in 2015.

Source: own elaboration.

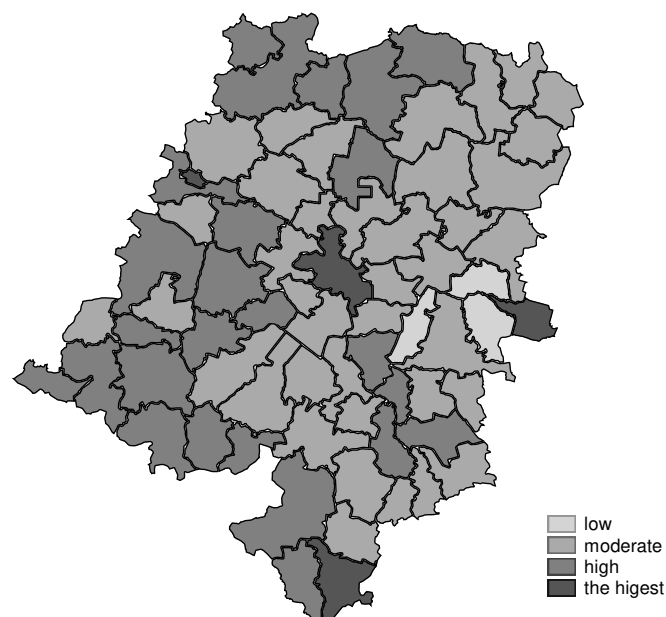


Figure 2. The spatial distribution of determinants of entrepreneurial activity across micro spatial units in the Opole Voivodeship in 2020.

Source: own elaboration.

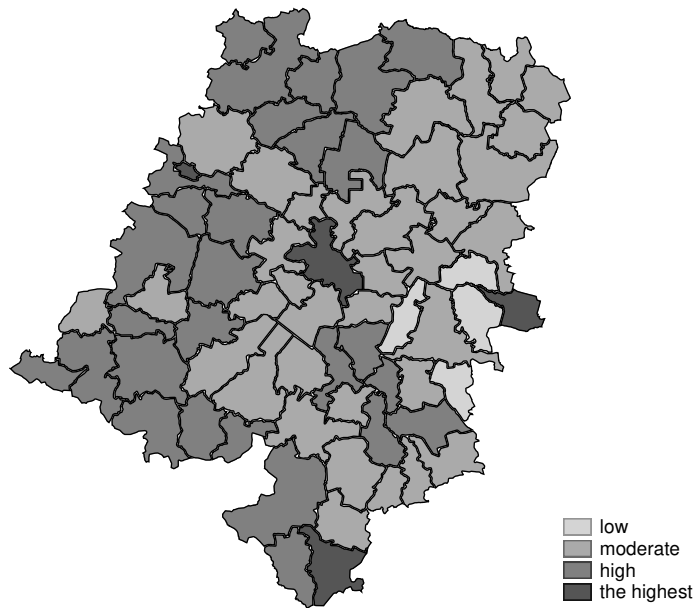


Figure 3. The spatial distribution of determinants of entrepreneurial activity across micro spatial units in the Opole Voivodeship in 2022.

Source: own elaboration.

The observed heterogeneity within the micro spatial units of the Opolskie Voivodeship provides evidence of distinct spatial patterns in the determinants of entrepreneurial activity within this peripheral region. Specifically, a clear division emerges across the years analysed: the western part of the Voivodeship shows a high level of determinants for entrepreneurship, with a trend of increasing development over time. In contrast, the eastern part exhibits moderate to low conditions for entrepreneurial activity, with micro spatial units characterised by the lowest conditions clustered in spatial proximity. It is striking that the areas with the most favourable conditions for entrepreneurship are generally not contiguous over the period analysed, suggesting a lack of spillover between neighbouring units. This may suggest the strong importance of local factors in entrepreneurship creation.

Our results show that the determinants of entrepreneurial activity vary at the micro level (NUTS-5) in a peripheral region and exhibit spatial heterogeneity, confirming Hypothesis 1. This is in line with previous studies on regional entrepreneurship, as local factors have been shown to play a crucial role in shaping entrepreneurial outcomes (Audretsch et al., 2010). While previous research has highlighted changes in regional entrepreneurial conditions due to external economic shocks, policy interventions or technological shifts (Malecki, 2018), we observe the persistence of spatial patterns in peripheral region over time. This is consistent with studies suggesting that entrepreneurial conditions in peripheral regions tend to be more resilient to external shocks (Fritsch, Wyrwich, 2013). This may be due to factors embedded in the local environment which tend to create ‘path dependency’ (Brekke, 2015) limiting significant changes in entrepreneurial outcomes over short periods of time. Our findings also confirm the observation of Glaeser et al. (2012), who found that urban areas tend to have more favourable conditions for entrepreneurship due to better infrastructure, access to markets and

higher levels of human capital. In addition, we find that rural areas tend to have more moderate conditions. This is consistent with research indicating that rural areas face greater challenges in fostering entrepreneurial activity, mainly due to lower access to resources and support systems (Calispa-Aguilar, 2024). Recent work by Duran (2023) has provided further evidence of how these disparities are widening, particularly in regions where technological advances or policies have not been equally distributed.

In contrast to previous studies, we found that the best conditions for entrepreneurship do not seem to spill over to neighbouring areas. This contrasts with the ‘agglomeration effect’ commonly reported in previous studies (Acs, Varga, 2005) which demonstrate that positive entrepreneurial conditions in one area can spill over to neighbouring regions through knowledge transfer and human capital mobility (Fotopoulos, 2023). The absence of such spillovers in the Opolskie Voivodeship is an interesting finding, suggesting a unique regional dynamic, possibly due to local factors such as limited connectivity or lack of cooperation between neighbouring units.

5. Summary

In this paper, we shed light on the extent to which the determinants of entrepreneurial activity differ at the micro spatial level in a peripheral region. Using the Opole Voivodeship in Poland as a case study, we present empirical evidence covering all 71 micro level NUTS-5 units that constitute the Voivodeship for the years 2015, 2020 and 2022. The results show that while, as hypothesised, the determinants of entrepreneurial activity vary at the micro level, the spatial distribution of these determinants remains relatively stable over time. This stability suggests two key interpretations: first, the resilience of many micro spatial units to external shocks, and second, the persistence of structural constraints that may limit entrepreneurial dynamism.

Our research contributes to the literature on entrepreneurship and regional development by demonstrating the spatially heterogeneous and persistent nature of determinants of entrepreneurial activity in peripheral regions at the micro spatial level. By identifying the lack of spillover effects between neighbouring units when one of them is considered to be the most conducive to entrepreneurship, we suggest that local policies, infrastructure and institutional frameworks play a dominant role in fostering or hindering entrepreneurship, even in close proximity. From a practical point of view, therefore, the results may have implications for regional development policies in terms of the prioritisation of local interventions for the promotion of entrepreneurship.

There are limitations to this study that suggest the need for further research. First, the study focuses on data for selected years, and while it demonstrates the heterogeneity of determinants influencing entrepreneurial activity in the periphery at the micro spatial level, it may be

anchored in broader environmental conditions, particularly at the national level, that we were not able to control for. Therefore, conducting comparisons over different time periods could provide an additional test of the robustness of the results. Second, due to constraints in the amount of data available at the micro spatial level, a limited number of determinants were used in our study. We recognise that other sets of determinants may lead to different conclusions at the spatial level, and therefore the inclusion of additional variables, as they become available, may extend the results obtained. Third, we suggest the use of alternative methods of data analysis at the micro spatial level in future studies. This could increase the robustness of our findings and contribute to a more comprehensive understanding of the determinants of entrepreneurial activity in this context.

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GREENWASHING AS A ECPRESSION OF OPPORTUNISTIC APPROACH OF THE BUSINESS WORLD TO ENVIRONMENTAL ISSUES

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Purpose: The aim of the article is to present the issue of greenwashing, the premises for its application, its expressions in the activities of enterprises and its main drivers.

Design/methodology/approach: The article uses a literature review and desk-research analysis concerning the analysis of legislative documents and data obtained from Reports including: The World of Organic Agriculture, European Securities and Markets Authority.

Findings: The article explains the multidimensional nature of greenwashing and indicates that the opportunistic attitudes of the business world are its main cause.

Research limitations/implications: Currently, efforts are made to introduce specific legal solutions, including those concerning the implementation of the ESG standard, in order to curb the "green lie" phenomenon.

Practical implications: The introduction of non-financial reporting obligations, including those concerning the impact of enterprises on the environment, will allow various stakeholder groups to evaluate the actual pro-environmental activities declared by enterprises, and thus will contribute to reducing greenwashing.

Social implications: The presented legislative solutions, primarily in Poland and the European Union (required disclosures) are the basis for a real assessment of the impact of the business world on the natural environment. As a result, control bodies, investors, customers and other stakeholders can compare companies, not only on the basis of their financial profitability, but also specific actions aimed at reducing the negative impact on the environment.

Originality/value: Highlighting the importance of compliance of companies with ESG standards, including those related to their impact on the natural environment, in order to curb the phenomenon of greenwashing is the value of the article. Non-financial reporting on the impact of business on the environment according to the adopted criteria provides opportunities for transparency, reliable assessment and increased trust in economic entities.

Keywords: greenwashing, ESG, environment.

Category of the paper: General review.

1. Introduction

Nowadays, the belief that a company is an integral part of society, not its separate part, striving solely to achieve economic goals is increasingly common. As P. Drucker (2002) writes: "a free enterprise operating in conditions of economic freedom cannot exist just because it is good for business; the meaning of its existence is that it is needed by society". Moreover, business entities are perceived as key and indispensable actors for developing solutions that will stop the threat associated with progressing, unfavorable changes, including environmental ones. It is the business world that is indicated by society as having the tools, technologies and resources, including financial ones, to stop the climate crisis, and finally, it is business that is responsible for taking the right actions. Meanwhile, economic practice provides abundant evidence that it is the constant pursuit of financial benefits, the lack of deeper reflection on the impact on the environment and the resulting long-term consequences that accompanies many business decisions that often have nothing to do with compliance with the principles of ethics and social responsibility.

Greenwashing is an example of such unethical behavior in business. This concept refers to all unfair practices applied by companies to present themselves as implementing the principles of sustainable development by creating a false impression or providing misleading information about the product/service. It is generally assumed that the use of such practices results from the pursuit of increasingly better financial results (greed). Based on the literature on the subject, other factors such as competitive pressure, investor and consumer demand, a firm's characteristics (industry, type of business, supply chain and lifecycle stage, the costs and implications of any strategic actions, organizational inertia) can also be indicated.

Research conducted by GreenPrint (2021) showed that 73% of respondents notice the impact of a product on the environment as a factor that is important when making purchasing decisions. In addition, nearly 64% declare a willingness to pay more for ecological and environmentally friendly products. At the same time, 74% of respondents do not have knowledge on how to properly identify such a product. The presented research results prove that society appreciates values related to environmental protection. In response to social pressure in the sphere of caring for the environment, many companies are implementing the concept of corporate social responsibility (CSR), in which communication with stakeholders, including publishing reliable information from this area in external reports, plays a key role. Such behavior results from the growing conviction of companies that building a positive image for the environment in the future will translate into achieving better economic results and increased competitiveness in a changing environment. It should be noted, however, that the lack of applicable CSR standards means that the form, scope and quality of environmental and social disclosures vary, and companies usually disclose only the positive aspects of their operations, while omitting those that are controversial.

Currently, a promising way to combat "empty words" in the area of environmental protection is the ESG standard implemented in companies. Business practitioners, especially global companies, emphasize that implementing the idea of sustainable development and the ESG standard is a way to build a company's resilience to social, economic and geopolitical changes and crises.

The aim of the article is to present the issue of greenwashing, the premises for its application, its expression in the activities of enterprises as well as its driving factors. It also indicates the main legislative solutions, including those related to the implementation of the ESG standard, the application of which should counteract the practices of the "green lie".

The article uses a broad review of Polish and foreign publications as well as data obtained from reports, including The World of Organic Agriculture, European Securities and Markets Authority, among others.

2. Opportunism as a premise of the “Green Lie”

Most definitions of opportunism found in the literature directly or indirectly refer to the definition by O.E. Williamson (1979, 1985 1993, 1996). According to O. E. Williamson (1998), opportunism should be understood as “devious pursuance of one’s own interest [...] which refers to incomplete or distorted disclosure of information, especially in a calculated effort to mislead, to disguise, to obfuscate or to otherwise confuse things. It also includes its more flagrant forms, such as lying, stealing and cheating”. Taking such actions is possible because people making choices do not act in a way that is usually attributed to the hyperrational homo oeconomicus. Neoclassical economists perceived humans as economic entities that have full and true knowledge as well as perfect information, allowing them to choose from a set of decisions the optimal one which maximizes utility. This view was questioned when H. Simon introduced the concept of bounded rationality in the 1950s. It proposed an opposing view to the neoclassical one, stating that people do not act rationally, mainly because they have incomplete information, and in their choices, they are guided by the principle of satisfaction, i.e., choosing the first option that satisfies the individual (Simon, 1955). Market participants may decide not to obtain additional information because of the high transaction costs associated with it. This is an incentive for companies to take opportunistic actions that take advantage of the resulting asymmetry of information. This in turn may lead to adverse selection, i.e., the displacement of better products from the market by worse ones (Akerlof, 1970). Thus, as a result of actions taken by companies, products better advertised as ecological are chosen more often than those that actually have a smaller negative impact on the environment. The extensive literature on the subject distinguishes several types of opportunism, considering such criteria as time, power of impact, formalization, intentions of the party and activity of the party (table 1).

Table 1.
Selected typologies of opportunism

Distinguishing criteria	Description
Website activity	Active opportunism - the party in the relationship deliberately restrains its actions; opportunism occurs through lying, distorting or falsifying facts, exaggerating difficulties and using unexpected events to obtain concessions from the other party.
	Passive opportunism, which consists in taking certain actions that are specified in the agreement as prohibited or ethically incorrect.
Website intent	Excessive opportunism - defined as the open pursuit of profit or advantage of one party in exchange at the expense of the partner, e.g., a supplier forces a price increase without providing any justification.
	Opportunism with cunning - a hidden pursuit of benefits with the deliberate intention of deceiving one of the parties to the transaction, e.g., a supplier demands a price increase, referring to deliberately distorted data as justification and conceals their distortion.
Formalization	Open opportunism is a situation in which a party to a relationship avoids the obligations arising from a formal agreement.
	Hidden opportunism is a situation in which a party violates the rules of social contracts.
Impact of results	Strong opportunism - a form that includes actions that violate contractual norms (terms, clauses, etc.), e.g., theft of common property; expropriation of knowledge or technology; misappropriation of key personnel, avoidance of contractual obligations.
	Weak opportunism - a form that includes actions that violate relational norms, consequently worsening the situation of one of the parties.
Time	Ex ante opportunism - whether and to what extent there is deliberate misleading in the initial stages of the relationship; it is associated with higher costs of creating extensive contracts aimed at limiting the devious behavior of the parties.
	Ex post opportunism - whether and to what extent a breach of the relationship occurs in its more advanced stages, it causes additional transaction costs in the form of monitoring, control or modifying and enforcing the terms of the contract.

Source: elaborated at (Wathne, Heide, 2000); (Kelly et al., 2018); (Barnes et al., 2010.); (Kashyap et al., 2012); (Seggie et al., 2013).

3. Greenwashing and its drivers

The term was first used in 1986 by J. Westerveld in an article in the New York Times (Global Compact Network Poland, 2023). The activist presented an example of the so-called "green lie", i.e., he described the practice of a hotel that encouraged guests to change their towels less often, justifying it with concern for the environment. The seemingly presented ecological action was in fact just a way to reduce the hotel's costs related to the laundry service. Practices such as the one described by J. Westerveld began to be so common and popular that in 1999 the word "greenwashing" was included in the Oxford English Dictionary (Polish Agency for Enterprise Development, 2023). Although many years have passed since then, no single, coherent definition of the concept of greenwashing has been developed in the literature on the subject. According to L. Witek (2013), these are deliberate actions aimed at creating a false image of a company, its operations or products as ecologically and environmentally responsible. According to M. Delmas and V. Burbano (2011), greenwashing can be perceived as two overlapping phenomena – on the one hand, related to the actual impact

of companies on the environment, and on the other, related to how companies try to hide their actual activities in order to build a pro-ecological and environmentally friendly image.

Sustainability has become a key element of strategy building; therefore, increasingly more companies are focused on issues related to climate and environmental protection. The fine line between real pro-ecological actions and just creating impressions can be difficult to distinguish. Greenwashing is the practice of manipulating or providing disinformation about the sustainability of products or services in order to “improve” the company’s image.

Many studies show that sustainability is one of the most crucial factors considered by consumers when buying products or services. It is therefore not surprising that companies try to emphasize their ecological approach. However, increasing pressure often causes companies to take a "shortcut" by making dishonest or unjustified statements about their activities, in order to create the illusion that they are actively combating climate change or to gain a competitive advantage. In this way, they risk being accused of "eco-hypocrisy". The catalogue of the most common "eco-fakes" has been defined as the seven deadly sins of greenwashing. They include the sin of the hidden trade-off, the sin of no proof, the sin of vagueness, the sin of irrelevance, the sin of lesser of two evils, the sin of fibbing and the sin of worshiping false labels (table 2).

Table 2.
"The Seven Sins of Greenwashing"

Name	Description
Sin of the Hidden Trade-off	Committed by suggesting a product is “green” based on an unreasonably narrow set of attributes without attention to other important environmental issues. Paper, for example, is not necessarily environmentally preferable just because it comes from a sustainably-harvested forest. Other important environmental issues in the paper-making process, including energy, greenhouse gas emissions, and water and air pollution, may be equally or more significant.
Sin of No Proof	Committed by an environmental claim that cannot be substantiated by easily accessible supporting information or by a reliable third-party certification. Common examples are tissue products that claim various percentages of post-consumer recycled content without providing any evidence.
Sin of Vagueness	Committed by every claim that is so poorly defined or broad that its real meaning is likely to be misunderstood by the consumer. “All-natural” is an example. Arsenic, uranium, mercury, and formaldehyde are all naturally occurring, and poisonous. “All natural” is not necessarily “green”.
Sin of Irrelevance	Committed by making an environmental claim that may be truthful but is unimportant or unhelpful for consumers seeking environmentally preferable products. “CFC-free” is a common example, since it is a frequent claim despite the fact that CFCs are banned by law.
Sin of Lesser of Two Evils	Committed by claims that may be true within the product category, but that risk distracting the consumer from the greater environmental impacts of the category as a whole. Organic cigarettes might be an example of this category, as might be fuel-efficient sport-utility vehicles.
Sin of Fibbing	Committed by making environmental claims that are simply false. The most common examples were products falsely claiming to be Energy Star certified or registered.
Sin of Worshiping False Labels	Committed by a product that, through either words or images, gives the impression of third-party endorsement where no such endorsement actually exists; fake labels, in other words.

Source: elaborated on (TerraChoice, 2010).

The phenomenon of greenwashing undermines the bargaining position of consumers and leads to wrong behavior and unfavorable decisions. The scale of the phenomenon is large, as shown by the study conducted by the American consulting agency Terrachoice (2010).

Out of over 1000 verified products offered to customers by American hypermarkets and promoted as compliant with environmental protection principles, only one was completely free from greenwashing. The agency estimates that in the USA as much as 95% of the analyzed information about products was incorrect. Companies undertake such activities because they bring the expected effects in the form of customer appreciation and loyalty. Creating an environmentally friendly image or product usually finds strong approval from consumers, which translates directly into the profits of entities practicing such behavior (Jakubczak, 2018). In this context, it is worth adding that the market for ecological products is recording a huge growth. Now, the turnover is estimated at around EUR 135 billion (Willer et al., 2024). As a result, the scale of green advertising is also growing. It has increased 10-fold over the last 20 years.

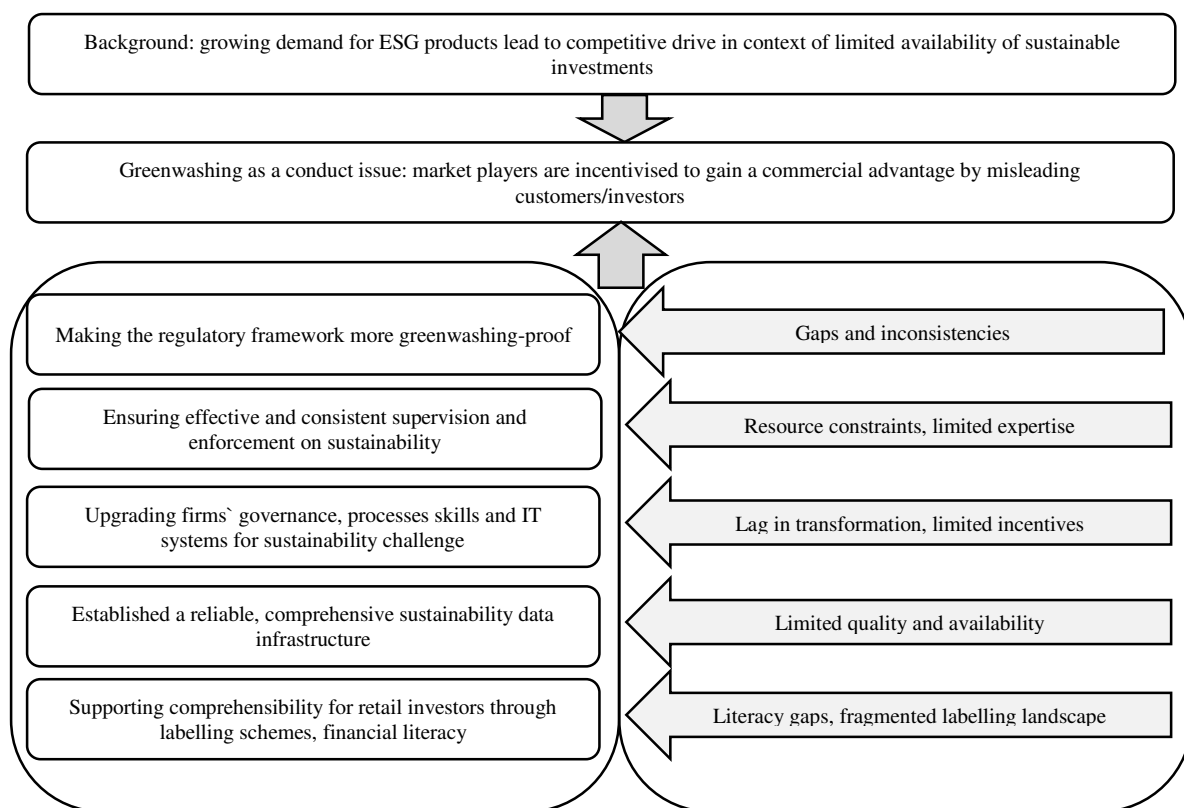


Figure 1. The multiple drivers of greenwashing risks.

Source: (ESMA, 2024)

The latest report by the European Securities and Markets Authority (ESMA, 2024) shows that the fundamental mismatch between the demand for investments that can make a climate/sustainability impact, and the supply of genuine sustainable investment opportunities is at the heart of the greenwashing issue. EMSA notes that “the competitive drive for market shares and revenue has led to both entity-level and product-level efforts at bolstering sustainability profiles”. The temptation to greenwash is therefore very high “in a context of very low levels of taxonomy-aligned assets and investment opportunities for which

sustainability performance appears to be beyond doubt or disagreement are still scarce”. ESMA said the risk is exacerbated by inadequacies in the regulatory framework such as unclear, ambiguous definitions of certain concepts; lack of standardized calculation of metrics; minimum standards failing to support the ambition level, such as for climate benchmarks; and the absence of regulation for certain widely-used concepts such as “impact investment” (figure 1).

4. Preventing the "green lie" - examples of legislative solutions

Greenwashing practices pose a variety of risks to companies, including potential financial losses and reputational damage that can significantly impact their market position and customer trust. Legal claims including accusations of misrepresentation and even breach of agreement can also occur.

In Poland, Great Britain or the United States, there are no uniform regulations against greenwashing (Stewarts, 2021), mainly due to the aforementioned diversity of practices undertaken by companies that are part of the so-called green lie. In Great Britain, the concept of greenwashing itself has no legal definition, and that is why companies are most often accused of deliberately misleading consumers, violating the Unfair Trading Regulations (Ungoed-Thomas, 2023). In the United States, as in Great Britain, the regulations primarily concern consumer protection against unfair business practices, contained in the Federal Trade Commission Act. In addition, the *Green Guides* developed by the Federal Trade Commission provide advice for companies on how to avoid misleading consumers, thereby avoiding the practice of greenwashing. This document is only an instruction and has no legal force, therefore it cannot be used to bring possible charges against companies using ecological lies. The lack of uniform regulations covering all possible greenwashing practices in the indicated countries creates opportunities for companies to take advantage of this fact and undertake opportunistic actions.

From a legal point of view, in order to act against greenwashing, two directives may apply at the EU level, i.e., the Unfair Commercial Practices Directive (Directive 2005/29/EC) and the Consumer Rights Directive (Directive 2011/83/EU). As a result, many companies must ensure compliance and adapt the offer of their products to consumers in accordance with these regulations. Infringements in this case may primarily constitute a violation of the prohibition of practices infringing the collective interests of consumers, regulated in art. 24 of the Act on Competition and Consumer Protection (Journal of Laws, 2007). This in turn creates a risk of incurring penalties imposed by the President of the Office of Competition and Consumer Protection. In addition, greenwashing may mean the use of unfair market practices towards consumers, referred to in the Act on Combating Unfair Market Practices. Such actions,

however, are associated with the risk of liability under the Competition and Consumer Protection Act, including claims for damages from consumers (KPMG, 2024).

5. ESG standard - a new approach to environmental reporting

The subject of greenwashing has been on the agenda of European legislators since 2007, i.e., since the Council Regulation (EC) No. 834/2007 on organic production and labelling of organic products, which, among other things, regulates and conditions the use of terms such as "bio" or "eco". In connection with the CSRD directive, ESG issues (including greenwashing prevention) are now enjoying increased interest from business. The environment area includes five topics: climate change (ESRS E1), pollution (ESRS E2), water and marine resources (ESRS E3), biodiversity and ecosystems (ESRS E4) as well as resource use and circular economy (ESRS E5). A summary of selected indicators in individual topics in the environment area is presented in table 3.

Table 3.

Examples of environmental measures within the ESG standard

Topic	Sub-Topic	Disclosure examples
Climate change (ESRS E1)	<ul style="list-style-type: none"> – Climate change adaptation; – Climate change mitigation; – Energy. 	<ul style="list-style-type: none"> – greenhouse gas emissions (tons of CO2 equivalent); – greenhouse gas emission intensity (tons of CO2 equivalent/revenue); – emission management (description of the process implemented by the company to reduce greenhouse gas emissions into the atmosphere and the emission reduction targets set); – amount of energy used in the organization (MWh); – amount of energy purchased from outside; – description of the process implemented by the company to reduce greenhouse gas emissions into the atmosphere and the set targets of emission reduction; – % share of energy consumption from non-renewable sources in the total value of energy used in the organization.
Pollution (ESRS E2)	<ul style="list-style-type: none"> – Pollution of air; – Pollution of water; – Pollution of soil; – Pollution of living organisms and food resources; – Substances of concern; – Substances of very high concern; – Microplastics. 	<ul style="list-style-type: none"> – noise pollution level; – total amount of sewage by quality and destination; – amount of hazardous waste produced in the reporting period (thousand tons); – waste management (description).

Cont. table 3.

Water and marine resources (ESRS E3)	<ul style="list-style-type: none"> – Water (water consumption, water withdrawals, water discharges, water discharges in the oceans); – Marine resources (extraction and use of marine resources). 	<ul style="list-style-type: none"> – water consumption (m³, % of reused water); – water resources management (description of processes implemented to optimize water consumption and thus minimize environmental impact).
Biodiversity and ecosystems (ESRS E4)	<ul style="list-style-type: none"> – Direct impact drivers of biodiversity loss (climate change, land-use change, fresh water-use change and sea-use change, direct exploitation, invasive alien species, pollution, others); – Impacts on the state of species (for example: species population size, species global extinction risk); – Impacts on the extent and condition of ecosystems (for example: land degradation, desertification, soil sealing); – Impacts and dependencies on ecosystem services. 	<ul style="list-style-type: none"> – impact on biodiversity (description of the policy and actions taken to monitor and minimize the company's impact on biodiversity); – investments located near protected areas; – % of revenues generated from areas of sensitive biodiversity.
Circular economy (ESRS E5)	<ul style="list-style-type: none"> – Resources inflows, including resource use; – Resource outflows related to products and services; – Waste. 	<ul style="list-style-type: none"> – Waste management (description); – % of waste recycled.

Source: own elaboration based on (Commission Delegated Regulation (EU), 2023).

Each topic contains a list of Disclosure Requirements, obliging the reporting entity to define - both quantitatively and qualitatively - its links to a given scope. Both the negative and positive impact of the organization on a given area is considered here (e.g., a company negatively affects ecosystems by taking up a large area for infrastructure but engages in the creation of mid-field woodlots in its area). The developed ESG principles also require organizations to analyze the risks that the discussed aspects carry. Companies must consider what threats to their operations are, for example, climate change (floods, droughts, heat waves, etc.) or a shortage of a key raw material due to the depletion of its resources. Business entities should also present the identified possibilities and opportunities they see in the changing climate and social context (e.g. for a car manufacturer, the depletion of crude oil reserves is a risk to its business model, but the broad promotion of electromobility may be an opportunity to create a new one, e.g. based on electric cars and the infrastructure necessary to service them).

6. Conclusions

The introduction of the obligation to submit non-financial reports is the first step towards limiting the freedom of companies in terms of the content they present in advertisements or on websites. However, it cannot be stated that this is a solution that will allow for ending the problem of greenwashing and opportunistic actions taken in connection with it, because this

obligation does not apply to everyone, but only to the largest companies. Therefore, it seems necessary to specify anti-greenwashing regulations and define greenwashing on a legal basis, not only on the basis of case law, but above all on an international scale in order to protect consumers. This is because it is them who suffer the consequences of opportunistic actions of companies that include undermining their trust in advertising, legal institutions or ecological certificates, as well as making suboptimal decisions resulting in contributing, most often unknowingly, to environmental pollution. Their ecological awareness and the decisions they make about purchasing certain products or using services have a real impact on which companies ultimately operate on the market and what products and services are offered to them.

Sustainability reporting is a new reality for European business. The era we are entering means the end of voluntary and selective CSR. ESG reporting will cover around 50,000 European companies (as well as non-EU companies with high turnover on the EU market), while obliging them to comply with strict reporting standards in the field of environmental protection, social policy and corporate governance. The CSRD directive that has been in force since 2024, imposes obligations that will apply to an increasing number of companies over time, increasing their environmental and social responsibility. In practice, ESG reporting requires companies to comprehensively understand and effectively manage their impact on the environment, society and corporate governance. Companies are obliged to publish detailed and reliable information on very specific aspects, measuring them in a precise way, which is the same for everyone. Thanks to this, control authorities, investors, customers and all interested parties can compare companies - not only on the basis of their financial profitability, but also on specific actions aimed at reducing the negative impact on the environment and society.

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ACTIONS FOR GENDER EQUALITY: THE CASE OF ACADEMIC STAFF AT RZESZÓW UNIVERSITY OF TECHNOLOGY

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Purpose: The situation of women in higher education has been undergoing continuous changes in recent years, with their participation in academic life steadily increasing. However, disparities still exist in terms of wages, academic promotion, and women's representation in leadership positions. The main objective of the article is to present the issue of gender equality and assess its state among the academic staff at the Rzeszów University of Technology.

Design/methodology/approach: In order to assess the gender equality situation at the Rzeszów University of Technology, both quantitative and qualitative research methods were employed. The quantitative research focused on analyzing data related to gender distribution in the employment structure, leadership positions, academic degrees and titles, participation in university bodies, and involvement in research projects. The qualitative research involved conducting an anonymous survey among 300 academic staff members.

Findings: The study revealed that the Rzeszów University of Technology largely ensures gender equality in recruitment processes and professional development. However, subtle forms of discrimination still exist, such as inappropriate behaviors and limited representation of women in leadership roles. Most respondents appreciated the university's efforts in supporting work-life balance and acknowledged PRz as an employer committed to gender equality.

Research limitations/implications: The study presented in this article is limited to the group of academic staff at the Rzeszów University of Technology (PRz). Future research could track the impact of the implemented actions over time, include comparative analyses with other technical universities, and involve a broader group of participants

Originality/value: The article highlights the state of gender equality among academic staff at the Rzeszów University of Technology. It presents a topic valuable for academic leaders, decision-makers, and researchers interested in gender equality issues.

Keywords: gender equality, gender equality in education, gender equality plan.

Category of the paper: Research paper.

1. Introduction

Equality is a fundamental social value that serves as the foundation of social order. It is often associated with protection against discrimination and equal rights, but in its classic sense, it primarily denotes equality of opportunity and equal access to rights and responsibilities, regardless of gender, race, religion, or other personal characteristics (Kopczewski, Pawalec, 2012). However, equality is not limited solely to equal opportunities. A critical component of this concept is equality of outcomes, which posits that merely providing equal opportunities is insufficient; it requires continuous monitoring and adjustment to achieve real, balanced results. In this context, gender equality has become a major area of research today and is a topic of international discussion. In national policies, the idea of gender mainstreaming—a strategy focused on integrating the social and cultural aspects of gender into all areas of life and decision-making processes—has gained increasing importance. In practice, this approach means that gender issues should be considered at every stage of public policy development, implementation, and evaluation, as well as within programs and projects.

Equality in the higher education sector is currently a priority goal within EU policy. Actions for gender equality in research and innovation form a vital part of the European Commission's Gender Equality Strategy for 2020-2025. Since 2020, the European Commission, aiming to strengthen the European Research Area, has reemphasized the priority of gender equality by requiring research and public institutions to adopt plans that support change in this direction (European Commission, 2020). Horizon Europe, a framework program for 2021-2027, mandates that holding a Gender Equality Plan (GEP) is an eligibility criterion for all public bodies, higher education institutions, and research organizations wishing to participate in the program (Kosakowska-Berezecka, Żadkowska, Pawlicka, 2020).

The position of women in higher education has been gradually improving (Dziedziczak-Foltyn, 2010). In recent years, women's participation in academic life has significantly increased. Poland ranks high within the European Union regarding the percentage of women among PhD graduates—over 56% of doctorate holders are women. Women are increasingly represented at universities, and the idea that discrimination against them in higher education is ending has gained traction. Nonetheless, considerable disparities in pay and academic advancement remain, particularly after obtaining a doctorate, and there are still visible gaps in leadership roles. Reports on this issue, both in Poland and across Europe, point to primary causes for these differences in academic careers between men and women, including unequal distribution of family responsibilities, lower self-evaluation of research projects, and pressures to meet societal expectations (Report "Women at Technical Universities", 2022).

It remains unclear, however, whether the limited advancement opportunities to higher positions in academia stem from gender-specific inequalities within this sector or are a reflection of broader, long-standing gender inequalities in the labor market and in access to positions of power (Dziedziczak-Foltyn, 2010).

The conducted research was used to examine and analyze the situation of gender equality at Rzeszów University of Technology. The aim of this article is to present the issue of gender equality at the university among the academic staff. The research problem is formulated as follows: How is the situation of gender equality shaping up in the academic environment at Rzeszów University of Technology, and what are the key challenges related to ensuring it?

The study presents findings that not only shed light on the current state of gender equality at a prominent Polish technical university but also offer a valuable basis for action. The results of the research can serve as a significant resource for academic institutions, policymakers, and organizations seeking to implement gender equality strategies in their own contexts. The innovative aspect of this study lies in its combination of quantitative and qualitative research methods, which provides a comprehensive understanding of the issues at hand. The findings also open up possibilities for further research and can be applied to inform policies and practices that promote gender equality in higher education, ensuring a more inclusive and equitable academic environment for all.

2. Research Method

To examine the gender equality situation at Rzeszów University of Technology, a quantitative study was conducted focusing on analyzing data illustrating gender distribution in employment structure, representation in managerial positions, academic degrees and titles, participation in university governing bodies, and involvement in research projects. The data analysis covered the period from 2020 to 2021. In the qualitative study, an anonymous survey was conducted with a sample of 300 academic staff members. The survey questions primarily addressed experiences of gender-based discrimination, work-life balance issues, and the university's existing solutions and actions on these topics. Academic staff members represented 31% of the eligible individuals in this professional group. The results of the research provided the basis for the development of the Gender Equality Plan, which is part of the Rzeszów University of Technology's strategy, supporting actions aimed at eliminating inequalities. The Gender Equality Plan is directed at academic staff, administrative employees, as well as students and doctoral candidates of the university. The document includes studies on the current state among employees and staff, as well as planned actions for the years 2022-2025.

3. Research

To assess the opinions of academic staff at Rzeszów University of Technology regarding the university's gender equality initiatives, a survey was conducted. The study included a sample of 300 individuals. Among the respondents, men slightly outnumbered women (56% men to 44% women) (Figure 1).

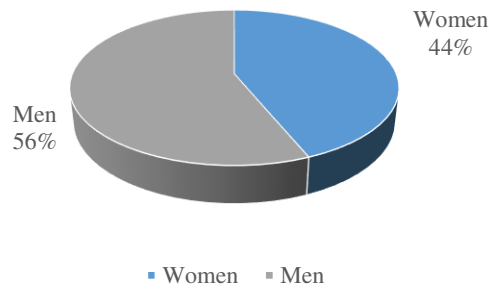


Figure 1. Gender of Respondents.

Source: Own elaboration.

Taking into account the age distribution of the respondents, the largest group was composed of individuals aged 36-45 years (29%), followed by those in the 46-55 years range (26%). The next group consisted of respondents aged 26-35 years (23%), followed by individuals in the 56-65 years range (14%). Employees over the age of 65 represented 6%, while the smallest group was made up of individuals in the 20-25 years range (2%) (Figure 2).

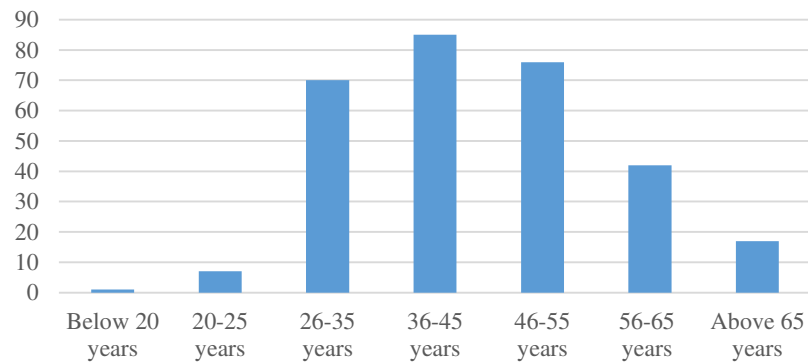


Figure 2. Age of Respondents.

Source: Own elaboration.

A significantly larger proportion of respondents held a doctoral degree—54% among women and 48% among men. A greater gender disparity is observed in higher academic titles, particularly in the case of habilitated doctor, where 13% of women and 24% of men hold this title. The gender gap is also evident at the professor level, with only 2% of women holding this title, compared to 7% of men (Figure 3).

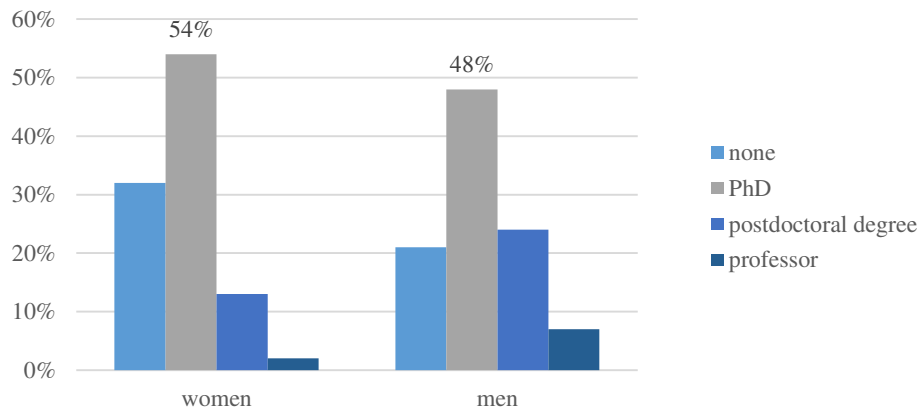


Figure 3. Academic Degree and Title.

Source: Own elaboration.

Regarding work experience, the majority of respondents reported having more than 21 years of experience—30% of female respondents and 37% of male respondents. The smallest group indicated less than 12 months of work experience, comprising 4% of women and 2% of men (Figure 4).

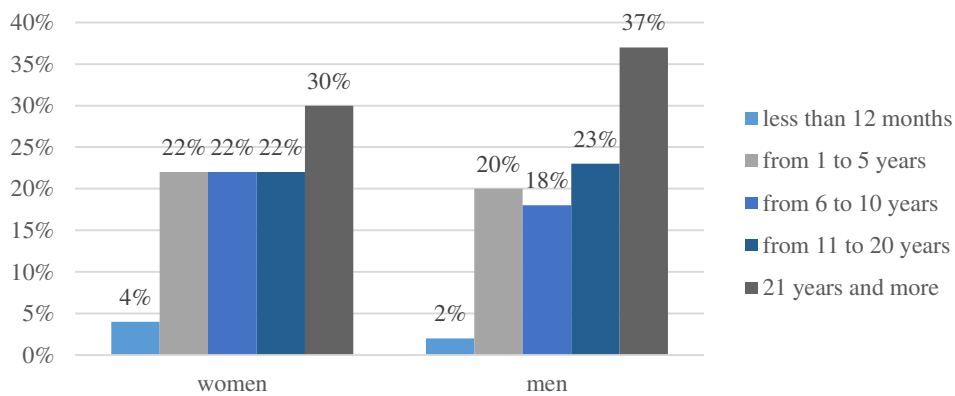


Figure 4. Work Experience.

Source: Own elaboration.

The largest proportion of respondents is employed under a permanent employment contract/appointment – 81% of women and 83% of men. This is followed by fixed-term employment contracts/appointments – 19% of women and 15% of men, and a civil contract or contract for specific work, held by 1% of men (Figure 5).

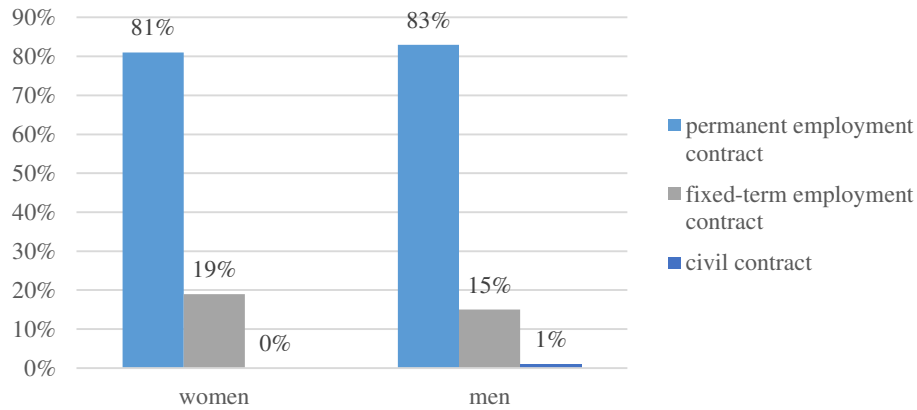


Figure 5. Employment Form by Gender.

Source: Own elaboration.

In the case of managerial positions, men are in the majority—18% of this group indicated they hold a managerial position, whereas only 7% of women provided this response (Figure 6).

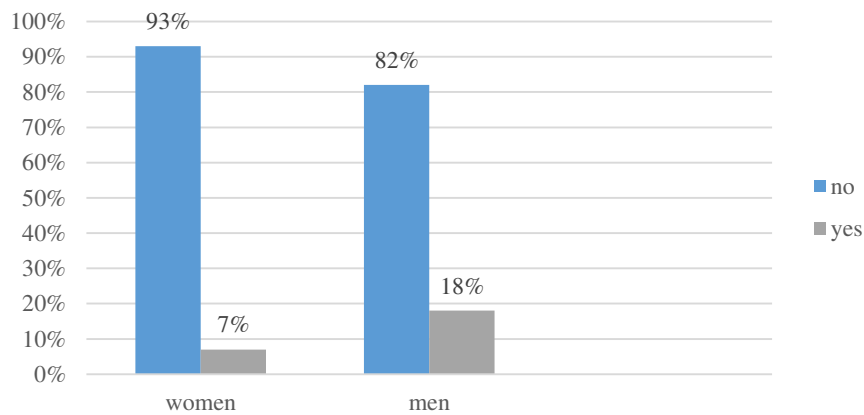


Figure 6. Managerial Position by Gender.

Source: Own elaboration.

The first question in the questionnaire concerned respondents' experiences with discrimination and unequal treatment based on gender during the recruitment process. The survey results directed at employees of Rzeszów University of Technology did not indicate noticeable discriminatory behaviors that would violate the principle of gender equality, either in recruitment or employment. Only 5% of women and 1% of men experienced unequal treatment during recruitment, including questions about family planning and having children, as well as suggestions that men were "more" welcome in this workplace (Figure 7).

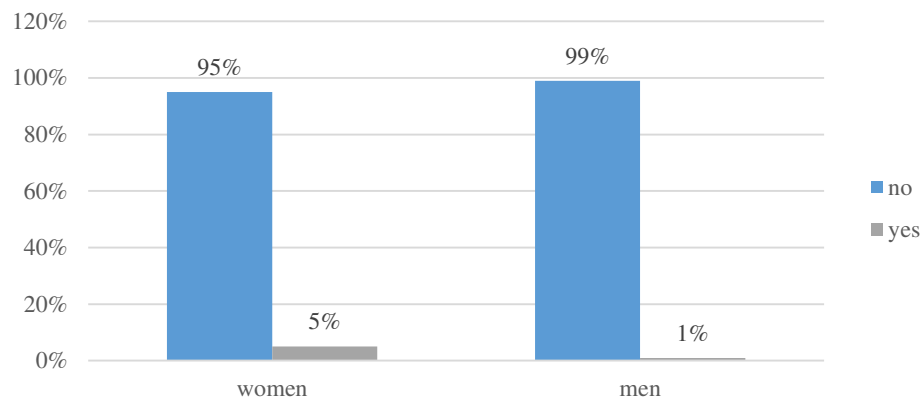


Figure 7. Experiencing unfair treatment based on gender during the recruitment process.

Source: Own elaboration.

In cases of discrimination in professional work, the results look somewhat different. Among women, over 25% of respondents indicated that they had experienced direct gender-based discrimination during their employment (Figure 8).

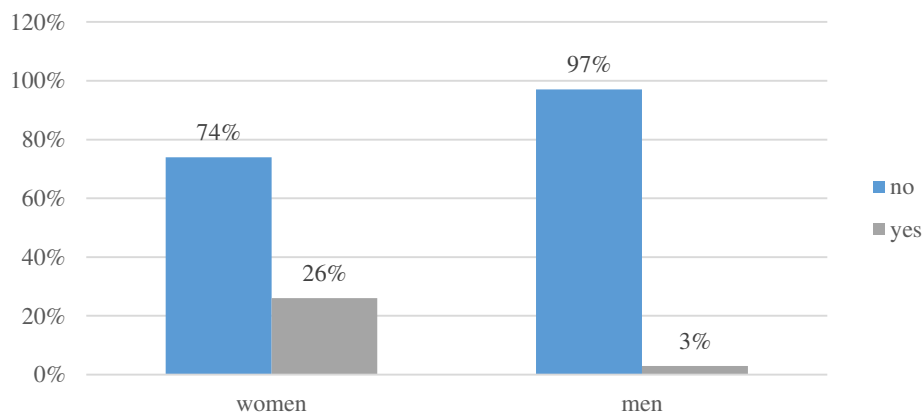


Figure 8. Experience of direct gender-based discrimination in professional work.

Source: Own elaboration.

Among the forms of such behavior mentioned by respondents were:

- inappropriate jokes,
- ambiguous comments,
- snide remarks,
- inappropriate conduct,
- gossip,
- public criticism and being silenced,
- lower wages,
- being burdened with organizational tasks,
- disregarding competencies, and
- limited opportunities for promotion.

The respondents primarily pointed to men as those engaging in such behaviors (Figure 9).

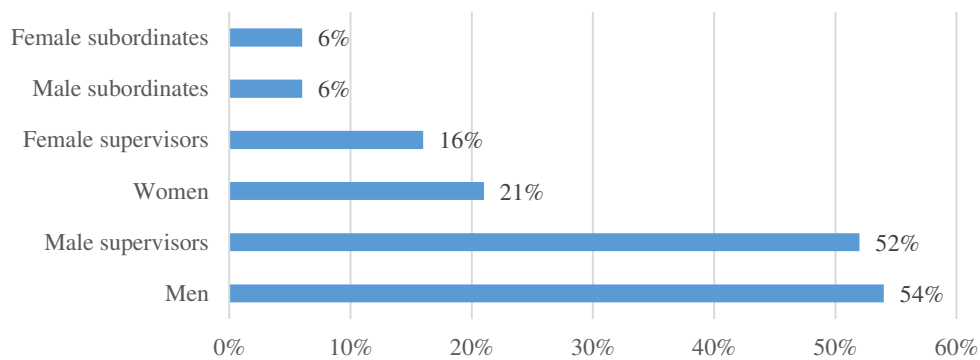


Figure 9. The person engaging in such behavior.

Source: Own elaboration.

In response to whether gender was considered a criterion in building a professional career, the vast majority of respondents answered negatively—88% of women and 97% of men (Figure 10).

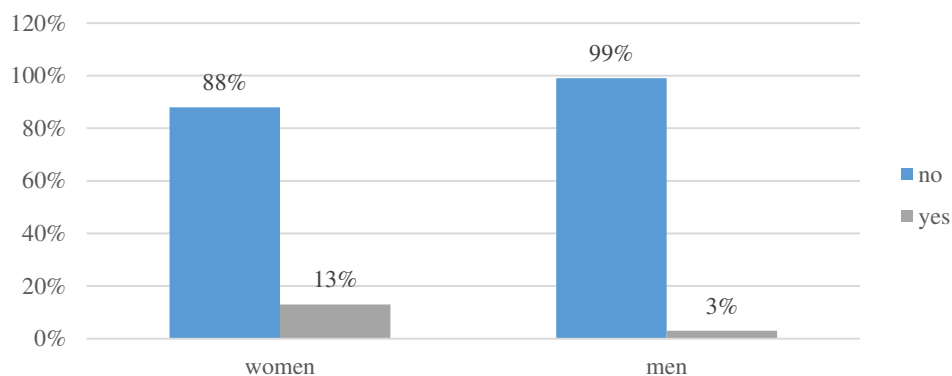


Figure 10. Gender as a determining criterion in the process of building an academic career.

Source: Own elaboration.

In the survey, approximately 80% of respondents believe that Rzeszów University of Technology, as an employer, has sufficient institutional solutions in place to ensure gender equality at the university. Among the remaining 20%, suggestions were made to enhance gender equality in access to personal, scientific, and professional development. These suggestions include:

- Appointing a rector's representative for gender equality.
- Equalizing maternity or parental leave pay for women.
- Replacing staff members who do not adhere to gender equality principles.
- Organizing mandatory training for staff on this topic.
- Establishing clear promotion and team selection criteria.
- Increasing the number of women in managerial positions.
- Ensuring pay equality relative to responsibilities and engagement.
- Raising employee awareness.
- Creating procedures that outline appropriate and inappropriate workplace behaviors.

To whether the scale of gender inequality among academic staff at Rzeszów University of Technology is high, the majority of respondents (49%) answered that they had no opinion (Figure 11).

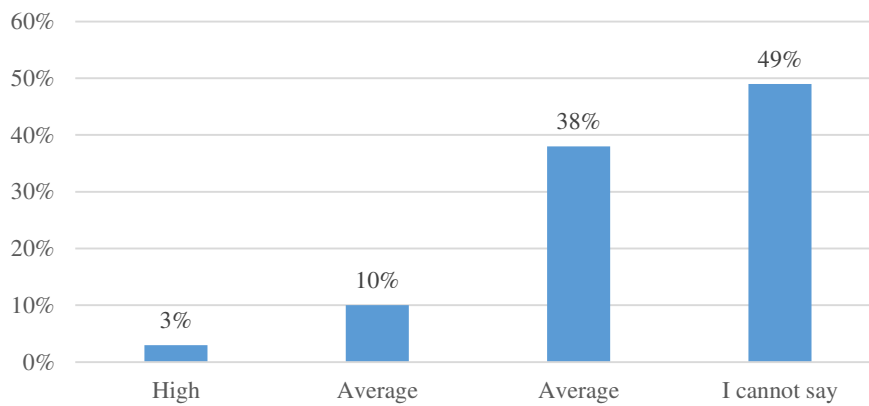


Figure 11. Assessment of the scale of the gender inequality problem at Rzeszów University of Technology.

Source: Own elaboration.

Regarding the question about gender inequality in their immediate environment and among direct supervisors, the vast majority responded that such a problem does not occur in their case (Figure 12).

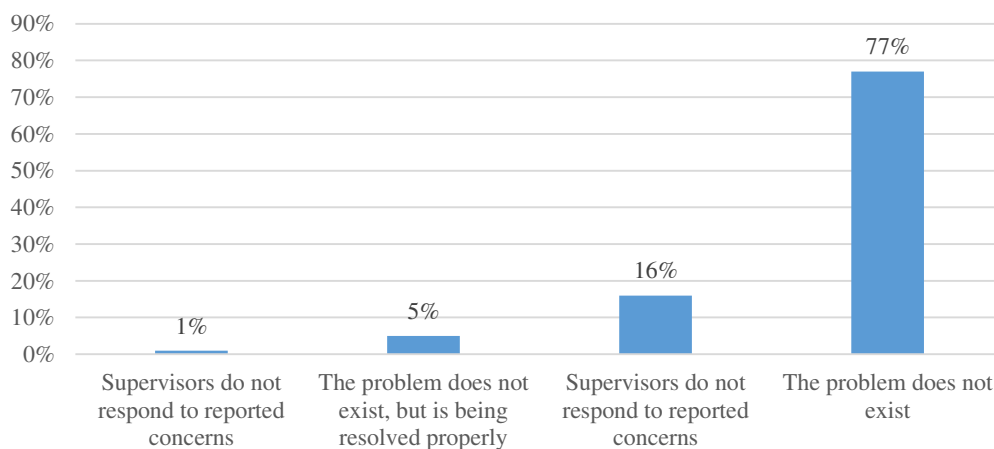


Figure 12. Assessment of the scale of the gender inequality problem at Rzeszów University of Technology.

Source: Own elaboration.

Another important element of the survey was the issue of 'work-life balance,' that is, maintaining a balance between professional work and personal life. Among the respondents, over 50% confirmed the ability to maintain this balance. When it comes to work-life balance in the division between men and women, the situation is quite similar—52% of female respondents and 58% of male respondents answered positively (Figure 13).

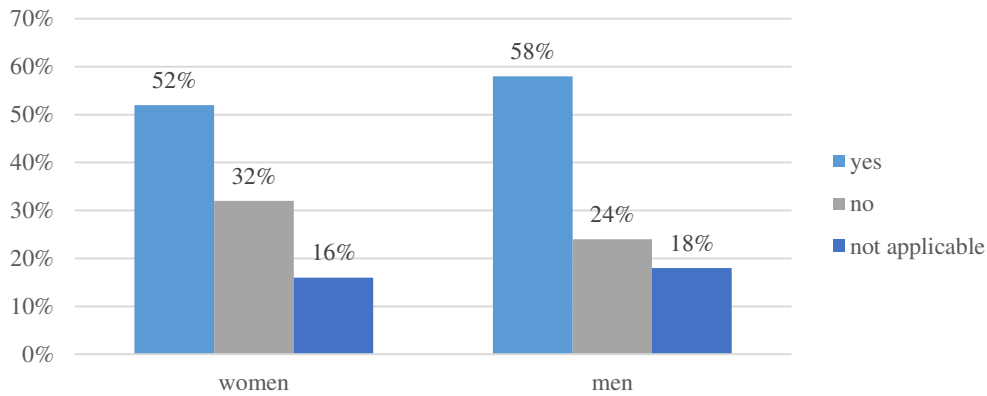


Figure 13. Maintaining 'Work-Life Balance' by gender.

Source: Own elaboration.

Respondents mainly appreciated Rzeszów University of Technology's current practices in creating conditions for maintaining work-life balance, which include:

- Flexible working hours.
- Subsidies for childcare.
- Availability of social and medical packages for employees' families.
- The option of taking personal leave.
- The possibility for employees to work remotely.
- Programs supporting the return to work after maternity or parental leave.

4. Conclusions

Rzeszów University of Technology is committed to upholding the principles of respect, freedom, and equality, which form the foundation of its operations. The research conducted has led to the development of a gender equality plan, which has become an integral part of the university's strategy for the coming years. The Gender Equality Plan at the university serves the entire academic community as a tool to ensure equal opportunities for scientific, personal, and professional development. It sets out five key strategic objectives: raising awareness of the need for equal treatment, striving for balanced gender representation in decision-making positions, ensuring equal career development opportunities, promoting work-life balance, and combating gender-based violence. These objectives align with the priorities set by the European Commission for gender equality initiatives. The findings of the research not only provide new insights into the state of gender equality at one of Poland's leading technical universities but also highlight the importance of further actions to improve equality in higher education. They serve as valuable foundations for institutions that wish to assess and address gender inequalities. The research shows that at Rzeszów University of Technology, there are no significant differences in recruitment processes or professional development opportunities

between women and men among the academic staff. It also demonstrates that there are no major gender disparities among the university's employees, although there is a slight male advantage, particularly in managerial positions. This reflects the general situation at most public and technical universities in Poland, which may result from stereotypical perceptions of women in technical fields. Furthermore, the research found that while the percentage of employees reporting discriminatory experiences is low, women are more likely than men to report such situations. The gender equality plan prepared at the university may be a step toward changing this situation. Although the majority of surveyed employees believe that the university already has sufficient solutions in place to ensure gender equality, further actions are necessary to overcome subtle yet significant barriers to equality, particularly in leadership and decision-making areas. More than half of the respondents also report successfully balancing their professional and personal lives. These findings underscore the validity and importance of continued actions by the university to promote gender equality and support work-life balance. As part of the plan, the university authorities are committed not only to implementing the proposed actions for equality but also to continuously monitoring and evaluating equality-related issues, allowing for prompt responses to potential problems.

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